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Impact Of Employing The WhatsApp Platform, Via Its Interaction Features, On Secondary Students' Mathematical Performance

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Abstract

Through a modified and validated five point likert scale survey, this study has examined the existence of a statistically significant association between each of the smartphones with a touch screen and the social media platforms, like WhatsApp and others, and each of students' math timed exams anxiety, behavior in class and competencies in the word problem solving domain in 18 secondary public schools and 31 private schools in Beirut. Examining the impact of the proper employment of the WhatsApp platform, via its interaction features and collaborative learning, on secondary students' mathematical performance, through their grades, also in the problem solving and communication domain was the problematic of this study. 1365 secondary students were selected through the random stratified technique to fill the survey and represent 7795 students, while 149 secondary students were selected through the purposive sampling technique for the aforementioned problematic situation. For the descriptive statistics, the researcher has used the frequencies, the percent, the mode and the bar diagram. For the inferential statistics, the researcher has used the Pearson's Chi-Square Test, the Multiple Regression Analysis, the Test of Normality, the Paired Samples and the Independent Samples T-Tests. The data collected was analyzed through the Statistical Package for the Social Sciences software (SPSS). Semi structured/depth interviews were then assembled with three principals and two math coordinators to better understand the outcomes and set up the future directions and the recommendations needed to enlighten on the topic of the study. Results revealed a statistically significant association between each of the two independent variables and each of the three dependent ones. Regarding the problematic of the study, results revealed a statistically significant difference between the means of each of the experimental groups and each of the control groups in most cases. The researcher recommends other researchers to replicate this study with different samples to theorize the effect of these smartphones and platforms on students' math timed exams anxiety, behavior in class and competencies. He also recommends them to take advantage of students' strong bounding with their smartphones and platforms in a way that benefits their math learning. Finally, the researcher recommends the blended mobile learning model for the construction of the upcoming advanced math curriculum.

Keywords: Math timed exams anxiety, behavior in class, competencies, word problem solving, performance, smartphones with touch screen, social media platforms, curriculum, interaction, collaborative learning, blended mobile learning model.

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Dedication

This thesis is dedicated to my deceased dear father, Faysal Anouti (may his soul rest in peace), whose words of high expectations, encouragement and push for tenacity still ring in my ears even after he passed away years ago.

To my dear mother, Asma Rida and my brothers Abed Al Rahman, Sawsan and Houssein for their never ending love, continuous support, encouragement, prompting, pride of my success and daily prayers.

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Definitions of Terms

5-point likert scale - a self-measurement rating scale developed for different purposes. Ethically, the participants should be completely free in agreeing, disagreeing or remaining undecided about the statements of the topics presented to them (McLeod, 2008).

Academic performance - the outcome of teaching, also known as the extent to which an institution, a student or a teacher fulfilled the educational objectives. Students' academic performance is continuously assessed and measured during the school year through projects, essays, presentations, quizzes and exams (Steinmayr et al., 2017).

Affective domain - humans' emotional area. It encompasses their motivations, enthusiasms, interests, feelings and the extent to which they accept, appreciate, value or reject things (Clark, 2015).

Anxiety - a psychological state of mind caused by unease and fear. It is considered by many as a true mental disorder translated through humans' physical signs like sweating, increasing pulse rate, muscle tensions, chills, headaches, and chest pain. Anxiety occurs when people feel powerless in their own abilities and cannot control, deal with or overcome what is coming up (Apóstolo et al., 2011).

Behavior – the way humans act. It is a motor activity that constitutes humans' physical actions. It may either be observable such as walking or talking, or unobservable, such as increasing in heart rate (Bergner, 2011).

Brainstem – a critical area located at the base of humans' brain that regulates the breathing and the heartbeat of a body (Joynt, 2020).

Cognitive domain - humans' mental skills area that includes their abilities to comprehend, apply, analyze, synthesize, evaluate and create knowledge (Clark, 2015).

Cognitive effort – the effort humans put to solve an assigned task and/or pay attention when studying a certain subject material (Longo & Barrett, 2010).

Concept- a general abstract notion, a retained understanding in the mind, an idea or a combination of ideas organized within and around a theory formed by merging its characteristic elements (William, 2018).

Constructivism - mainly, it is a philosophical view of learning through-which individuals acquire information, know meanings, answers, theories, concepts and solutions, construct their knowledge through researches, inquiries, interpretations and analysis of prior experiences, and even criticize their own learning experience (Dagar & Yadav, 2016).

Cortisol - the human's body main stress hormone (Fager, 2017).

Depression - initially, depression is a reaction. It occurs when everything surrounding us seems too hard to deal with. The more things are difficult to change, the more humans become overwhelmed in an unimaginable way (Walshe, 2015).

Epistemology - the theory of knowledge, also known as the critical study that evolves through time and justifies humans' beliefs by determining the logical origins of sciences, their values, objectives and scopes (Moser, 2010).

Self-confidence - one's belief and trust about his or her abilities to successfully face the day by day challenges and demands (Ackerman, 2016).

Self-esteem - a favorable self-impression, pride or a high opinion of oneself, a self-respect, or a sense of one's self-worth (William, 2014).

Silicon Valley - an assembled Californian center for innovative technology enterprises (Amadeo, 2020).

Stress - a psychological state of mind like the anxiety. Here, humans can control elements surrounding an upcoming event and even master it (Apóstolo et al., 2011).

Supernormal stimulus - an artificially invented stimulus that results in a response stronger than the usual one (Allaby, 2020).

Teaching approach – teacher's personal philosophy about the educational system. His definition of education, the role of the teacher, the school administration, the students and their parents, and the way teachers should act in class with their students to gain their trust and create a comfortable learning environment (Rosenschein & Tebbe, 2019).

Teaching methods - methods used by the teachers for instruction. It includes using the assigned textbook by the school only or supporting it with extra sheets. More importantly, it is about applying the teacher-centered approach, by taking the lead role in the class and delivering information to the students who passively listen and write on their copybooks, or the student-centered approach by asking questions that lead to collaboration and discussions among the students in a way that helps their learning and critical thinking (Epstein, 2019).

Teaching technique – a strategy developed and designed by the teacher. It enables him performing a task and achieving it, like using the flipped classroom, flashcards or games to teach the students the table of multiplication, or the social media platforms to improve their grammar when they review online posted tweets and try correcting the grammatical errors (Santos, 2018).

Working memory – an area that retains the information and manipulates them to guarantee humans' well execution of the tasks (Chai et al., 2018).

List of Abbreviations

ADD- Attention Deficits Disorder.

ADHD- Attention Deficit and Hyperactivity Disorder.

BBC- The British Broadcasting Corporation.

CBS- Columbia Broadcasting System.

CDPH- The California Department of Public Health.

DV- Dependent Variable.

EMF- Electro Magnetic Field.

HHD- Handheld Devices.

IV- Independent Variable.

MKO- More Knowledgeable Other.

MPC- Medial Prefrontal Cortex.

MWS- Mathematical Workspace.

NASA- National aeronautics and space administration

PDA- Personal Digital Assistant.

RAS- Reticular Activating System.

SNS- Social Networking Sites.

SPSS- Statistical Package for the Social Sciences.

VDT- Visual Display Terminal.

VMPFC-The ventromedial Prefrontal Cortex.

ZPD- Zone of Proximal Development.

Chapter 1: Introduction

1.1. Background of the Study

In 2007, Steve Jobs introduced his "I-Phone", the first revolutionized smartphone with a touch screen. A phone of advanced technology that works by touching anything displayed on its screen (Hill, 2010).

I-Phone was then followed by similar phones, produced by other enterprises like Samsung and Blackberry, a wide range of social media networking sites and platforms to form different online communications (M. Jones, 2015), and applications (Jackson, 2018; K. & Patil, 2013).

These smartphones and social media platforms, took the world by storm and caused an inversion in everyone's daily life routine. They enabled teenagers and adults to play, connect, chat, network and post private images (Vaidya et al., 2016).

In addition to that, any adult or teenager was able to express his personal opinions and views about political and societal events. He was also able to expand his social life zone by creating a global digital life that enabled him interacting with people who weren't even on the same continent thanks to the internet connection (Vaidya et al., 2016).

Throughout the years, smartphones developed rapidly and people everywhere started using it in more than 30 languages. They were additionally introduced to new applications and numerous social media platforms of different features, such as WhatsApp, Instagram, Twitter, Facebook, LinkedIn, Blogger and Snapchat (Atila, 2019a).

The majority of people in the world became glued to their smartphones and social media platforms to stay socially connected. Sadly, college and school students were not excluded from this drastic change and excessive usage (Şen, 2015).

Most students nowadays, even at early ages, have smartphones. Through applications and platforms supported by internet connection, these phones allow them to remain connected with others during the day, in late nights, at home, on road, in vehicles, and even in the midst of their learning sessions in the classrooms (Şen, 2015).

Locally, things were not different as many school students at different ages started either holding smartphones or asking their parents to buy phones similar to the ones owned and held by their classmates and friends.

In turn, the researcher, among many teachers, started to notice the expansion of these smartphones among students, something that was not casual for decades in different levels of schools.

The universal expansion of the smartphones and social media platforms was met with disparities of opinions among the researchers in different fields of studies. Some warned about their negative effects on different aspects of humans' lives, while others supported them because they truly believed that smartphones and social media have many benefits that could be used with proper employment (Danach, 2018; Daraei, 2015; Hossain, 2019; Hughes, 2018; Muller, 2016; Vahedi & Saiphoo, 2018; Yatama, 2016).

Anxiety, behavior and learning were among those aspects. Humans' behavior is the way they act when they are influenced by a phenomenon or environmental/biological factors (Wali & Regis, 2014).

Anxiety is a severe internal feeling of unease and fear that occurs when humans feel challenged about an upcoming situation like exams, interviews and financial issues. It can be translated by physical signs like sweating, increasing pulse rate, muscle tensions, chills, headaches, and chest pain (Williams, 2019).

Learning is the action of memorizing, understanding, acquiring information and skills, constructing and increasing knowledge (Rossum & Hamer, 2010).

Internationally, researchers, throughout their studies, and news reporters, through their articles and reports, such as Strickland (2014), Schulz (2015), Carr (2017), Vahedi and Saiphoo (2018), and Hossain (2019), warned about the negative impact of the excessive usage of the internet, messages, calls, applications, games and social media platforms, through the smartphones, on humans' behavior, anxiety and learning.

Regionally, smartphones and social media platforms also caught the eyes of many researchers in the Arabian Gulf who observed their negative influence on humans in different aspects of their life.

Researchers like Mohammad and Al Ksayri (2014), cited in the Arabic references, who investigated the impact of smartphones on the behavior of children (Mohammad & Al Ksayri, 2014).

Hindi (2015), cited in the Arabic references, who detailed the negative impact of social media on the society and the individual (Hindi, 2015).

Al Azzam (2017), cited in the Arabic references, in his master's thesis, who indicated that smartphones' addiction negatively affects students' learning (Al Azzam, 2017).

Locally, many articles, concerning the impact of the addiction of smartphones and social media on people in general and students specifically, were written and published.

On July 25, 2016, on the official website of Addiyar Newspaper, an article indicated that smartphones' addiction distracts students from learning and influences their behavior and anxiety, which in turn negatively affects their performance through their grades (Charles, 2016).

The article also suggested that forbidding our students from using their smartphones during their scholar days is not a solution and many ways should be found to change students' ways of using their smartphones (Charles, 2016).

On the first of May 2018, on the official website of Aliwaa Newspaper, Dr. Kassem Danach, through his face-to-face interview, assured that the social media networking represents a threat to young people because of the time they drain in the digital world (Danach, 2018).

Danach (2018) confided that students' frequent usage of their social media negatively affects their learning and performance, through grades and participation, in schools and official exams (Danach, 2018).

Additionally, Danach (2018), the lecturer in computers engineering, stated that people lost too many values and traditions by breaching standards of behavior and misjudging the importance of things in life. Why did this happen? Because people's obsession with their social media platforms and networking sites enabled them to control their will and change the ways of thinking of many humans worldwide (Danach, 2018).

On their official website, Al-Manar television clarified that the excessive usage of social media is a factor that affects humans' life, education and work. On top of that, it was stated that the social media addiction negatively affects students' learning and grades, and that those who are aged between 13 and 22 years do not easily learn how to control themselves to use their social media platforms lesser and better (Al-Manar, 2018).

On its official page, Lebanon 24, a website that aims to convey realities in Lebanon, regional and international subject matters, specified that there is a relation between the frequent daily usage of social media and symptoms of attention deficit disorder and hyperactivity, the act of behavior in adolescents (Lebanon 24, 2018).

In their study, the four Lebanese researchers Al Hilo, Jrej, Korkomaz and Yousef (2018), cited in the Arabic references, through a survey prepared at the Lebanese University, faculty of education, tried examining the impact of the social media addiction, through its networking sites, on the universities students in Lebanon, the state of Palestine, the kingdom of Saudi Arabia and the Hashemite Kingdom of Jordon (AL Hilo et al., 2018).

Results of their study revealed that 85.5% of the participants admitted that they were addicted to their social media and that it has negatively influenced their frustration, jealousy, anxiety, depression and their behavior in life. They found themselves lying, cursing, acting aggressively with others, talking and laughing improperly, things they were not used to do in the past (AL Hilo et al., 2018).

Through the passing years, as a math teacher in the secondary level, the researcher started seeing changes in students' behavior in class. More and more students started becoming anxious about their upcoming math timed exams and many of them started lacking competencies in diversified mathematical domains in different levels and classes.

Many mathematics teachers started pointing out at the social media platforms, like WhatsApp and others, and the smartphones with a touch screen as a causal factor for students' math timed exams anxiety, changes in their class behavior and lack of competencies in many mathematical domains.

Unfortunately, these accusations were built on teachers' personal opinions and not studies based on actual statistical data, such as the current study in this dissertation.

Despite these accusations, the research tried to determine the most common used social media platform by students in the secondary level and if they are using it in their mathematics learning. For that, the researcher distributed a preliminary survey (Appendix A) to 100 students in one private and one public secondary school in Beirut.

Results of the survey showed that WhatsApp is the most common used platform among these students with 76 counts, followed by Instagram with 18 counts and Facebook with 6 counts, while Twitter and Snapchat had zero counts.

These results conform to those in the list of the most worldwide used social media in 2019. The list revealed that WhatsApp ranks fourth and used by 700 million monthly active users with 43 billion messages sent every day (Figure 1) (Atila, 2019b).

Figure 1: WhatsApp Monthly and Daily Usage (Atila, 2019b).

Results of the preliminary survey also showed that all 100 students have smartphones and social media platforms, 92 students use them to spend time with their friends, 64 students want to stay connected all the time, and 84 students admit spending too much time on their platforms.

In addition, according to the table below, 88 students acknowledged not using social media platforms for learning mathematics, while only 5 students used them for Algebra, 3 students for Geometry and 4 students for problem solving.

In turn, these results clearly show the misusage of the social media platforms by these students in the secondary level, their vigorous attachment to them, major neglect and weak employment of their platforms in learning mathematics.

Usage of social media as a mathematical learning instrument

	Frequency
No, I don't use social media to learn math	88
Yes, for Algebra	5
Yes, for Geometry	3
Yes, for Problem Solving	4
Total	100

Through the passing years, smartphones and social media became a hot topic to examine by a larger number of researchers. So, they started targeting their effects on people at different ages, in work, schools, universities and social life.

Regarding adults and students in schools and universities, Hughes (2018) recommended examining that impact on their anxiety in topics relevant to their learning (Hughes, 2018).

Math anxiety, the fear of mathematics and its tasks, like the timed exams, is a type of anxiety (Goswami & Szűcs, 2019) that affects students' learning in mathematics (Beilock & Maloney, 2015; Nisar, 2013; Young et al., 2012), the acquisition of rules, concepts, theorems and skills, understanding and construction of knowledge (Verschaffel et al., 2012).

Over the last 60 years, many researchers revealed factors that affect students' math anxiety. However, we still need to learn more about it and the new factors that contribute to it as well (Dowker et al., 2016).

Based on what was mentioned above, the researcher finds himself asking: Is it possible that the social media platforms, like WhatsApp and others, and the smartphones with a touch screen, through their applications, messages, calls, internet service and games, are associated with students' anxiety regarding their math exams, behavior in class and mathematical learning in schools?

On the other hand and in between all of the negativity that was mentioned above, many researchers emphasized on the fact that the smartphones and the social media platforms can enhance students' learning and performance with proper employment.

Employing the smartphones and the social media for the benefit of students' learning is still relatively new worldwide because many teachers are still avoiding employing them as a teaching technique in their teaching methods (Daraei, 2015).

Internationally, in his doctorate dissertation, Kim (2014) studied how Korean learners can improve their oral skills and speak a foreign language like French more freely by using the mobile technology and internet connection provided by the smartphones. Two experiments were carried out in 2008 and 2010 with two groups of Korean learners, where the first group consisted of 13 participants while the second one was formed of 6 learners. By the end, the researcher concluded that the asynchronous exchange between the tutor and his students through the smartphone seemed to have encouraged the learners to practice orally and speak French more freely (H.-K. Kim, 2014).

One year later, in her research study Daraei (2015) examined the impact of employing Facebook on students' satisfaction in learning mathematics through social media instead of relying on the traditional learning method. Results of her study revealed that the overall average grade of students who were taught through the traditional teaching perspective was 16.46 over 20, while that of those who were taught through the Facebook was 17.32 over 20. These results clearly showed that students can achieve better grades through proper employment of social media (Daraei, 2015).

In the next year, Muller (2016) assured that the transformation of the landscape of education can only be done via the interaction features of the social media platforms, through smartphones, in a digital learning environment that can truly serve students' learning through social interaction and cognitive collaboration (Muller, 2016).

Three years later, in his study, Hossein (2019) found out that college students are willing to utilize their smartphones and social media platforms for the benefit of their learning if they were guided by their teachers or experts in this domain (Hossain, 2019).

Regionally, researchers also tried examining the impact of employing the smartphones and the social media platforms and networking sites on students' learning in schools and universities.

In his master's thesis, Ahmad (2016), cited in the Arabic references, examined the impact of employing Facebook on the achievement and creative thinking, the ability to think outside the box to come up with something new (Doyle, 2019), in history lessons of grade four students through control and experimental groups. Results of his study revealed that students who were taught through Facebook in the experimental group performed better in the exam than those who were taught in a traditional way in the control group (Ahmad, 2016).

Also in her master's thesis, Al Azzam (2017), cited in the Arabic references, found out that employing the smartphones in higher education in the Jordan universities is relatively weak and recommended holding special courses and workshops for both students and teachers to employ the smartphones and the social media in the educational systems of schools and universities. In her research study on employing Facebook in the Arabic Language at a university in Algeria, Bozifi (2016), cited in the Arabic references, demonstrated that using the social media platforms and networking sites in education is still limited to those who dare to employ it for the benefit of students' learning. Bozifi (2016) assured that social media serves students' learning process in college and other different levels when they interact, through its features, with their teachers. She also emphasized that educators should seriously consider adopting this new type of learning at a distance, through its platforms and networking sites, to strengthen the connection between themselves and their students (Bozifi, 2016).

Locally, in his interview with Al Liwaa Journal, Danach (2018) revealed that the social media platforms and networking sites open the way for collaboration and creative thinking, especially through heterogeneous online groups formed of people with different needs, thoughts, information, knowledge and skills (Danach, 2018).

On their official website, Al-Manar television published an article about the impact of the social media platforms on students' performance according to their grades. In the article, it was indicated that the proper employment of social media is about students exchanging information and creating knowledge, which in turn can help enhancing their results (Al-Manar, 2018).

In her master's thesis in the faculty of education in the Lebanese University, Salloum (2016), cited in the Arabic references, examined the impact of Blogger, a social media platform and networking site, on the development of grade eight students' writing skills in the Arabic Language in a private school in Beirut. To know from where to start, Salloum (2016) used a survey of fifteen questions to assess students' knowledge about the Blogger and to find out if their teacher uses it as a teaching technique in her teaching methods. Results of her study showed that the writing skills in the Arabic Language of

67% of the participants improved through the Blogger. For that, the researcher recommended using the Blogger and other social media platforms and networking sites in the Arabic Language and other subject materials (Salloum, 2016).

Also in her master's thesis in the Lebanese University in the Faculty of Education, Yatama (2016), cited in the Arabic references, examined the impact of using social media on college students' practices, cooperation and motivation in the French Language through a Facebook page. The researcher was satisfied with the results of her experiment and recommended that teachers, especially those who are social media users, should play a key role in enhancing students' learning by adopting the platforms and networking sites as a teaching technique because they enable their students to learn and collaborate at any time from any place (Yatama, 2016).

Finally, in their attempt to integrate social media in the math curriculum, El Rouadi and Anouti (the researcher in this dissertation) (2020) developed a digital learning environment to teach the lesson "counting" in mathematics to 22 students in the second year secondary during the Corona virus crisis (VOVID-19) (EL Rouadi & Anouti, 2020a).

To create such environment, the researchers avoided using tools like papers and pencils, and completely relied on the features of the WhatsApp platform and the slides of the Microsoft PowerPoint (EL Rouadi & Anouti, 2020a).

At first, the researchers created eleven PowerPoint presentations that covered the whole content and exercises, and then started sending them one after the other to the students through a WhatsApp group every two days. In between those days, one of the researchers interacted and collaborated with the students through the online group at synchronic and asynchronous times (EL Rouadi & Anouti, 2020a).

For evaluation, every student was asked to send the assignment of each presentation through WhatsApp before the end of the second day, and by doing so they were able to know about their mistakes and learn from them (EL Rouadi & Anouti, 2020a).

Students' performance was assessed through an online exam at the end of the experiment. 95.45% of the students successfully passed the exam and the class average turned out to be 16.0455 over 20 (EL Rouadi & Anouti, 2020a).

Despite these results, it turned out that many elements play major roles in making or breaking any online experiment. Students' will and complete participation are fundamental. Teachers' readiness to move on and embrace this renovation is a must, otherwise we will remain stuck in the inertia of teaching and learning (EL Rouadi & Anouti, 2020a).

More importantly, in this learning environment and regardless of the proper construction of any lesson through the PowerPoint slides, the online interaction and the cognitive collaboration between the teachers and their students are taken for granted (Devi et al., 2019).

Why? Simply because many humans can learn verbally and/or visually. Some have the ability to learn by just reading, others by listening, while for many people listening and reading are essential to learn (Paivio, 1986).

These intriguing experiments make us wonder about the results of employing social media through smartphones for the benefit of students' learning and performance in a mathematical domain and how to achieve them.

Why? Because Paivio (1986) indicated that humans can widen their learning in two ways, either verbally or visually (Paivio, 1986); and it happens that social media can provide students with recorded voices (verbal aids) and images (visual assistance) that may be useful in enhancing their mathematical learning and performance.

Now why mathematics should be the subject material specifically? Many reasons solidify the importance of mathematics in life.

Cockcroft (1982) assured that it is almost impossible for anyone in this world to live without a minimum usage of some kind of mathematics during the day (Cockcroft, 1982).

Most people skeptic the importance of mathematics in real life. Those people fail to realize that math concepts are extremely important for humans' understanding, thinking and problem solving. A research at the Stanford University revealed that children who learn mathematics properly pay more attention to their surroundings and thrive in cognitive tasks that involve making decisions. To indicate the importance of mathematics in human life, even in the simplest of things, a recent study in the United States showed that children with fractions deficits cannot read the clockwise to tell the time properly. Additionally, money is considered to be very important for humans. Mathematics allows people to calculate their cost, revenue and profit, and balance their accounts according to the sum they own and the amount they have to spend. Finally, mathematics improves our analytic thinking and reasoning abilities. Thinking analytically allows us to think critically about our local, regional and international surroundings, something mathematics enable us to do so. Reasoning analytically permits us to think logically when we have to face a certain situation in life. Combined, they cement our abilities to frame any problem we face in our social life, education or work, identify the reasons behind it, set up a strategy, assemble the proper steps and take the proper decision to solve it (Pi Day, 2018).

Many say that math is not important in real life. One can hate math, don't care about it, dislike it or even despise it because of its abstract image, variables, numbers and equations. Unfortunately, they don't spare time to recognize the importance of math to their surroundings (Schuster, 2020). Surroundings like Smartphones, computers and the internet that work on a binary code, a math form (Jamison, 2014). Simply put it that way, without math, we'd be lost (Schuster, 2020).

Due to the aforementioned importance of mathematics for humans' logical and analytical thinking and life, since many previous researchers assumed that social media could be employed for the benefit of students' learning and performance, and since the researcher is a mathematics teacher in the secondary level, then the researcher finds himself asking: is it possible to employ the WhatsApp platforms, the most common used social media platform by the 100 secondary students and the fourth most used social media platform worldwide with more the 43 billion daily messages, for the benefit of secondary students' mathematical learning and performance in a mathematical domain?

1.2. Rationale of the Study

For a research, it is important for the researcher to explain the rationale, importance, of his study through specific and ideal arguments (Dudovskiy, 2019).

Smartphones and social media platforms have become a must for people of all ages all over the world. We have become attached to them as any other organ we need to survive and keep on going. They have even become a source for conducting deals, gaining money for income, and finding homes and jobs for many people in different countries (Miakotko, 2017).

Unfortunately, many people became addicted to their smartphones and social media to an extent that numerous reporters began writing about them and researchers started examining their effects on humans' behavior, education, work and productivity.

These researches were conducted in regions such as in Sweden "Rouis, Limayem and Salehi-Sangari (2011)", Great Britain "Strickland (2014)", The United Arab Emirates "Al Ksayri and Mohammad (2014)", the United States of America "Schulz (2015)", Tehran Iran "Daraei (2015)", Riyadh Saudi Arabia "Hindi (2015)", Jordan "Al Azzam

(2017)", Toronto Canada "Vahedi and Saiphoo (2018)", Dublin "Hughes (2018)", Lebanon "Al Hilo, Jrej, Korkomaz and Yousef (2018)" and Bangladesh "Hossain (2019)".

Hughes (2018) recommended examining the impact of anxiety in different aspects of humans' education and work, just like the math timed exams anxiety that affects students' learning in mathematics. Locally, reports, like Addiyar Carlos Charles (2016), Al-Manar (2018) and Lebanon 24 (2018), warned about usage of the smartphones and the social media platforms on students' performance, learning, behavior, and anxiety.

So, there is a need to examine the association, and in turn, the impact of the social media and the smartphones with a touch screen on students' learning, behavior and anxiety in specific topics in schools and universities.

On the other hand, many researches in different countries, like Malaysia "Ng and Abdol-Latif (2011)", Tehran Iran "Daraei (2015)", Iraq "Ahmad (2016)", Jordan "Bozifi (2016), Lebanon "Salloum (2016)", Philippines "Orlanda-Ventayen and Magno-Ventayen (2017)", Al Azzam (2017)", Saudi-Arabia "Albalawi (2017)", Sri-Lanka "Balalle (2018)" and India "Bhoite, Patil, and Patil (2019)", tried examining the impact of employing social media and smartphones on students' learning in college and schools because they believed that, despite all of the negativity surrounding them, smartphones and social media, with proper employment, can be useful in the teaching and learning process.

This dissertation was not a replica of other researches in different regions. On the contrary, it has showed the disadvantages of the frequent usage of the smartphones and the social media platforms on students in the secondary level, and the impact of the proper employment of the WhatsApp platform, via its interaction features and collaboration, on students' mathematical performance.

Many studies, researches and articles, concerning the negative impact of social media and smartphones on humans' life, education and work in general, can be found in literature. Despite that, there is a huge gap in literature that needs to be filled with empirical studies regarding the impact of employing the social media platforms and networking sites, on students' learning and performance in the elementary level, middle schools, secondary level and higher education (Sung, Chang, & Liu, 2016).

In summary, this study tried validating the lectures of Ward (2013) and Muller (2016), who assumed that smartphones and social media platforms are beneficial in the educational field, and that they can support students' learning and performance at any place and time (Muller, 2016; Ward, 2013).

1.3. Significance of the Study

With the recent growth of technology and the introduction of a wide selection of smartphones and social media platforms, learning and studying have not remained students' priority nowadays. Teachers started realizing that students' attention and focus have been diverted from the white board to their phones (UĞUR & KOÇ, 2015).

Unlike most researchers who focused on the impact of the frequent usage of the smartphones and the social media platforms on the behavior and learning of college students, this study has contributed to theory by examining their association with students' behavior in class and competencies in a math domain in the secondary level in private and public schools through a survey of modified items that suit its objectives.

Also, this study has added to theory by investigating the associations between smartphones and social media platforms, and students' math timed exams anxiety in the secondary level because literature has only noted their influence on humans' anxiety in general and not the type associated with students' learning, like math anxiety.

On the other hand, intuition is a proper subconscious instrument that pops up at any moment without any prior thinking about it and could be used to justify an idea or even a theory as it spontaneously leads to finding the exact strategy that we need to complete a given task (Arwanto et al., 2018).

The social interaction among people influences their intuition, seeking and acquirement of information (Fisher et al., 2016). Thus, it reinforces the role that social media can play in students' mathematical learning and performance.

Why? Because when students properly understand something, it is sculpted in their minds for a long period of time and they can explain it even better to others when solving problems (Congos, 2018).

According to Bruno, a mathematical philosopher known for his work on rational intuition in the 16th century (Bonnet, 2005), rational intuition is the action of logic and analytical thinking we need to solve a given problem (Markie, 2013).

This research study, through its employment of the WhatsApp platform, has contributed to practice and emphasized not only on students' regular intuition but also on their rational intuition.

Even-more, with the development of technology, it makes sense using what is available for the benefit of teaching and learning, just like with the smartphones with a touch screen that create opportunities for those who are willing to be indulged in their usage (Heick, 2016).

Even though using technology in teaching should be purposeful, many fail to realize the big difference between using and integrating technology.

Using technology is predominated by teachers. It is mostly related to instructing the learners, delivering content in a different way, facilitating activities feasible without it and tackling students' lower order thinking skills. On the other hand, integrating technology is related to the curriculum objectives and goals, engaging students with the content, facilitating their collaboration inside and outside the classes, developing their thinking skills, creating new ones and encouraging their higher order thinking skills (Heick, 2016).

This research has contributed to practice by employing the WhatsApp platform, via its interaction features and collaboration, for the service of students' mathematical performance in the problem solving and communication domain in the secondary level, their cohesive work outside the classes and diversified ways of thinking.

By integrating WhatsApp in teaching and learning mathematics, teachers in the secondary level were presented with a contemporary technique that may enhance students' results in schools and official exams in the word problem solving domain through cognitive efforts and online interaction.

In addition to those practical contributions, this study has provided students, parents, teachers and principals, a worthy baseline information on statistical bases.

All of the aforementioned might provide a start for those who are appointed for the construction of the upcoming developed curriculum. Why should they take notice of the results of this experiment?

Simply because according to Albalawi (2017), the new curriculums are effective in modern education if the smartphones are properly integrated within the teaching processes of the learning environment (Albalawi, 2017).

1.4. Statement of the Problem

Mathematics, just like in the Lebanese curriculum, is a wide material formed of many domains. For that, the researcher had to select one domain to examine the impact of employing a social media platform on secondary students' mathematical performance.

According to the book published by the Center for Educational Researches and Development in Lebanon (CRDP) in 2001, pp. 163, 173 and 193, mathematics in the secondary level is comprised of four domains: calculation processes, numerical functions, geometric activities and problem solving and communication domain (Frayha, 2001).

The critical thinking is one' ability to think in a clear and rational way, analyze, reason, predict and seek information (Lau, 2009).

The word problem solving is a description by words and numbers for a given mathematical problem (Verschaffel et al., 2019), and according to Chukwuyenum (2013), it tackles students' critical thinking and enforces their skills in other mathematical domains (Chukwuyenum, 2013). For those reasons, the researcher selected the problem solving and communication domain for his study.

Despite the fact that problem solving takes a major part in any math curriculum, many students have deficiencies in understanding the content of the problem, extracting relevant information, describing, explaining, applying concepts, integrating, validating and taking decisions (Tambychik & Meerah, 2010).

Additionally, despite the massive negativity surrounding social media (Carr, 2017; Schulz, 2015; Vahedi & Saiphoo, 2018) on humans' anxiety, learning and behavior, many researchers like Daraei (2015), Yatama (2016), Muller (2016), Danach (2018) and Hossein (2019) recommended employing its networking sites and platforms, through smartphones, in education.

These researchers assured that students' learning and performance can be enhanced, and their critical thinking can also be supported through the interactive features of the social media platforms and online collaboration.

The preliminary survey distributed by the researcher revealed that WhatsApp is the most common used social media platform among one hundred students in the secondary level in Beirut on a daily basis.

Based on all of the aforementioned, we find ourselves asking if the proper employment of WhatsApp, via its interaction features and online collaboration, could enhance students' mathematical performance, through their grades, in the problem solving and communication domain.

1.5. Research Questions

The following research questions were constructed based on the statement of the problem.

1. Is there a statistically significant association between the smartphones with a touch screen and students' math timed exams anxiety in the secondary level in the private and public schools in Beirut?

2. Is there a statistically significant association between the smartphones with a touch screen and students' behavior in class in the secondary level in the private and public schools in Beirut?

3. Is there a statistically significant association between the smartphones with a touch screen and students' competencies in word problem solving in the secondary level in the private and public schools in Beirut?

4. Is there a statistically significant association between the social media platforms, like WhatsApp and others, and students' math timed exams anxiety in the secondary level in the private and public schools in Beirut?

5. Is there a statistically significant association between the social media platforms, like WhatsApp and others, and students' behavior in class in the secondary level in the private and public schools in Beirut?

6. Is there a statistically significant association between the social media platforms, like WhatsApp and others, and students' competencies in word problem solving in the secondary level in the private and public schools in Beirut?

1.6. Problematic Research

For any study, the problematic of the study should be a clear statement built upon the research questions and the literature (S. Smith, 2018).

Additionally, it should state its question, its context, its relevance, and its aim. The context is about what is already known or assumed. The relevance is about the importance of its problematic situation, and the aim is about what should be done concerning it (Swaen, 2016).

Even-though many researchers like Rouis, Limayem, and Salehi-Sangari (2011), Strickland (2014), Schulz (2015), Carr (2017), Fager (2017), Carlson (2018), Zipps (2018), and Anwar and Shah (2018) warned about the negative impact of the frequent usage of social media on humans, others like Daraei (2015), Muller (2016), Orlanda-Ventayen and Magno-Ventayen (2017), Albalawi (2017), Balalle (2018), Bhoite, Patil and Patil (2019) and Hossain (2019) assumed that social media could be used to enhance students' learning.

For that, in addition to examining any statistically significant association between each of the smartphones and the social media platforms, like WhatsApp, and each of students' math timed exams anxiety, behavior in class and competencies in the world problem solving domain in the secondary level, this research study also aimed at examining the impact of employing WhatsApp, via its interaction features and collaborative learning, on students' mathematical performance in the aforementioned domain through their grades.

1.7. Problematic Research Question

What is the impact of the proper employment of the WhatsApp platform, via its interaction features and collaborative learning, on students' mathematical performance, through their grades, in the problem solving and communication domain in the secondary level?

1.8. Operational Definitions

Smartphones with a touch screen: According to the literature, smartphones with a touch screen are mobile phones of advanced technology that work by touching anything displayed on their screen (Hill, 2010). This dissertation has adopted the same definition presented in the literature.

Social media platforms: According to the literature there are two definitions. Mostly, social media platforms are defined as different forms of online communication used by people to post, blog, comment and share ideas, messages, images and videos. On the other hand, Bryer and Zavattaro (2014) defined social media as the technology that enables social interaction and cements humans' collaboration and deliberation (Bryer & Zavattaro, 2014). To combine both definitions, Devi, Gouthami and Lakshmi (2019) defined social media as the "the relationship that exists between networks of people" (Devi, Gouthami & Lakshmi, 2019). Thus, social media reflects the type of relationship between people. This dissertation has adopted the first definition in its first phase and then the definition of Bryer and Zavattaro (2014) in its problematic in its second phase.

Math timed exams anxiety: According to the literature, it is a type of anxiety, a severe internal feeling of unease and fear that occurs when humans feel challenged about an upcoming situation, related to the fear from math exams with a time limit (Goswami & Szűcs, 2019). This dissertation has adopted the same definition presented in the literature.

Behavior: According to the literature, behavior is defined as the way humans act when they are influenced by a phenomenon, environmental or biological factors (Wali & Regis, 2014). In addition, behavior can also be defined as humans' manners. Though for some, manners are thin and reflect what society expects from our action regardless of how we feel and think, while behavior is deeper and expresses humans' own beliefs (Natarajan, 2018; Pang, 2015). Finally, behavior can be defined as an expression of human feelings because of their influence on it (Morzaria, 2019). This dissertation has adopted the first definition because it has examined the statistically significant associations between the smartphones and the social media platforms, and students' ways of act in class.

Competencies: According to the literature, competencies are defined as a set of applied skills and knowledge, gained through learning, and exerted on the content of a given problem to be solved during a certain context, a circumstance (Lebrun, 2019). Competencies are also defined as our ability to start something and finish it successfully (Barber, 2016). This dissertation has adopted the first definition of competencies because it has examined students' ability in organizing the given content of a math word problem, translating it into math equations, selecting the adequate model to solve it, moving from one model to another, reasoning, analyzing and validating the result(s).

The WhatsApp platform. According to the literature, it is a reliable social media platform that enables the smartphones users to stay in contact with others through texting, audio recordings, images and videos individually or in groups (Rouse, 2013). While checking its problematic situation, this dissertation has adopted the same definition by employing the WhatsApp features for the benefit of students' mathematical performance in the problem solving and communication domain.

The problem solving and communication domain. According to the official mathematical guide of evaluation, this domain is one of the four domains in mathematics in the secondary level. It encompasses the lessons: distribution in two variables, probability, conditional probability and random variables, functions of economic, simple interest, compound interest, annuities, and numerical sequences (Frayha, 2001).

Interaction. According to the literature, generally speaking, the interaction is the action of interchanging services between entities or information/experience between people through dialogues (Hornbæk & Oulasvirta, 2017). In its problematic situation, this dissertation has adopted interaction as the action of interchanging information and experience between the students themselves and the researcher.

Collaborative learning. According to the literature, it is a teaching and learning perspective. It involves students of the same school, or different ones, teaming together intellectually with each other or their teacher to solve an exercise, complete an assignment, come up with a project, achieve a common goal online or through face to face interaction (B. Smith & MacGregor, 1992, 1992). Here, students are active and they are meant to be responsible for learning and sharing their knowledge with each other and/or their teacher to properly build and develop their skills (Kreijns et al., 2003). This dissertation has adopted the same definition in its problematic situation.

Students' Performance. According to the literature, it is the outcome of education and the extent to which predetermined educational objectives are achieved (Steinmayr et al., 2017). It is determined by their classwork, essays, presentations, homework, projects implementations and exams grades (scores) (Aba & Makinde 2020; Steinmayr et al. 2017). It is usually affected by many factors like anxiety and depression (Bernal-Morales et al., 2015), their motivation, beliefs, feelings and attitude towards a subject material, behavior and ability to pay attention in class, parents' education, economic status, type of school, teaching resources, teacher's performance, his subject knowledge and attitude towards his material (Enu, Agyman, & Nkum 2015; Grootenboer & Hemmings 2007; Metzler & Woessmann 2010). In this research, students' performance was assessed through their grades in the pre-established and validated post-tests.

1.9. Operational Hypothesis

In order to investigate the research questions and the problematic situation, seven hypotheses (the first six hypotheses are for the research questions and the seventh one is for the problematic of the study) were built as follows:

H1: There is a statistically significant association between the smartphones with a touch screen and students' math timed exams anxiety in the secondary level in the private and public schools in Beirut.

H2: There is a statistically significant association between the smartphones with a touch screen and students' behavior in class in the secondary level in the private and public schools in Beirut.

H3: There is a statistically significant association between the smartphones with a touch screen and students' competencies in word problem solving in the secondary level in the private and public schools in Beirut.

H4: There is a statistically significant association between the social media platforms, like WhatsApp and others, and students' math timed exams anxiety in the secondary level in the private and public schools in Beirut.

H5: There is a statistically significant association between the social media platforms, like WhatsApp and others, and students' behavior in class in the secondary level in the private and public schools in Beirut.

H6: There is a statistically significant association between the social media platforms, like WhatsApp and others, and students' competencies in word problem solving in the secondary level in the private and public schools in Beirut.

H7: Students' mathematical performance in the problem solving and communication domain in the secondary level will be statistically and significantly reinforced through collaborative learning and via the interaction features of the WhatsApp platform**.**

1.10. Scope of the Study

The dissertation has basically focused on the attributions of employing the WhatsApp platform, via its interaction features and collaborative learning, on students' mathematical performance in the problem solving and communication domain in the secondary level in Beirut.

In addition, this dissertation has also examined the association of each of the smartphones and the social media platforms, like WhatsApp, with each of students' math anxiety, behavior in class and competencies in the problem solving and communication domain in the secondary level in Beirut, the capital and largest city of Lebanon (Alhiyari, 2020), The city of Beirut that consisted of the Rawcheh area, Mina Al Hosn, Ras Al Nabaa and Tarik Al Jadida districts, Hamra street, Verdun, Msaytbeh, Salim Slam, Zkak El Blat and Dar Mreisseh neighborhoods, Al Basta, Barbour, Badaro, Kola, Al Madina Al Riyadiyah, Solidere, Gemmayzeh and the Achrafieh area (Bou Akar & Hafeda, 2011).

This dissertation was satisfying with the aforesaid achievements. It has not addressed the aforementioned associations in other regions or classes, nor the impact of employing other platforms and networking sites on students' mathematical performance in other domains in the secondary level, middle schools or elementary level.

1.11. Exploratory Work

The first phase of the study was about examining the statistically significant association, if any, between each of the smartphones with a touch screen and the social media platform, like WhatsApp and others, the independent variables, and each of students' math timed exams anxiety, behavior in class and competencies in the word problem solving domain, the dependent variable.

All of 18 public schools in Beirut were selected and 31 secondary private schools that follow the Lebanese curriculum, which accepted participating in the study, were also selected.

In the first phase of the study, 1365 secondary students, meaning 17.5% of the secondary students out of each of the 49 distinct secondary schools in Beirut were selected through the stratified sampling technique, as justified in the methodology chapter, to represent the sample of the first phase and fill a validated and modified 5-points likert scale survey to represent 7795 secondary students.

The second phase of the study was about examining the impact of employing WhatsApp for the benefit of students' mathematical performance in the problem solving and communication domain.

149 secondary students, among the 7795 who constituted the population of the study, were selected through the purposive sampling technique, as justified in the methodology chapter to examine the impact of employing WhatsApp on their mathematical performance in the aforesaid domain.

Moving back to the first phase of the study, the researcher set his sight on determining the statistically significant associations between the independent and dependent variables, if any, through a validated survey of modified items developed in English and Arabic (Appendices B and C).

Associations between the smartphones and the social media platforms, like WhatsApp, and students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in the secondary level in private and public schools in Beirut.

At start, the researcher had to receive acceptance from the general director of education and higher education to enter the campuses of the 18 secondary public schools in Beirut. For that, he applied for it on the sixteenth of October 2019 (Appendix D).

On the sixteenth of December 2019, the researcher received the awaited acceptance under the condition of providing the General Directorate of Education with the research results after its completion (Appendices E and F).

Between the mid of November and the end of December 2019, the researcher presented the research topic and received formal acceptance from the principals of 31 secondary schools in Beirut, out of 42 that follow the Lebanese curriculum (Appendices G to AK).

On the sixteenth of January 2020, the researcher received acceptance from the ethics committee to distribute the survey among students in the secondary private and public schools in Beirut after submitting a request at a previous date (Appendix AL).

Between the seventeenth of January and the first of March 2020, the researcher distributed the surveys among the students of 49 distinct schools, 18 private and 31 public secondary schools, and then collected their answers.

The head of deputies of a secondary private school welcomed the study. For him, it is important to reveal if there is any association between smartphones and students' behavior in class based on actual statistics of collected data.

The principal of another public secondary school informed the researcher that the problematic of the study is as much important as determining the aforesaid associations. For him, employing social media, especially the WhatsApp platform, in the service of students' learning is extremely beneficial for them because it teaches them investing the time spent on social media in what benefits their learning and performance in the exams.

According to him, they can interact online from their sitting rooms at a distance and add to their learning in mathematics, physics and any other subject material. Unfortunately, they are not doing so. They are busy sending and receiving images and videos. All they care about is having fun with meaningless conversations without realizing that they are wasting precious time they can use in studying to improve their learning and performance in the exams.

Even more, the head of deputies of another public secondary school praised the importance of the study due to the imposing presence of social media and smartphones in society and more importantly among students in schools and universities.

The educational official at a well-reputed private secondary school saw the survey items and informed the researcher that she had never seen a similar study before. She asked how the researcher and the director of the dissertation were capable of linking the variables.

She acknowledged the fact that smartphones and social media are associated with humans' anxiety and behavior. However, she questioned how they were associated with math anxiety.

The researcher informed her that math anxiety is a type of anxiety according to previous neurosciences studies. Math anxiety has the same symptoms but it is typically associated with math tasks. Thus, there could be an association between these two variables.

In her opinion, smartphones and social media are not negative cause for students' learning, math anxiety and behavior. Here, the researcher informed her that this study was not about determining if they were causal factors or not.

It was about determining a statistically significant association, if any, between each of the dependent and the independent variables, after-which future studies could be dedicated to determining if these smartphones and social media platforms are causal or not.

In an important note, the educational official requested to be informed with the results of the study and those of her school if possible. The principal of a secondary school and his head of deputies had a very positive perception about the study. They labeled it as "exciting study" and asked to be informed about the results.

The analysis of students' answers in the survey revealed a statistical significant association between each of the smartphones with touch screen and the social media platforms, like WhatsApp and others, and each of students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in the secondary level.

Regarding the problematic situation in the second phase of the study, the researcher set his sight on examining the impact of employing the WhatsApp platform on students' performance in the problem solving and communication domain in the secondary level, through their grades.

Before each experiment, the class delegate was requested to sign the consent form to participate on behalf of his classmates (Appendix AM)

This domain in the secondary level includes the lesson "probability" in the second year secondary scientific and humanities/economic. The lessons "conditional probability and random variables" in the third year secondary, sections general sciences, life sciences, economics and sociology.

In addition to the lessons "statistical distribution in two variables, numerical sequences, functions of economics and social sciences with logarithmic and exponential functions, simple interest, compound interest and annuities" in the third year secondary, section economics and sociology.

At the beginning, every experiment was designed based on Engstrom's system of activities: the tool, the community, the rules, the division of labor, the subject, the object and the outcomes, where the tool was the WhatsApp platform while the community was reflected by the actively engaged secondary students.

Rules were set up among the students in order to avoid miscommunications that could slow down the process of the learning experiment. Students were forbidden sending funny images and videos because, according to them, they were not accustomed to using the WhatsApp platform for the benefit of their mathematical learning and performance.

The division of labor was constituted of two parts. In the first part and according to the scaffolding of Bruner, the researcher determined students' learning gaps, what they knew and what they needed to know more in the lessons (Firestone, 2015).

For that, the content of each lesson was detailed. Rules, formulas and theorems needed for the participants were written on papers and sent to them to read and discuss online at a predetermined time later on.

This was also done because according to kuzniak (2011), the human brain is formed of two planes: the epistemological and the cognitive planes. The more you feed the epistemological plane with definitions, meanings, rules and theorems, the better the abilities to analyze, visualize and prove become (Kuzniak, 2011).

By time, the second part of the division of labor in each experiment developed and leant on the four components of the deliberate practice and Bruno's scaffolding: students' active engagement through motivation, the repetition, the retention and the consolidation.

Through motivation, students' active engagement in the community enabled the researcher solving similar and different exercises multiple times in order for them to retain and retrieve information whenever they needed to do so. Additionally, it enabled him receiving and discussing their answers with them, and consolidating the previously written rules, concepts and theorems at the end of each experiment.

The subject was the learner and the object was the motive behind the experiment whose outcome was reinforcing students' mathematical performance in the problem solving and communication domain, through their grades, in the secondary level.

In April 2018, the researcher studied the effect of employing WhatsApp on the performance of 18 students in the lessons "conditional probability and random variables" in the third year secondary, section general sciences.

Due to time constraint, the researcher used a post-test only control group experiment to examine the impact of the WhatsApp platform on reinforcing students' mathematical performance in the lessons "conditional probability and random variables".

Additionally, this experiment was designed to compare the participants' grades with other students who were traditionally taught by a teacher of same qualifications as the researcher and who had the same or near mathematical average.

The researcher sent a summary of the lesson via the WhatsApp platform according to kuzniak (2011) and Bruner's scaffolding as previously mentioned. Later on, exercises were prepared to reinforce students' performance according to their needs and skills.

In the next step, the researcher created a WhatsApp group through-which he interacted and collaborated with the students. During the next ten days, the researcher and the students met online at a synchronic predetermined time for two hours at night.

In his first step, the researcher sent an exercise related to students' common gaps to solve and send back through the WhatsApp group. After receiving the answers, the researcher started notifying the students about their mistakes. Then, after finishing correcting and discussing the first exercise online, the researcher sent another one to solve and send back, and so on.

In the following days, students were kept supported with different types of exercises that suited their different needs and skills. At first, the researcher was the center of the experiment and during the interaction he was capable of satisfying students' different needs to a certain extent through the WhatsApp features by texting and sending images and recorded voice notes; and even-though it was not easy to do at first, the researcher and the participants adapted to the experiment and things got easier gradually from one day to another.

At the end of the experiment, students' performance was assessed through a validated exam (Appendix AN). 13 students out of 18 (72.22%) succeeded in the exam while 5 students (28.78%) failed. The most important result emerged from the experiment was the experimental group grade average that turned out to be 6.9028 while that of the control group was 5.8611 over 10. In turn, this result was a great start to solidify the role of the WhatsApp platform as a supporting instrument for students in a rigid material like mathematics.

To wrap up things out and assess the fulfillment of the experiment objective, the researcher adopted the open-ended interview, through-which the interviewees are usually asked to express their feelings and thoughts (Thibodeaux, 2019).

14 students out of 18 (77.77%) thought that it was a very beneficial experiment and helped them rectifying many of their misconceptions and reinforcing some of their poor understanding in the lessons “conditional probability and random variables”.

4 students (22.23%) endorsed the experiment. Though, they were more in favor of reducing the number of participants because they believed that it would provide more time for everyone involved to interact with each other and the teacher.

Between May 2018 and the mid of June 2018, for 35 days, the researcher examined the impact of employing WhatsApp on 26 students in the third year secondary, section economics and sociology, using a “post-test only control group” experiment.

These students volunteered to participate in the experiment for a whole month prior to their official exam. At first, the researcher was the center of this learning experiment. However, by time and through continuous persistence, students began to collaborate and interact frequently in a way that made the researcher more of a facilitator.

Students started to send and receive more than 200 chats per day. They even started replying directly to each other in a way truly admired by the researcher. The low achievers at the beginning were more of receivers than providers. However, with constant interaction and collaboration, their role was reversed and they became more active.

In an important note, one student, who was a slow learner and a participant in the WhatsApp group, kept receiving notes, written solutions and voices from the others, but insisted on interacting directly with the researcher privately due to her learning abilities.

She was not capable of collaborating with others adequately and properly, and believed that she can benefit more by interacting directly with the teacher. Though, she confessed that she benefitted from everything sent and discussed in the group.

At the end of the experiment, students admitted that, for the first time in their lives, they valued the WhatsApp platform as a learning instrument as more than 990 chats were sent and received a day prior to the official exam. Something they never imagined they were capable of doing, which in turn indicated that their highly anticipated official exam had for sure motivated them in doing so.

Students' improvement was assessed by their performance in the mathematics exam in the official exam (Appendix AO). Results of the official exam in mathematics showed that students' overall mathematical average escalated from 36.1854 to 45.6154. An increase of 26.06%, which in turn cemented the role of the WhatsApp platform as a learning instrument in a rigid material like mathematics.

To wrap up things out and assess the fulfillment of the experiment objective, students were asked to express their opinions about it. All 26 students were in favor of replicating the experiment with others next year.

They assured that the current employment of the WhatsApp platform provided them with the time they needed to understand, solve more exercises and collaborate in a way that was not possible in class because of the condensed curriculum and the time allocated for discussions in class.

One of the participant thought it would be even more beneficial for the teacher and his students to start employing the WhatsApp platform in teaching and learning mathematics at the beginning of the academic year.

A second participant declared that she was happy with scoring 25 over 70 because her mathematical scores are usually much less than that. A third participant also assured that without the collaboration and interaction provided by the WhatsApp group he would not have scored more than 15 over 70 because of his poor skills in solving mathematics.

A fourth participant revealed that he used the online interaction and collaboration to support his friend in another school, which in turn had a positive effect on her mathematical grade.

A fifth participant assured that the role of the teacher is extremely important in the experiment because he can attract the students due to his character and knowledge in his subject material, which in turn would positively influence their collaboration, interaction, learning and performance in exams.

A sixth participant assured that the role of the math teacher is extremely important in this kind of experiments. His knowledge, character, patient and promptitude are corner factors that can make the WhatsApp platform a usable instrument in teaching a subject material like mathematics.

Finally, a seventh participant, who scored 69 over 70, revealed that prior to the official exam, he did not believe that social media could be beneficial. Before the experiment, he intended turning off his smartphone to avoid any distraction. However, because of the interaction and collaboration provided by the WhatsApp group, he was capable of solving math exams from other schools and exercises proposed in previous official exams.

He admitted that he could not believe that he benefited that much. For that, he encouraged all math teachers to replicate the same experiment to benefit their students' mathematical performance, especially those in the third year secondary.

In September 2019, the researcher studied the effect of employing WhatsApp on the performance of 16 students in the lesson "statistical distribution in two variables" in the third year secondary, section economics and sociology.

This time, the researcher used a pre and post-test only control group experiment designed to compare the grades of the 16 students, whose mathematical learning was supported with online interaction and collaboration, with students in three other classes who weren't.

At first, the pre-test (Appendix AP) showed that students did not know anything about the lesson. Next, during the two weeks allocated for explaining the lesson and solving its exercises, the researcher kept interacting online, collaborating and supporting these sixteen students on a daily basis with additional work based on his experience similar to those of the teachers of the three other classes.

At the end of the experiment, students' performance was assessed through a validated post-test (Appendix AQ). The test showed that 12 students (75%) out of 16 succeeded while 4 students (25%) failed.

To wrap up things out and assess the fulfillment of the experiment objective, students were asked to express their opinion about it. A participant stated that she benefited a lot on a personal level from the online collaboration and interaction because usually she needs to practice a lot to perform better in exams.

She revealed that the learning sessions assigned during the previous academic years are not enough for students to properly understand the lessons and adequately solve the exercises.

The online interaction and collaboration filled that gap because she, like many of her colleagues, was relieved to have a needed support outside the school. She was capable of asking any type of questions and receiving a well elaborated answer from the other participants, like the high achievers, and the researcher.

In previous academic years prior to the experiment, she used to suffer from the inability to understand the solutions written in math guides because of the ways they were written. She revealed that many students, including herself, are not usually sure of their solutions, and additionally confessed that without this type of interaction and collaboration, she would not have practiced and solved most of the exercises.

Enter the WhatsApp experiment that enabled her asking, collaborating and interacting in a way that wiped the obstacles she usually faced. Even-more, she indicated that she felt less anxious before the math exam than she usually feels because the experiment made her more confident about her ability to succeed in the exam.

A second participant revealed that prior to the experiment, she used to face many obstacles in solving the assigned homework and recapping the content given in class, even if it was written on her copybook. She used to ask her friends randomly but always lacked a more knowledgeable person to reach.

That is why she used to skip studying mathematics and solving her homework. In her opinion, interacting and collaborating with her colleagues online, with the presence of an expert, like the teacher, is extremely important to really benefit from the WhatsApp as a learning instrument.

A third participant assured that she benefited greatly from the online interaction and collaboration. Usually, she had poor understanding of mathematics and needed to be supported in order to reinforce her mathematical learning and performance in exams.

She was always in need for help and even-though she used the WhatsApp platform to ask for answers in the past, it was not the same as interacting with those of different skills and needs under the supervision of an expert teacher.

The participant indicated that she gained confident in her abilities because she started solving mathematics correctly with a lesser number of mistakes after each daily interaction.

A fourth participant revealed that, because of the voices and the chats sent by the teacher and the higher achievers, he was capable of listening and reading them multiple times, which in turn enabled him reinforcing his poor mathematical understanding and rectifying many of his misconceptions.

A fifth participant, one of the three students who failed the post-test, revealed that he usually scored much less than his current grade in prior classes. Despite that, he was sure that, through continuous online interaction and collaboration, he'd be able to achieve better scores in future math exams.

Due to the Lebanese revolution, the next step in the experiment was postponed till December 2019. This time, the researcher studied the effect of employing WhatsApp on the performance of 21 students in the lessons “conditional probability and random variables” in the third year secondary, section life sciences.

The researcher was not the teacher in class this time around. However, the actual teacher allowed him to support his students with extra math exercises, through the WhatsApp platform, after reviewing each one of them.

In addition, he stipulated that the researcher had to start supporting the students through online interaction and collaboration within ten days prior to their exam for at least one hour per day.

At the end of the experiment, students' improvement was assessed through a post-test validated by the math teacher and his colleague (Appendix AR). The test showed that 20 students out of 21 (95.24%) succeeded while 1 student (4.76%) failed.

To wrap up things out and assess the fulfillment of the experiment objective, three students were asked to express their opinions about it. The first participant admitted that he was not comfort about interacting and collaborating with another math teacher, the researcher here, especially through the WhatsApp platform.

For him, this platform is all about wasting too much time chatting, sending and receiving images and videos; and contrary to all of his expectations, the experiment was very beneficial for his math grade.

The second participant revealed that his friends from another school formed a group on WhatsApp to help each other in math. Unfortunately, it was not successful at all because they lacked someone they could depend on. They needed someone with a good expertise in mathematics to refer to through online interaction and collaboration.

The third and final interviewee indicated that the online experiment provided him with the much needed support to become better in math. Even-though he did not have a tutor and used to solve extra exercises in math guides on his own, he was not getting any better.

The online interaction and collaboration allowed him to ask questions as much as he needed, something he was not capable of doing in class, which in turn positively influenced his math grade. In addition to the three interviewees, the researcher asked the teacher to give his opinion about the results and discuss them. The teacher revealed that students' overall grades average was 12.9565 over 20. To his surprise, their grade average in the lesson "conditional probability and random variables" turned out to be 13.9130 over 20.

Why was he surprised? Because students usually perform lower than they do in this lesson and their grades decrease. This lesson requires more analysis and understanding of the content given. Students should be able to move from a math text to symbols and vice-versa, something harsh they don't have to deal with in many lessons.

According to this teacher, practicing through the online interaction and collaboration has for sure provided the students with the time and the exercises they needed to not only hold on to their grades average but also perform better.

One thing is certain, the proper employment of the WhatsApp platform can provide students what they lack for in classes due to time constrains and the limited number of learning sessions.

Additionally, in December 2019, the researcher studied the impact of employing the WhatsApp platform on the learning, generally speaking, and the performance specifically of 23 students in the lessons "conditional probability and random variables" in the third year secondary, section general sciences.

This time also, the researcher used a pre and post-test only control group experiment designed to compare the grades of the 23 students whose mathematical learning was supported through the WhatsApp features with other students who weren't.

At first, the pre-test (Appendix AS) demonstrated that students did not know the content of the lessons. Next, during the time allocated for explaining the lessons and solving their exercises, the researcher kept interacting online, collaborating and supporting these twenty three students on a daily basis with additional work based on his experience similar to that of the teacher of the other class.

At the end of the experiment, students' performance was assessed through a validated post-test (Appendix AT). The test showed that 19 students out of 23 (82.608%) succeeded while 4 students (17.392%) failed.

To wrap up things out and assess the fulfillment of the experiment objective, students were asked to express their opinions about it. A participant indicated that the role of the teacher in the experiment had more significance for him than his role in the class because of the direct free of boundaries collaboration.

He was capable of interacting directly with the teacher and asking some questions he would not have asked in the class. Though, he indicated that the experiment would have failed miserably without the deep experience of the teacher, the researcher in this case, because they needed detailed explanations and speedy answers through recorded voices to keep moving on.

According to this participant, the recorded voices are very beneficial for everyone. Anyone can listen to them during the digital meeting and later on, which in turn can reduce the load on the teacher during the online interaction.

Moreover, this participant believed that not all teachers are capable of succeeding in such interaction. The teacher is required to have deep knowledge in his subject material first, teaching experience second and finally the ability to deliver the content to his students in the simplest possible way online, a skill many teachers have yet to acquire and conquer.

It is not easy that all participants benefit from the interaction and collaboration because many might ask some questions that might not be relevant to others. In this case the teacher has to expect that, be patient and answer all questions to keep moving.

A second participant indicated that conditional probability and random variables are two of the hardest lessons for any student to learn and master. The number of sessions provided in the class is not enough for students to properly understand and apply the rules, theorems and formulas.

Thus, supporting students with supplementary exercises through the interaction and collaboration provided by the WhatsApp platform is an excellent idea that benefits both teachers and students. Unfortunately, it is not as easy as it seems because not all teachers are capable of turning the WhatsApp experiment into a success.

Why is that? Because it depends on the teacher before the student. Students might be used to receiving information in class and not accustomed to the online interaction that serves their learning especially in mathematics.

In simple words, the teacher has to be creative in the WhatsApp experiment. He is going to rely on writing, sending, receiving, tagging, repeating many solutions, explaining through recorded voices and using educational YouTube videos for specific purposes.

Contrary to what many may think, the teacher here is not substituting teaching in classes. He is supporting his students outside the walls of the classrooms. He is acting in a more responsible way to reinforce students' mathematical learning and performance as much as possible from a distance.

Students might not be willing spending their time after school in reinforcing their math performance. They have to be aware of the benefits of such experiment and it is up to the teacher to make sure that everyone is online to benefit from what is going on.

Add to that, in a later time, he should interact with those who could not attend for different reasons. So the WhatsApp experiment is a combination of efforts from both students and teachers, and without the aforesaid, it would definitely fail.

A third participant also pointed out that he does not believe that all teachers are willing or capable of replicating the WhatsApp experiment. Why? Because many of them are usually satisfied with the content they give in class and have no intentions in making extra efforts to reinforce students' mathematics learning and performance.

On the positive side, those who are willing to spend more time supporting students' learning and performance can really benefit from such experiment. In his opinion, the successful direct online interaction between the teacher and the students is a corner stone to make the experiment a true success.

According to a fourth participant, the WhatsApp experiment is not easy to properly accomplish. In her opinion, it is up to the teacher who has to come up with the easiest solutions possible that suit students of different skills and needs.

It is better if he sends the exercise, gives students some time to solve it and interacts with them later on. We are flipping the roles this way, and students depend on themselves before discussing their answers with their colleagues and the teacher.

The teacher and the students have to be patient because their math learning in the condensed Lebanese curriculum is getting supported in a rich digital interaction that can enhance their confident in solving mathematics, something not common at all for many.

Finally, in an important note, the participant assured that the teacher can detect students' weaknesses from the type of questions they always ask, which in turn enables him to strategize his way in reinforcing their math performance through WhatsApp.

The fifth participant did not believe how much she asked during the interaction. She assured that she is not the type of students who ask questions and interact with the teacher in class. However, during the online interaction and collaborayion, she found herself free to ask anything, which in turn positively influenced her understanding of the content.

In her opinion, the online interaction and collaboration depend in the first place on the patience of the teacher and the time he is willing to spend to make the WhatsApp experiment a true success.

In January 2020, the researcher studied the effect of employing WhatsApp on the learning of the previously mentioned 16 students in the third year secondary, section economics and sociology, in the first part of the lesson "numerical sequences".

Due to time constraint, the researcher used a post-test only control group experiment designed to compare the grades of the 16 students, whose mathematical performance was supported with online interaction and collaboration, with students in another class who weren't.

At the end of the first week of the three weeks devoted for explaining the lessons and solving their exercises, the researcher started interacting online, collaborating and supporting these sixteen students on a daily basis with additional work based on his experience similar to that of the teacher of the other class.

At the end of the experiment, students' performance was assessed through a validated post-test (Appendix AU). The test showed that 13 students out of 16 (81.125%) succeeded while 3 students (18.75%) failed.

This time around, one of the students who failed the "distribution in two variables" exam managed to pass the "numerical sequences" exam through online support.

Additionally, the class overall mathematical average increased from 3.3438 to 3.5313 over 5, which in turn solidified the role of the WhatsApp platform as a learning instrument in a rigid material like mathematics even more.

To wrap up things out and assess the fulfillment of the experiment objective, students were asked to express their opinions about it. A participant indicated that the online group interaction was really new for her and turned out to be very beneficial.

She was capable of asking some questions she could not have asked in class, rectifying some her misconceptions and correcting many of her mistakes because of the participants' discussions and the direct connection with the teacher, the researcher in this study.

In her opinion, in this digital age, the online interaction and collaboration is a must for students to know about because they are not aware of the benefits of social media on their learning. They only see them as entertainment gadgets to spend lots of time chatting, sending and receiving funny images and videos.

A second participant revealed that it was not easy for her at the start. She got distracted many times by her phone contacts every time she was online interacting and collaborating with the participants of the WhatsApp group. She started ignoring replying them because it was an unprecedented opportunity for her to improve her math grades.

A third participant, who is a high achiever, indicated that what was done was not about replacing classroom teaching with the online interaction. On the contrary, she believed that it was about supporting students' mathematical performance in a digital environment mostly associated with fun times.

Even-though she was classified as a high achiever, she benefited from others discussions because she was able to see the solutions of her colleagues and touch the way they think. Most importantly, she felt less anxious about math timed exams because she was able to solve more exercises from an outside resource and discuss new ideas with the teacher and the participants, something that was not doable in class at all times due to time constraints during the learning sessions inside the classes.

Also in January 2020, the researcher studied the effect of employing WhatsApp on the performance of the 16 students mentioned above in the second part of the lesson "numerical sequences" in the third year secondary, section economics and sociology.

Due to time constraint, the researcher used a post-test only control group experiment designed to compare the grades of the 16 students whose mathematical performance was supported with online interaction and collaboration with students in two other classes who weren't.

As usual, the researcher started interacting online, collaborating and supporting these sixteen students on a daily basis with additional work based on his experience similar to those of the teachers of the other classes.

At the end of the experiment, students' performance was assessed through a validated post-test (Appendix AV). The test showed that 14 students out of 16 (87. 5%) succeeded while 2 students (12.5%) failed.

The most important result emerging from the experiment is that the class overall mathematical average increased from 3.5313 to 3.7031 over 5, which in turn helped solidifying the role of the WhatsApp platform as a learning instrument in a rigid material like mathematics.

To wrap up things out and assess the fulfillment of the experiment objective, students were asked to express their opinions about it. Most students were thrilled with the results and appreciated the fact that their overall grade average in mathematics is gradually increasing from one exam to another through the support provided by the online interaction and collaboration.

A new experiment was also implemented in January 2020. This time the researcher examined the impact of employing WhatsApp on the learning of 21 students in the third year secondary, section life sciences in the lessons "conditional probability and random variables".

The researcher here was not the main math teacher of these students and they were assigned to a WhatsApp group under the collaboration of their teacher.

Through this group, students' mathematical performance in this lesson was supported regularly. The main goal here was assessing students' improvement, if any, in this lesson compared their performance in other topics.

At the end of the experiment, students' improvement was assessed through a validated exam (Appendix AW). The researcher and the math teacher assembled a midyear math exam. There were many concerns by the math teacher about the probability exercise due to its hardness.

According to Anderson's taxonomy, the exercise was about remembering the formulas and remarks, understanding the given content, applying the formulas correctly, analyzing by breaking down given information, and finally evaluating by judging a determined value.

Results of the experiment revealed that four students (19.08%) failed in the probability exercise, while nine students (42.85%) failed in the other topics combined. Students' overall grade average in "conditional probability and random variables" turned out to be 12.5952 over 20, while their overall grade average in the other topics combined was 11.1071 over 20.

The main teacher of the class was asked to give his opinion on the results. He revealed that he was skeptical about his students passing the probability exercise because of its hardness.

For that, he considered students' scores in this lesson to be excellent, even-though some high achievers were still confused with assembling the formulas correctly. More importantly for him, many moderate achievers were capable of scoring at least 10 over 20, something considered to be as a very good accomplishment.

For him, low achievers need more practice, focus and collaboration in class and online to become better in this lesson and other topics, even-though they scored better in the probability exercise than they usually do in other math topics.

Between the end of January and the beginning of February 2020, the researcher studied the effect of employing WhatsApp on the performance of the same 16 students mentioned above in the first part of the lesson "functions of economics and social sciences" in the third year secondary, section economics and sociology.

Due to time constraint, the researcher used a post-test only control group experiment designed to compare the grades of the 16 students, whose mathematical performance was supported with online interaction and collaboration, with students in other classes who weren't.

As usual, the researcher started interacting online, collaborating and supporting these sixteen students on a daily basis with additional work based on his experience similar to those of the teachers of the other classes.

At the end of the experiment, students' performance was assessed through a validated post-test (Appendix AX). The post-test showed that 15 students out of 16 (93.75%) succeeded while one student (6.25%) failed.

The most important result emerging from the experiment is that the class overall mathematical average decreased from 3.7031 to 3.2617 over 5.

Four students were interviewed to better understand why their overall grade average in mathematics decreased instead of increasing as usual.

All four students agreed on the fact that this lesson is much deeper than the previous lessons. Many parts in the exam required deeper thinking, and even though they managed to pull a good overall grades average, they could have performed better with more practice, something possible to do thanks to the WhatsApp platform. More importantly, they admitted that they would have for sure performed much worse without the additional online practice.

Also in February 2020, the researcher studied the effect of employing WhatsApp on the learning of the same 16 students mentioned above. This time, the researcher intended examining the impact of the Bruner's scaffolding and the deliberate practice on students' mathematical performance through the WhatsApp platform in a midyear exam.

Supporting students' mathematical performance through the WhatsApp was more difficult because of the many chapters required for the exam. The researcher interacted and collaborated with the students in a longer number of hours on a daily basis for an extended number of days.

At the end of the experiment, students' performance was assessed through a central exam developed for the Economics and Sociology students in four distinct schools (Appendix AY)

Results showed that 15 students out of 16 (93.75%) succeeded while 1 student (6.25%) failed. The lowest grade was 8.5 over 20, the highest grade was 20 over 20, while the other 14 students maintained an average close to 12 over 20.

The student with the lowest grade admitted that he did not score better because he only depended on the online practice with his colleagues and the researcher. Though, he also admitted that he would have scored much better had he put more effort to study on his own in addition to the online purposive practice.

The student with the perfect score assured that she wouldn't have reached a full mark without the online deliberate practice. Practicing online provided her with the opportunity to review all of her previous information in addition to solving much deeper exercises related to all chapters assigned to the exam. It was different than reviewing on her own because she had direct connection to her colleagues and most importantly the researcher, the expert in this case.

Between the last ten days of February 2020 and the first of March 2020, the researcher examined the impact of the deliberate practice and the scaffolding of Bruner through the WhatsApp platform on the performance of the same 16 students mentioned above in the lesson "simple interest, compound interest and annuities".

Due to time constraint, the researcher used a post-test only control group experiment designed to compare the grades of the 16 students with others who weren't. At the end of the experiment, students' performance was assessed through a validated exam (Appendix AZ).

Results showed that 15 students out of 16 (93.75%) succeeded, while 1 student (6.25%) failed. The lowest grade was 4.5 over 10, the highest grade was 10 over 10, while the other 14 students maintained an average close to 6.946 over 10. Results also showed that the class overall grade average ameliorated and reached 7.4219 over 10.

A teacher of one of the control groups participated in validating the interest exam for grade twelve section economics and sociology, and evaluated the exercises according to Anderson's taxonomy.

The first exercise was about understanding the given, recalling and applying previously acquired formulas. The second exercise was a problem solving question. Students had to do multi steps to reach the solution.
They were not guided during the process of solving it. They had to analyze by breaking down the given content and evaluate by judging the results obtained at the end to make the proper decision.

The third exercise had multi ideas integrated with each other. The first two parts were about remembering previous facts, understanding the given of the content and then applying the right formula. The third part tackled the first five levels of Anderson's taxonomy. In addition to remembering, understanding and analyzing, students had to break down the given info, analyze and judge according to it.

The fourth and final exercise was about remembering, by recognizing and recalling facts, understanding the meaning of the content and applying a previously acquired formula. This exercise combined two parts to make a new one by which the students had to calculate the rate of interest. Thus, it was about creating.

1.12. Limitations of the Study

This study has faced three limitations. First, 11 principals out of 42 refused to cooperate with the researcher simply because they do not usually participate with educational researches or do not care about them.

Second, due to the alleviation that was approved by the ministry of education and higher education in 2014 concerning the number of lessons and objectives in mathematics in all classes, the problem solving and communication domain in the first year secondary was excluded from the study.

Third and finally, the researcher was not capable of employing the WhatsApp platform on a larger number of students, such as those in the second year secondary, because of the Lebanese revolution and the Corona virus crisis, and because he had to look up for teachers with same skills and classes of same or near mathematical grade average in order to maintain the conditions of the appropriate identifications of the control and experimental groups.

1.13. Delimitations of the Study

The general director of the ministry of education and higher education and those who are in charge in its different departments, principals in private and public schools, head deputies, deputies and teachers played a fundamental role in filling the survey in the first phase of the study.

They were the ones responsible for facilitating the conduct of the research and assuring that students answered the survey fully and adequately with complete freedom during its time allocated.

In the second phase of the study, teachers' cooperation and acceptance to employ the WhatsApp platform on their students enabled the researcher to enlarge the number of participants and replicate the experiment even more, which in turn provided more results for the research statistics.

In addition to that, the volunteering and collaboration of 26 students with the researcher on a daily basis for 35 days prior to their official exams in third year secondary, section economics and sociology, provided the latter with a model that set out the possibility of improving students' performance through the WhatsApp platform, their participation and full collaboration.

1.14. Upcoming Parts

In addition to the chapter 1, this dissertation is constituted of 4 other chapters, Literature Review, Research Epistemology and Methodology, Statistics, Discussions, Conclusion, Recommendations and Future Considerations.

Chapter 2, Literature Review, encompasses the dissertation's theoretical framework and reviews a book, books chapters, Masters Theses, PhD dissertations, conference papers, researches, websites, documents, reports, video recordings, journal and Newspapers articles related to the presented topic in three languages, English, French and Arabic.

It comprises the impact of the smartphones and social media on the society and their negatives on the students. Impact of math exams anxiety on students and the spatial point of social media in Maslow's hierarchy of needs. Educational technology theories and practices, the role of the internet connection and the potentials of the mobile learning, smartphones and social media in education.

Additionally, it comprises teachers' perceptions on employing social media in education, the role of ergonomics in teaching, didactics of mathematics in a digital dynamic learning environment, the mathematical workspace models, and the spatial points of the teachers and students in a digital era. Finally, it presents the research questions, the problematic research and its question, the operational definitions and hypothesis.

Chapter 3, Research Epistemology and Methodology, displays the subject selection, the population and sample sizes, reasons behind the selection of the research pragmatic paradigm, the study design, the instruments, the survey's validity and reliability according to the Cronbach's alpha values, the type of the experiment, the data collection and its analysis.

Finally, this chapter justifies usage of the percent, frequencies and the mode for the descriptive statistics. Additionally, usage of the Pearson's chi-square test, the independent samples t-test, the paired t-test and the normal distribution for the inferential statistics.

Chapter 4, Statistics, lays out the tables of frequencies and percent, the bar diagrams, the mode in the descriptive statistics, results of inferential statistics according to Pearson's chi-squares tests, the paired t-test, the independent samples t-test, the normal distribution and the interpretations.

Chapter 5, Discussions, Conclusion, Recommendations and Future Considerations, answers the research questions and problematic situation, in addition to the conclusions, recommendations and directions for future studies.

Chapter 2: Literature Review

2.1. Purpose of the Review

This chapter expounds the theoretical framework of the research study and reviews literature related to the smartphones with a touch screen, the social media platforms, and students' math timed exams anxiety, behavior in class and mathematical learning and performance.

2.2. Theoretical Framework

In 2007, new sets of smartphones and social media platforms for connection and social interaction were introduced to the world. They facilitated humans' connection through voices, images and live videos (Konok et al., 2016).

Throughout the years, people all over the world became attached to their smartphones and platforms (Konok et al., 2016). They became an essential part of humans' daily life routine and not the part that should have supposedly supported them in work, home and school for the benefit of their productivity and education (Sarwar & Soomro, 2013).

By time, these platforms and smartphones became a must for students to have and hold everywhere in the world even at early ages. Children in the elementary level started using them for chatting, texting, commenting, blogging and replying for an unacceptable number of hours on a daily basis, which in turn created major concerns regarding their impact on the users' health, mentality, performance and behavior (Selvaraj, 2013).

Researchers started examining the impact of the smartphones' usage on humans' anxiety, behavior and learning because of the increased rates of distraction and loss of focus. Some medical researchers even tried to link between the increased usage of the social media among adults and grownups on one hand, and issues regarding their health status on the other hand. Nonetheless, it is still unclear how to associate these two sides because of the need of more studies (Strickland, 2014).

In her thesis, Amelia Strickland (2014) examined the existence of possible negative associations between social media and anxiety. As a result, she indicated that 45% of adults in Great Britain feel anxious when they are forced to leave their social media for some time for various reasons (Strickland, 2014).

In addition, she found out that the teenagers and youth are more anxious than the adults when they are unable to access their platforms to chat, reply and comment (Strickland, 2014).

Strickland (2014) revealed that the strong connection between humans and their smartphones/social media is medically known as the *"Phantom Vibration Syndrome"* (Strickland, 2014).

This kind of syndromes signifies people who suffer anxiety, a severe internal feeling of unease and fear that occurs when humans feel challenged about an upcoming situation like exams, interviews and financial issues (Williams, 2019).

Strickland (2014) found out that this anxiety is associated with humans' constant obsession of checking their social media platforms every while during the day and even in late nights as many of them wake up from their sleep just to check new texting, chats and comments (Strickland, 2014).

In his research study, Hossain (2019) revealed that smartphones, through their applications, calls, messages, internet connection and games negatively affect the behavior and understanding of the content of college students (Hossain, 2019).

In their research study, Vahedi and Saiphoo (2018) revealed that the smartphones, through their features and applications are significantly negatively related to humans' behavior and anxiety when their usage becomes a problematic situation for their owners (Vahedi & Saiphoo, 2018)

Math anxiety is the fear of mathematics and its tasks, like timed exams. It is considered as a type anxiety according to the Center for Neuroscience in Education in the University of Cambridge as previously mentioned in the introduction (Goswami & Szűcs, 2019).

Based on all of the aforementioned, smartphones, through their draining of time and usage of messages, video and voice calls, internet, games and applications, impact human's anxiety, behavior and learning. Consequently, they could be associated to students' math timed exams anxiety, since it is a type of anxiety, behavior in class and competencies in the word problem solving in mathematics in the secondary level, since they are an essential part for students' successful learning (Strembitsky, 2013) (Figure 2).

Smartphones, Through their Draining of Time and Usage of Messages, Video and Voice calls, Internet, Games and Applications → Could be Associated to Students' Math Timed Exams, Behavior in Class and Competencies in the Word Problem Solving in Mathematics

Figure 2 : Relationships between SmartPhones and Students' Math Timed Exams Anxiety, Behavior in Class and Competencies in the Word Problem Solving in Mathematics (Strickland, 2014; Vahedi δ Saiphoo, 2018; Hossain 2019).

Furthermore, in her doctoral dissertation, Jessica Schulz (2015) pointed out on the negatives of social media, through smartphones and networking sites, on humans' behavior, because of their frequent and longitudinal usage, and on the process of learning of its users. Additionally, Schulz (2015) exposed the fact that Facebook is negatively correlated with college students' academic performance and achievements through high rates of distraction that regress their understanding in class (Schulz, 2015).

In his Bachelor thesis, Hughes (2018) indicated that social media drastically impacts humans' behavior and anxiety in work and education (Hughes, 2018).

In his research study, Hossain (2019) also revealed that the social media platforms, through smartphones, negatively impact the behavior, skills and understanding of the content of college students (Hossain, 2019).

Therefore, since social media platforms, through smartphones and time drained aspect, negatively impact human's learning, anxiety and behavior, then it could be associated to students' anxiety in math timed exams, behavior in class and competencies in the word problem solving in the secondary level (Figure 3).

Social Media Platforms,
Through Smartphones
and Time Drained Aspect → Could be Associated to Students' Math Timed
Exams Anxiety, Behavior in Class and Competencies
in the Word Problem Solving in Mathematics

Figure 3: Relationships between Social Media Platforms, Through SmartPhones and Time Drained Aspect, and Students' Math Timed Exams Anxiety, Behavior in Class and Competencies in the Word Problem Solving in Mathematics (Schulz , 2015; Hughes ,2018; Hossain 2019).

Further, in chapter two of her book, pp. 13-26, Yamagata-Lynch indicated that Lev Vygotsky's zone of proximal development (ZPD) theory is the distance between the learners' actual development without any assistance and their potential development, what they can achieve, under an adult/teacher leadership or with more eligible and qualified peer(s) through social interaction, cognitive efforts and communications that could enhance and modify their understanding of concepts, rules and ways of learning (Yamagata-Lynch, 2010).

Vygotsky's zone of proximal development (ZPD) enables educators and researchers a better understanding of humans' activities when they collaborate and interact in meaningful processes with their environment, such as students participating in learning activities while socially collaborating with other peers (Yamagata-Lynch, 2010).

Since the WhatsApp platform provides students with the opportunity to interact and collaborate with well qualified peers and experts, then its employment for this study could be based on Vygotsky's zone of proximal development (ZPD).

The only difference between the proper employment of the WhatsApp platform and Vygotsky's zone of proximal development (ZPD) is that the latter takes place inside the confines of the classrooms, and even-though Vygotsky emphasized on collaboration, it is not necessary that it can only be done inside the classes (Ellis, 2001).

In an era ruled by technology, this collaborative learning, a student-centered teaching perspective, could be also used through internet connection in a digital online learning environment (Ellis, 2001).

Connectivism, a learning theory in a digital age, has many similarities with Vygotsky's zone of proximal development and extends his concept outside the confines of the classes where students can collaborate from any place through the online networking provided by the prosperous technology of this modern era (Mattar, 2018).

Through Connectivism, learning is no longer internal and students do not have to sit passively in class to acquire information from their teacher. On the contrary, students are capable of engaging and learning outside the classroom in a digital learning environment through online collaboration by sending and receiving rules, theorems and concepts from their teachers and each other (Siemens, 2005).

Based on that, through the Connectivism learning, it could be possible for the researcher to move Vygotsky's zone of proximal development (ZPD) outside of the confines of the classrooms by properly employing WhatsApp, the most commonly used social media platform among students in the secondary level as previously mentioned in the introduction, and investing its interactive features for the benefit of students' learning and performance.

Moving on, Anderson's taxonomy, an updated revised version of bloom's, is formed of six verbs: remembering, understanding and applying (the lower level of the taxonomy), and analyzing, evaluating and creating (the upper level) (Wilson, 2016).

Remembering is about using the memory to recall previously learned facts. Understanding is the proof of comprehending ideas. Applying is about applying previously acquired concepts. Analyzing is for organizing, assuming, examining and concluding. Evaluating is about making judgments out of given information. Creating is about gathering ideas and combining elements for a new pattern (L. Anderson & Krathwohl, 2001).

The critical thinking is the ability to think in a clear and rational way to be able to analyze, reason, predict, and seek information (Lau, 2009).

It is embedded in the problem solving and communication domain in mathematics, the most important mathematical domain, and enhances students' mathematical learning and performance (Chukwuyenum, 2013).

The problem solving and communication domain passes through the lower level of Anderson's taxonomy and lies in its upper level (Figure 4) whose objectives are about extracting relevant information, describing and analyzing, conducting and reasoning, validating and interpreting (Frayha, 2001).

The problem solving and communication domain

Upper level of the taxonomy

Lower level of the taxonomy

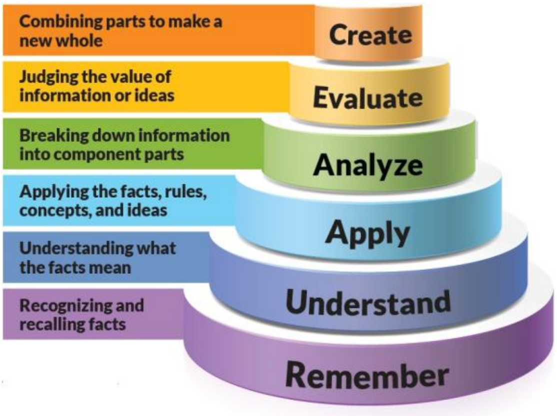


Figure 4 : Anderson Revised Bloom's Taxonomy (Wilson, 2016).

Since the connectivism, a learning theory in a digital age, provides students online interaction and collaboration to learn even more and reinforce their performance in different subject materials, and since the WhatsApp platform provides such types of interaction and collaboration through its interactive features, then its proper employment could possibly reinforce their mathematical performance in the problem solving and communication domain when they find themselves remembering, understanding, applying, analyzing, judging and even creating, according to Andersons' taxonomy

Based on that and all of the aforementioned, employing the WhatsApp platform, via its interaction features and online collaborative learning, might serve a pedagogical purpose, for the better of the teaching and learning axis, and reinforce students' mathematical performance in the problem solving and communication domain (Figure 5).

The WhatsApp Platform $\xrightarrow{\text{With Proper Employment}}$ Could Reinforce Students' Mathematical Performance in the Problem Solving and Communcation Domain

Figure 5 : Reinforcement of Students' Mathematical Performance in the Problem Solving and Communcation Domain trough Proper Employment of the WhatsApp Platform (Yamagata - Lynch, 2010).

Now, such employment can be put to test according to the seven elements of Engström's third generation system of activities: rules, community, division of labor, subject, object, outcomes and tool (Yamagata-Lynch, 2010), the four components of the deliberate practice (Kee, 2019) and Bruno's scaffolding (Wheeler, 2017): students' active engagement through motivation, the repetition, the retention and the consolidation.

T*he tool* is the WhatsApp platform while *the community* is represented by the selected students in the secondary level assigned or divided into WhatsApp groups.

Rules are the formal or informal regulations of the activities during the digital learning environment, like forbidding jokes. They are set up among the students in these groups to avoid possible slowing down of the process of the digital learning experiment.

The tasks are assigned in the *division of labor*. The subject is the learner(s) in this case while *the object* is the motive behind the experiment whose *outcome* is reinforcing students' mathematical performance in the problem solving and communication domain in the secondary level (Figure 6).

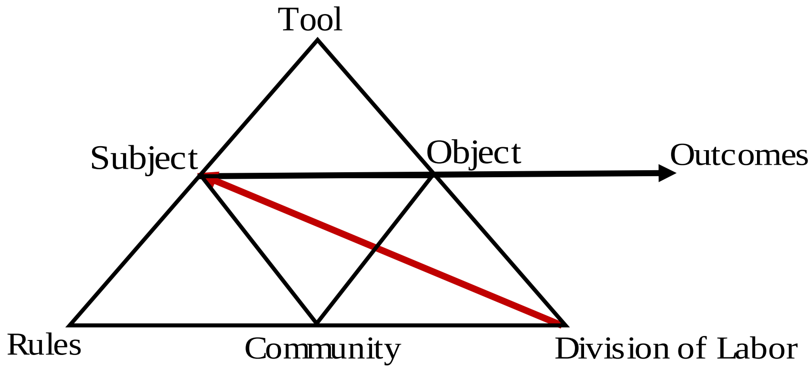


Figure 6 : Engstrom's System of Activities (Yamagata - Lynch, 2010).

Additionally, this employment relies on the deliberate practice because students' math performance can become better if they actively, purposely and gradually practice mastering similar exercises and more complicated ones (Kee, 2019).

Based on that, it is possible for the researcher in the division of labor to reinforce students' mathematical performance in the problem solving and communication domain through the deliberate practice.

Even more, student learning new skills and concepts is like a carpenter using scaffolding to properly build the stages of a new house. The construction of the learning starts from the ground up where the new is built on top of the known (LaGrange, 2015).

Scaffolding, a theory first developed by Jerome Bruner in 1976 (Wheeler, 2017), is provided in a learning environment to support the construct of a deeper level of learning of an individual or a group of students (LaGrange, 2015).

Through scaffolding students are capable of building new knowledge and reaching a higher level that is above their current one. More importantly, students' learning is supported when they fail to achieve a task on their own (LaGrange, 2015).

For a proper scaffolding, first the teacher has to find out students' learning gaps, what they know and what they need to know. Second, he has to determine what scaffolds enable them bridging these gaps (LaGrange, 2015).

Finally, he has to know the weaknesses and the strengths of his students, through-which he can provide them with a feedback on their work to do better and a tailored assistance that is adjusted on a needed basis (LaGrange, 2015).

Scaffolding is embedded in Vygotsky's zone of proximal development (ZPD) (Figure 7), where the teacher, also called the More Knowledgeable Other (MKO), is aware of his students' current status (Figure 8), (The Simple Life Channel, 2017).

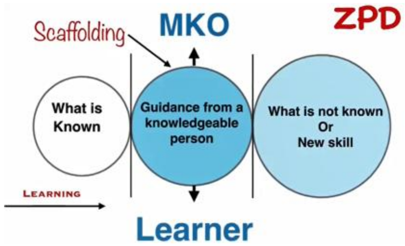


Figure 7 : Scaffolding and The ZPD (The Simple Life Channel, 2017).

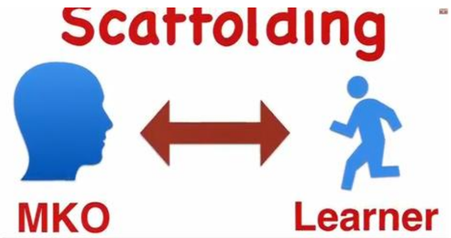


Figure 8 : The Scaffolding Theory (The Simple Life Channel, 2017).

For effective scaffolding, the learners are supported and guided according to the teacher's expertise through social interaction with cognitive efforts. However, this support and guidance is gradually removed as the learners become more skilled (The Simple Life Channel, 2017).

In an important note, technology, with effective instructions, can provide the teachers with flexible scaffolds for learning. Through that, teachers can design learning environments that support the success of students (LaGrange, 2015).

Based on that, it could be possible for the teacher to identify the gaps of his students in the problem solving and communication domain in the secondary level to determine the proper scaffolding to use, and then try reinforcing their math performance through extra problems sheets, social interaction and online collaboration provided by the WhatsApp platform. Thus, through connectivism, it could be possible for the researcher in the division of labor of Engström's third generation system of activities to reinforce students' mathematical in the problem solving and communication domain in the secondary level through the scaffolding of Bruner and the deliberate practice.

2.3. Impact of Smartphones and Social Media on Society, Including Students

The unprecedented growth of technology caused people to be hooked to their social media. It became a must for people to use at any time and place possible. Though, the effects of its various features differed according to the way people used their social media platforms and networking sites. Social media expanded immensely among people of different ages in diverse countries. Its platforms and networking sites enabled people to stay connected all the time, post their opinions, ideas, issues and news, and exchange images and videos. Social media even became an important part in different aspects of humans' life. It played a vital role in positively or negatively transforming the lifestyle of many people. Through social media, some people learned how to collaborate for a common purpose and build new relationships using platforms and networking sites such as Facebook, blogger, WhatsApp and Twitter. Others found themselves hindering their social life, education and work due to the excessive usage of their social media. Unfortunately, many people became addicted to their social media. They started spending most of their time connecting with others. This act did not go without some repercussions, as this excessive usage diverted their concentration and weakened their focus during work and study. Even worse, many youngsters were drastically affected by this exposure. They started to behave differently due to others posting images of improper ways of act that looked cool for them to adopt. Not surprisingly, changes in behavior can happen because the ways the masses think, act and live are posted online and available for all social media users (Siddiqui & Singh, 2016).

Due to the imposing presence of social media and smartphones on society, many researchers started examining their effects on people. Some researchers focused on the positive side of social media and smartphones on society, while others worked on exposing their negative effects.

Humphreys (2007) revealed that people have abandoned the desktop computers because of their smartphones. The researcher stated that, unlike desktop computers, people can communicate and stay informed about the latest news in public and private places through their smartphones, a trait many find as a must in a digital age where things move quickly and changes occur frequently. In addition to that, the social networks, such as Facebook, LinkedIn, WhatsApp and Instagram, have more leverage than the computer desktops due to their ability of creating a digital social life that suits the perception of any user, another trait that many find impossible to abandon (Humphreys, 2007).

Five years later, Baruah (2012) indicated that the social networking websites and platforms, through smartphones, positively affect societies because they provide their citizens the opportunity to interact with others at a distance, develop new friendships and share common thoughts and interests (Baruah, 2012).

On his famous talk show, Maher (2017) unveiled that the social media tycoons, who pretend building a better friendly world, are nothing more than farmers, with fancy suits and t-shirts, who grow tobacco and sell a harmful product to adults and children. For many people, especially youngsters, checking their cumulative likes on their social media on a regular and daily basis is the new millennial smoking. Smoking is addictive and targets humans' lungs (Dresden & Luo, 2019) but social media addiction aims at their souls and hacks their minds. According to Maher (2017), the social media platforms and networking sites are designed to take control of humans' attention and make them feel compelled about checking in on a constant basis. The accumulation of their likes can flood their brain with a gratify feeling without knowing that, those who are in charge, hold on to their likes to force them keep checking in more and more even during their meals. Facebook alone has more than two billion followers and many of them check their phones near 150 times every single day. The moment these people wake up, they feel thoughts streaming into their heads that they are missing the digital environment they dream to live in. Maher (2017) revealed that a regular human checks his smartphone every fifteen minutes or less during the day even if there are no alerts, notifications, messages or calls. This human finds himself feeling uncomfortable or even anxious for not checking new comments on his posts, so he checks in just to get rid of those feelings. A recent Australian research implemented among 3000 people, aged less than thirty, found out that nine out of ten people admit feeling anxious when they can't use their smartphones or when their batteries are too low for usage due to their smartphones addiction. Those people do not know that Steve Job, the inventor who revolutionized the world with his I-phone, did not allow his children to use it because he did not want technology to interfere in their lives. Ironically, infants nowadays hold their phones in their hands whether they know how to use them or no. This strange consumption of time is historically unmatched. Nowadays, people are sitting on the same table in a restaurant or at home attached to their smartphones and social media platforms chatting, liking, commenting, blogging and posting videos instead of talking to each other because they have that irresistible feeling of showing sides of their lives to anyone possible online as if they are in a reality show (Maher, 2017).

To add to the reveals of Maher (2017), it was clear that smartphones and social media invaded all societies around the world and that many people became attached to their smartphones and social media. They even started sleeping next to them. Due to that, experts, through reports, started warning people about the harms caused by such act. They advised the masses about the need to keep them away during their sleep. According to the California Department of Public Health (CDPH), sleeping next to the phones on the nightstand can have detrimental effect on humans' health. The CDPH revealed that these phones send radio frequency signals that can easily break through humans' brain. Due to the significance of this topic, the CDPH assured that people are exposing themselves to high levels of headaches, loss of memory, learning deficits, bad sleeping modes, impotence, tumors and even brain cancer. Because of that, the CDPH advised those who keep their phones near them day and night to reduce their exposure to the radio frequencies emitted by their smartphones, keep their phones far from bed at night and even turn them off. Moreover, people were advised not to use their smartphones when the signal is low because they will send higher levels of frequencies, avoid frequent usage of video calls and take off the headset when there is no need to it (Ali, 2019).

It is amazing that the internet was initially built to unify the world, make people smarter and eliminate all distance boundaries for communications. Sadly, despite not having enough common points and interests with anyone, many people nowadays use the internet to post their personal opinions, images and videos online without caring what others might think about them. Hence, people became great consumers for social media platforms and networking sites but poor producers of what benefits their work, social life, health and most importantly their education. Why is that? Because the lengthy usage of social media can enforce one's unhealthy self-esteem, convince him that he is not less important than anyone in the world and influence his narcissism through others' online acts. Regrettably, people don't realize that this method of usage alters their lives to the limit that they can't wake up and pass one week without using their social media; and by doing so, the tech enterprises gain more money on their expenses (Bangera, 2018).

Moreover, values have always been an important topic to keep an eye on because, basically, they set the standards for humans to distinguish right from wrong, which in turn define their ethics. In the early 80s, people thought that television impacted humans. During that time, a lot of people argued about the possible influence of television on humanity. For that, many researches were dedicated to investigate the impact of some of the flagship shows on human values, thoughts of freedom and equality (Besley, 2008).

Similar to the television, since its inception, social media has been surrounded by controversies, theories and contradicted opinions. Some supported it while others warned about the effect of its frequent usage on society and human ethics. While experts, like businessmen, tend to use the social media platforms and networking sites to expand their business relationships and reach, or spread, important information, regular people use their social media to extend their list of social connections without taking into consideration their implications on their way of living, thinking, judgment, work, time, family values and ethics. Unfortunately, this world expansion does not come without a cost. Posting personal or business information should not be accessible to the masses because some people will take advantage of that and bully whoever they can and hack their privacy, which in turn creates anxiety and depression (Johnson, 2015).

Disparities of opinions about the effects of social media addiction on society kept proliferating more and more. In her article, published on the BBC future story, Galer (2018) stated that just like with the internet, video games, alcohol, smoking and gambling addictions, people can become addicted to their social media and neglect their surroundings and everything else happening in their life or outside it. Galer (2018) indicated that no major concerns are needed about social media as long as it is not interfering with one's productivity in his work and study. On the other hand, social media addiction is a totally different case to deal with. Just like alcoholics and persons addicted to nicotine, people suffering from social media addiction tend to withdraw themselves from society, change their mood every then and now, and change their opinions constantly. A conference at the Royal Society of Medicine, about humans' mental health and social media, revealed that, despite all researches, we are still unable to determine the reasons behind the social networking sites (SNS) addiction. In addition, it was declared that smartphones addiction seems to be linked to the SNS addiction since social media is embedded in smartphones through its platforms and since many people are literally attached to their phones as if they were an organ of their body. Galer (2018) revealed that researches showed that if someone spends more than two hours using social media on a daily basis then he is likely to be on the line to suffer from addiction, anxiety and depression symptoms. In addition, Galer (2018) stated that, one day, social networking sites addiction could be classified as a mental disorder. Sadly, to make things seem worse, Galer (2018) assured that even if social media addiction is recognized as a mental disorder around the world, it might be too late for people to admit that this disorder is negatively affecting their lives (Galer, 2018).

Furthermore, in an episode of the Fox News Insider, Lee (2018) indicated that screen addiction is causing our children unacceptable exhaustion. An average 8-10 years old child spends near 8 hours a day behind a screen. Also, younger adults remain behind their screens up to 11 daily hours during their vacation. Why is that happening? Simply because two third of parents nowadays do not know how much time their children spend on social media during the day. What's most important is that children usually model what they see. Thus, when they see inappropriate act they may very well copy it and even start disrupting their class sessions. Shockingly, some parents think that children using their smartphones is what's best for them, not knowing that these electronic screens may damage their development of communication skills (Lee, 2015).

Even-more, a recent American research showed that it is impossible for children to grow up nowadays without the constant daily exposure to electronic screens. Children in schools are addicted to their smartphones without knowing that the Electro Magnetic Field (EMF) from wireless technology causes deadly radiation that affects insects, animals, plants and people, especially children, through a Wi-Fi service in school (Carlson, 2018).

What's more frightening is that the technology leaders and executives, who created those screens and pushed the false idea that kids will become brilliant thanks to them, keep their children away from using them because they know that these electronic screens are poisonous to anyone who uses them (Carlson, 2018; Zipps, 2018).

What is really happening, is that the rates of depression and anxiety among children have significantly increased through the roofs because the excessive usage of these electronic screens negatively affects their emotions and mental states of minds by separating them from the real world and attaching them to an extremely loveable digital environment (Carlson, 2018). While parents and schools districts think and believe that technology is the key to modern education, the fact of the matter is that this exaggerated usage deactivates diverse brains functionalities just like in the case of nowadays children who are not capable of reading words in a book page anymore (Zipps, 2018). So, according to the aforementioned, social media and smartphones can negatively affect humans, including students, in diversified aspects. Students, who are an essential part of the society, represent the future and their adequate education helps building it.

Thus, it is always important to examine new factors that might be associated with their education. In addition, it is essential to show some of the previously determined factors that negatively affect them, as elaborated about next.

2.4. Negatives of the Excessive Usage of Smartphones and Social Media on Students

In education, social media has its positive and negative influences. We need to admit that the smartphones and the social media platforms/networking sites have become an essential and inseparable part of everyone's daily routine for texting and/or staying informed with news (Pempek et al., 2009).

The improper usage of social media wastes students' time with useless chats and derives them from learning what is beneficial for their future careers. Students keep on using their social media more frequently without realizing that it can be extremely valuable and beneficial for their learning with the appropriate usage (Kuppuswamy & Narayan, 2010).

Social media is powerful at distracting students during class sessions, at home and in public or private places. Many students are not able to engage in a face to face interaction with others or pay attention to their teachers in classes or people in streets because they are busy looking or thinking about what others might be posting online. Not to mention that students collapsed their own privacy by posting their private information and images on the networking websites and platforms. One of worst effects of social media on students, is that it allows anyone to blog and write online posts, even with false information. These posts lead to inevitable failure when students read them and take what is written for granted (Dunn, 2011).

Besides that, most students are using their social media for tasks that are completely unrelated to their education through simultaneous communications and ongoing connectivity (E. Wood et al., 2012).

Today's students differ from the ones who were sitting in their seats a decade ago. Students nowadays have their own smartphones and portable computers. They remain connected with each other every single day through their smartphones and social media even if they were at a far distance. Unfortunately, due to the diverse features of laptops, smartphones and social media, many students are multitasking by web surfing, playing games, texting and chatting all at once, if possible, even during their learning sessions (Kraushaar & Novak, 2010; E. Wood et al., 2012).

These multitasking activities are distracting students' attention, reducing their focus and diminishing their working memory inside the classroom and outside it. They are decrementing students' productivity, performance in exams and cognition (Kraushaar & Novak, 2010; E. Wood et al., 2012), their mental processes for remembering, thinking, evaluating and problem solving (Cherry, 2019).

The recent development of technology has not only caused its devices, like smartphones, to expand widely among students, but it has also allowed them to penetrate their lives and distract them from their surroundings by negatively influencing their abilities to think, understand and create knowledge. For example, these phones have negatively laid their mark on students in higher education. It is not necessary anymore for them to utilize their brains, pay attention, stay focused and write on their copybooks during the lectures. They can download the whole lecture from the internet at a later time, rewind it as much as they need to and try to understand its content on their own (Goundar, 2014).

Moreover, smartphones, through their applications and social media platforms, enable secondary students to expand their digital social life presence even during their classroom sessions. It is a shame that students keep on increasing their contacts in their digital life without caring about the fact that this way of act negatively affects their academic performance, anxiety and behavior and causes them misconceptions, false understanding, in their subject materials. Social media platforms, through internet connection, can provide a digital gathering for friends at a distance and a path for students' common thoughts and interests. This trait allows people to enhance their social skills and cognitive domain by socializing with others, acquiring information and creating knowledge in a way that benefits their education. This aspect of social media that benefits education might be known among college students. Sadly to say, it is not generally a common among students in schools, especially those who are in the secondary level. Why is that? Simply because the consciousness of students in the secondary level differs from the awareness of universities undergrads and graduates' who try to pursue a higher level of education with a bachelor, a master's or a PhD degree. The reality is that the social media platforms are diverting students' attention; and instead of taking advantage of their social media to enhance their learning, students are using it in vain activities of no educational benefits by chatting, messaging, texting, voice and video talking (Almu & Buhari, 2014).

Students' current usage of the social media platforms and networking sites is lightening their ability to learn on their own, wasting their time, distracting them all the time and negatively affecting their anxiety and stress. Students lose valuable time because of the way they use their social media platforms and networking sites. They can be easily distracted and pulled from what they are seeking online for educational purposes. Due to that, many students copy their homework or submit it late. Even-more, in many universities, students use their social media during lectures without thinking that they are causing themselves to lose valuable learning time. Students, who use their social media excessively, are usually at a loss of focus, exhausted, lazy, distracted and not motivated (Bhoite et al., 2019).

Now while it is possible that social media could be used to ease students' learning processes during their scholar year by providing the low and high achievers new learning opportunities through interaction with others at distance, many are still not investing them for educational purposes (Almu & Buhari, 2014).

This point showcases the problematic situation of this research and enlightens on the importance of employing social media, like the WhatsApp platform here, in education in a macro level and in a mathematical domain in a micro level.

After years of sending and receiving messages and videos, chatting and talking through social media, students might reach a point when they become aware that their platforms and networking sites could be used to enhance their learning and performance, through their grades, in school and official exams.

It is almost impossible imagining students giving up on using social media for their entertainment. However, they may learn that it can serve their education if it was properly employed; and while this act of behavior is negatively affecting students' school performance, in projects, assignments and exams (Junco, 2012; Junco & Cotten, 2011), they can use their smartphones to further their learning, creativity, sociability, acceptance and interaction, to empower their self-esteem through interaction and collaboration inside and outside the classroom (Corbeil & Valdes-Corbeil, 2007).

2.5. Eclectic Researches about the Negatives of the Excessive Usage of Smartphones and Social Media on Society, including students

According to Rouis, Limayem and Salehi-Sangari (2011), Facebook, among the social media platforms, gained the attention of many researchers due to its significant importance for many people worldwide and massive expansion among the masses. Why? Because Facebook presents the youth, adults and grownups from different generations diverse opportunities to interact with anyone in the world, create their own profile, according to how they see fit, post and share their images, beliefs, ideas and videos. Unluckily, this popularity comes at an expensive cost. It leads everyone to extensive usage by their own will, which in turn creates stress, anxiety, changes in behavior and decline in work productivity and academic performance (Rouis et al., 2011)

Due to its frequent and excessive usage, many studies were assigned to uncover the reasons that cause people, from all over the word at different ages, to get attracted, join this virtual world and become persuaded to use it repeatedly on a daily basis. Through Facebook, many people keen on exposing their marital status and family images, posting private information, personal and political opinions, and sharing them with everyone without any remorse, something that was unaccepted decades ago. The researchers pointed out that the negative effect of Facebook on the work output should be properly addressed and that its harmful impact on students' academic performance should be extensively handled. Many students spend near eight hours per day on their social media. This act of behavior seems to be causing them unacceptable decline in their grades; and even-though they admit that social media is distracting them, consuming their time and has taken over their life, they are unable to quit signing in, even if there is no reason to log in, because they adore staying in contact with everyone. The strange thing is that even-though social media is an information mine to explore, its unpredictable attraction and ability in diverting students' attention has yet to be understood. Instead of taking advantage of it for the benefit of their learning, many students spend their time sharing images, uploading videos, commenting on others' profiles, engaging in lengthy discussions and staying in contact with old and current friends to expand their bridge of friendships and digital social life. This common attraction has negatively affected students' academic performance, focus, homework preparation and working memory (Rouis, Limayem, & Salehi-Sangari, 2011).

They have become easily distracted by any coming message, chat or comment; and as a result, they are left with little time and effort to study and complete their assignments. The researchers revealed that the frequent usage of social media, like Facebook, distracts its users from their main assignments and hinders their concentration in work and learning. This situation is common to many students except those who can multitask, who can do one or more than one thing at the same time, and those who are aware of the importance of thriving in their academic performance. These students control their emotions and organize the time they spend on their social media all by themselves. To better understand the aforementioned, it is fundamental for us to know that there are two kinds of students. There are "*the open students*", who are willing to try anything new that can support their abilities to pay attention, remember, read, reason and learn better. Then, there are "*the extraverted students*", who suffer decline in their studies because they need to be socially satisfied (Rouis, Limayem, & Salehi-Sangari, 2011).

These extraverted students usually log in more frequently to check their profile and spend too many hours on the leisure activities offered by their social media. They enjoy the social interaction by discussing, accepting invitations for more friendships, leading groups and sharing thoughts with others, even if they had never met these guys in real life. Through a validated and reliable survey, the researchers conducted their study on 239 undergraduate students in the business, social sciences and engineering faculties. They tackled the time spent by students on Facebook and their academic grades averages. Results of the study revealed that most students' cannot multitask. Thus, their constant presence on Facebook is negatively associated with their grades because of their inability to keep on focusing on their studies while remaining connected with others at the same time. So, for many, the more they are attracted to their Facebook, the less their grades become (Rouis, Limayem, & Salehi-Sangari, 2011).

In the next three years that followed 2011, smartphones spread among people so fast like fire in the bushes. These phones became indispensable and a must to have for many during the day. Park and Park (2014) revealed that approximately 32 730 000 Korean citizens use their smartphones excessively, which in turn may lead to smartphones addiction. The researchers revealed that the number of children addicted to smartphones is twice as that of adults and that the rate of addiction increased from 3.6% to 4.3% in one year for children who have yet to attend schools. As a result, users could seriously suffer from attention deficits disorder (ADD) that affects their ability to pay attention and a visual display terminal (VDT) that weakens their sight. More importantly, this addiction could negatively affect the developments and functionalities of the right part of the brain related to creativity, awareness, imagination, intuition and left hand control (Figure 9), the cerebellum in the back of the brain responsible for balance and walking (Figure 10) and the brain's front lobe that controls the consciousness, speaking and judging (Figure 11) (Park & Park, 2014).

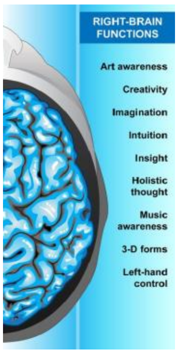


Figure 9 : The Right Brain Functionality (Oringer, 2019).

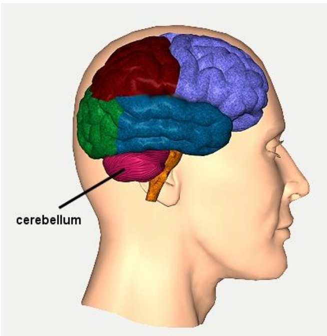


Figure 10 : The Cerebellum in the Back of the Brain (Oringer, 2019).

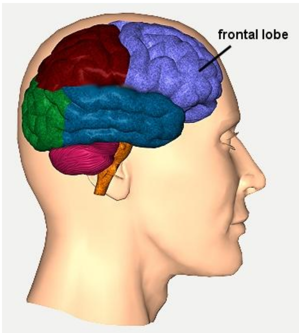


Figure 11 : The Frontal lobe in the Brain (Oringer, 2019).

The consequences of the smartphones addiction are serious and the masses have to know about them. Many parents do not know that they are sending a negative message to their children when they sit in front of them and use their smartphones for a long period. Their illiteracy about the whole situation and the limited number of researches about the smartphones addiction, unlike the countless number of researches about the internet and games addictions that could be easily found, are harming them and their children (Park & Park, 2014).

In the next year, in 2015, El-Badawy and Yasmin (2015) indicated that introducing the social media platforms and networking sites to the masses, because of the recent rapid and massive booming in technology, triggered many researchers to question their effects on students' academic performance in schools, through their grades. These platforms and networking sites spread widely among people all over the world because they allow their users to interact with each other, through the internet connection, for entertainment at any time and place. The researchers stated that while some educators truly believe that social media can positively influence students' learning, many schools are completely against incorporating the social media networking sites and platforms in their educational system. The administrations of these schools fear cyberbullying, harassment or changes that may affect their students' behavior by imitating others' ways of act through online interaction. For their study, El-Badawy and Yasmin (2015) examined the impact of social media on students' academic performance in Egypt based on their overall grade average. One hundred ten students aged between 14 and 19 from multiple schools participated in the study, among-which 85% were in grade eleven (El-Badawy & Hashem, 2015a).

The researchers used a likert scale survey to determine the most common used social media platform in this sample of students, the daily number of hours spent on using these platforms and the reasons behind using them. In addition, these students were asked to state their grade average. Results of the study showed that 41% of students use the Facebook platform and that 33% of the participators spend between one to three hours using the social media platforms on a daily basis. In addition, while most students stated that they use the internet for information when they are stuck answering questions in their homework, some revealed that they use the YouTube to learn how to solve their math equations through the online videos. Moreover, the chi square test showed that students' frequent social media usage does not affect their overall grade average nor the daily number of hours they spend for studying. Despite that, the researchers recommended examining the impact of social media on other samples of students especially with lack of previously conducted researches about it (El-Badawy & Hashem, 2015a).

These results contradicted with Naizabekov (2012) who previously found out that students postpone their studies because of the powerful distraction caused by their social media (Naizabekov, 2012).

The findings of El-Badawy and Hashem (2015) also conflicted with Feeder and Stephen (2018) who examined the impact of the social media networking sites on the academic performance of a sample of 30 students in higher education in 2018. Feeder and Stephen (2018) found out that most of the respondents were active on the networking sites for at least three hours per day and for more than fifteen hours per week. In addition, the majority of these students disclosed that social media does not positively contribute to the their academic performance because the way they are using their social media is hurting their grade average (Feeder & Stephen, 2018).

Moreover, results of El-Badawy and Yasmin (2015) did not also conform to Mowafy (2018) who showed, through her master's thesis, that college students' academic performance depends on their social media usage. Their average grades are negatively correlated with the time they spend on social media. For that, Mowafy (2018) recommended the administrations at higher education to create a social media networking sites, through-which students can interact with their teachers and peers, and learn how to use their social media for the benefit of their learning (Mowafy, 2018).

Through the years, concerns towards smartphones took off. They became a popular subject for magazines to write about. Television shows started publishing the latest news about their positivity and the too much talked about negativity. In his face-to-face interview on the popular television program “60 minutes rewind”, aired on the ninth of April 2017 on the CBS television network, Tristan Harris, a former manager in the Google product, admitted that many people are staring intently, all the time, at their smartphones nearly everywhere. These people are addicted to their smartphones because Silicon Valley, the home and the headquarter of the top high technical enterprises in the world, like the Apple Inc. and Adobe systems companies, is developing the phones, applications and social media platforms to get people hooked for good. People at Silicon Valley are working hard on programming the phones and platforms in a way that makes people feel the need to check in constantly by hijacking their brain. For hideous reasons, none of the corporations in the tech business prefer to expose this dark reality for people to know about (Fager, 2017).

Harris resembled the smartphone to a slot machine. Every-time someone checks his phone, it is as if he is playing the slot machine by pulling the lever to get an exciting reward. Sadly, creating a habit like this is one of the ways used to hijack people's mind. The interviewee revealed that, similar to the slot machine rewards, the chances of getting more likes on Facebook or Instagram, new followers and cumulative tweets on Twitter, available for everyone at all ages, make smartphones, through the apps and platforms, that appealing to the masses. Further, Harris revealed that new ways are always thought off and created to make people use these product as long as possible. For example, Snapchat is known as the most loveable service for messages among teenagers. So, the corporation responsible for this product created "streaks", a feature that shows the number of days in a row that the user sent and received messages from someone (Fager, 2017).

At first, this didn't seem to be a big deal. What happened is that kids became obsessed about not losing their streak. They started giving their password to other kids to keep it ongoing while they were out with their parents or in a trip vacation. This situation forces us to ask ourselves if these features are designed mostly to smoothen people's lives or to hook them to the product on their expenses and if the so called home of tech juggernauts, Silicon Valley, is programming apps or people by shaping the feelings and changing the thoughts and actions of those who use their product. Why? Because in reality, contrary to what many believe, technology is not neutral like most people think. It is up to the people to control themselves and choose how to direct and utilize the technology provided. The fact of the matter is that a selected number of tech companies, through carefully chosen people according to a predetermined purpose, want billions of people to lose control and use these electronic screens for a long period because it is their way of making money and pouring cash in their pockets. The ongoing distraction caused by these applications, due to constant texting, chatting, sending and receiving electronic mails, is undermining the relationships among people and disabling our kids from focusing on their surroundings. Why? Because the juggernauts techs are solo focused on humans' brainstem, the most primitive humans' emotions responsible for their fear and anxiety, to captivate on their attention as much as possible so they will use their product even more during their days and nights (Fager, 2017).

Unfortunately, parents are not aware of the complexities of what their kids are dealing with when they are using their smartphones, apps and social media platforms. They think that smartphones are similar to the mobile devices they used to have in the last century. They do not know that thousands of engineers are working every day redesigning and updating these phones secretly to make them more attractive and persuasive so that people, at all ages in different countries, remain stuck to the screens of their smartphones. How is that possible? Well, because when a computer programmer understands the work of the brain, then he will know how to write codes and algorithms through which the brain will do the things he wants from him. Simply, this *"brain Hacking"* rouses a neurological reaction that affects people's behavior and makes them come back to use their phones with no stopping. Algorithms such as the one that suggests holding off the Instagram likes of a random user for a certain period of time so that he will constantly keep on signing in because there are no new likes for his images (Fager, 2017).

Now while this whole situation might exist on the expense of people, it is for sure profitable to the corporations. The reality is that, because of the highly successful addictive codes that make people log in and see the advertisements, advertisers on social media, such as coca cola the soft drink company, has doubled the amount of money spent on its advertisings to reach more than thirty one billion dollars in just two years. What is most dreadful about the smartphones and social media is that the tech corporations do not care about the impact of technology on humans' anxiety levels. Many people become anxious when they do not check their phones every fifteen minutes, even with no buzzes or notifications. Not checking the social media platforms generates cortisol, the human's body main stress hormone; and because of it, humans become anxious, thus eventually their goal would be getting rid of that anxiety, so they check in (Fager, 2017).

Unfortunately, checking in does not eliminate this anxiety. It reduces temporarily and starts to increase again by time after putting the phone aside. Every time we receive a text notification or an alert the level of anxiety starts to rise due to the release of the cortisol. This fact alone suggests that these phones are imprisoning humans in a constant case of anxiety whose only antidote is the phone itself. Now while it is possible that smartphones and social media could be used for the good of humanity, corporates techs are just focusing on making their product much better and more irresistible, every passing day for their own good only, by creating a humans' dependent behavior that continuously responds to their product. In January 2017 the I-Pone company refused a habit-breaking app called "space". This inadmissible app was designed to create a delay for twelve seconds and postpone any social media launch (Fager, 2017).

The I-Phone company discarded it from their store of applications because they cannot risk distributing any app that would make people use the I-Pone or their apps even less. Even though the I-phone company changed its decision and reinstated distributing the "space" app on their stores, this reflection clearly reveals the hidden curriculum of the tech corporations and their agenda that not so many people are aware off (Fager, 2017).

In the same year, in his Newspaper article, Carr (2017), stated that, according to Apple data collection, a typical I-Phone owner checks up his messages, chats, alerts, social media and applications on an average scale of 80 times during a regular day, meaning that he checks it up about 30 000 times in a year. This reality signifies that this phone has become an inseparable trustworthy companion for its user because of its ability to present his thoughts, intentions and beliefs in a digital world in front of everyone. For that, it is easy nowadays to understand the true personality of anyone by just looking at the content of his smartphone through his images, videos, recordings and chats. On the sixth of October of that year, Carr (2017) indicated that more than fifty percent of the I-Phone users admitted that they cannot imagine spending their day without it in their hands or being nearby. In addition, they couldn't believe how they were able to live and work without it in the past before its public introduction (Carr, 2017).

Now, while many people think positively about their smartphones, many of them fail to realize that these extraordinary and lovable phones create different types of anxiety and negatively influence their thinking and attention towards their surroundings or to what is important for them to do because of their excessive phone usage. The writer revealed that researchers found out that smartphones are considered a trouble for people because they weaken some of the brain's functionalities when they become dependent on them in everything in their life. Carr (2017) also revealed that the smartphones' vibration or alert causes a direct distraction for many people and hinders their performance as it makes it difficult for them to concentrate in work or on the task on hand. In addition, Carr (2017) declared, through previous research studies, that people's performance and focus at work become dull if they do not check their smartphones when they ring or buzz. He also stressed on the fact that the blood pressure of many people increases, their pulse fastens and their skills of problem solving incline because they heard their phones buzzing or ringing but they weren't able to check them. Furthermore, Carr (2017) indicated that some researchers suspected that humans' attachment to their smartphones might be lessening the intelligence of their users, and for that they implemented an experiment on 250 undergraduates, through a test, who were either asked to keep their smartphones in another room, in their pockets or in front of them (Carr, 2017).

The results of the experiment showed that the ones who kept their smartphones in front of them performed the worse, the ones who kept them in their pockets or in their handbags near them performed averagely, while the ones who left them in another room scored the best. These results lead to the fact that the commonly frequent and lengthy usage of the smartphones by humans disrupts their focus and thinking, and decreases the power of the brain functionality. In addition, the writer pointed out at four studies. The first study showed that the integration of the smartphones with students' daily life and the unacceptable prolonged usage divert their attention and hinder their understanding, reasoning and problem solving abilities. More importantly, the more they use these smartphones, the more their mental abilities suffer. The second study uncovered that some can perform poorly in tests and tasks if their smartphones were kept in front of them even if they were turned off (Carr, 2017).

The third study revealed that undergraduate students, whose smartphones were forbidden in a lecture, almost scored a full grade in a test related to the subject matter of the same lecture. Finally, the fourth study showed that smartphones diminish the trust, empathy and understanding of others, and hinder the front face conversation abilities of their users, suggesting that humans' thoughts and feelings could be deformed due to external factors people are not familiar with just like with the smartphones. The writer stated that the brain is a system responsible for humans' thinking and monitoring, that we are by nature attracted to new things surrounding us. That is why the smartphones, also called *"supernormal stimulus"* (Carr, 2017), stand alone at the top of the list of objects that intrigue our curiosity and attention, even when they are turned off, more than anything else. For that, the writer suspected that smartphones are originally designed as a magnet of minds capable of hijacking one's attention when they are around because of their varied functionalities that appeal to the masses (Carr, 2017).

Even-more, Carr (2017) declared that the improper usage of the World Wide Web internet connection has negatively affected people's comprehension and knowledge, even though it was supposed to make people smarter through its information when it was launched twenty five years ago. To make things worse, smartphones allow people easy access to websites data through the internet search engines that enable them looking and finding almost anything online. Thus people, like students, do not encode more information to increase their knowledge because they can easily look up for anything they need. Carr (2017), indicated that this act negatively affects students' working memory and their remembering and thinking abilities because they are transferring their abilities of reasoning, thinking and turning acquired information into knowledge from their brains to their smartphones (Carr, 2017).

This newspaper article uncovers the negatives of the smartphones on humans in diverse aspects by hijacking their minds and imposing themselves on their will, work, education, performance, achievements, and social life. Thus, since the smartphones hijack humans' education and since in the word problem solving domain in mathematics in the secondary level is an essential part our students' education, then these smartphones could be possibly associated to students' competencies in the secondary level.

Moving on, we all know that social media has become the first thing to check after waking up in the morning and the last thing to check before sleeping at night for many people. Time flies fast through social media when people engage in conversations with others at a near or far distance, post photos about their social and professional lives, send and receive funny images and videos. This bright image of social media might lead anyone to think that it is harmless and offers the entertainment people need to lessen the pressures of their daily life routine. Unfortunately, it is not true as it has a dark side that hinders humans in different aspects of their lives because of the way it is commonly used. Through the desktop computers, laptops or smartphones, social media platforms and networking sites, like WhatsApp, Facebook and Twitter, enable their users to chat, reply, tweet and retweet, share, and interact with others on their free will. Due to that, most users nowadays have at least two social media platforms that can satisfy their needs in the digital social life. In addition to the powerful attraction of the interaction features of social media, its low cost that suits the masses is one additional factor that plays a role in its expansion among them. So, it is normal that this imposing reality created many concerns for the researchers in humans' social life, health and mental wellbeing. In his Bachelor thesis, Hughes (2018) indicated that social media has drastically affected humans' behavior, the way they act as previously mentioned in the introduction, and their interaction. People, like students, started acting in a different way than what they were used to in work, home and classes, and their free time became a chance to chat, reply, post and retweet (Hughes, 2018).

This change in humans' behavior is a warning that should not be neglected by the researchers who should continue their ongoing studies to enlighten people about the impact of their reckless usage of social media on different aspects of their wellbeing. Hughes (2018) stated that one of the reasons that social media could lead to addiction is because it satisfies people's need to present themselves in a bright figure among their families, friends, colleagues and those who are at a distance. Thus, people are keen on using the social media platforms more frequently to keep their shining image online in front of everyone without realizing that they are gradually losing contact with the real world in favor of the digital life. A decade ago, people used the desktop computers and the laptops to access the networking sites. However, with the presence of smartphones, the social medial platforms became accessible for anyone holding a smartphone at any time and place. This reality might feel good at the first sight, but as a matter of fact, this availability is challenging for people, especially the youth like the students, because it can distract them and reduce their focus on road, at home and work, and during their studies (Hughes, 2018).

In addition to the negative impact of the social media platforms on humans' behavior, Hughes (2018) warned about its effect on their anxiety, like math exams anxiety as mentioned in the introduction, and especially on the youngsters, like the students who use their social media regularly and frequently during the day. Thus, more researches are needed to better understand the relationship that exists between the two sides to know how to deal with it in an adequate way, especially that some previous researchers labeled social media as a harmful experience for humans while others supported it through their experiments. One can take Facebook as a clear example about the negativity of social media. For years, Facebook has been known as a popular networking site/platform among students due to its features' ability in engaging them in fun experiences. However, due to that overwhelming and increasing popularity, many started questioning its negative effect on students' learning, like poor or false understanding of their subject materials, their behavior, through the way they act inside and outside the school, and their state of mind, like stress, depression and anxiety (Hughes, 2018).

For his study, Hughes (2018) developed a 5-point Likert scale online survey about stress, depression and anxiety, the number of social media platforms used and the frequent usage of Facebook. The survey was approved by the ethical committee in the Dublin Business School and was sent to 73 participants, males and females, who aged at least 18, via their mails to answer it. Later on, the researcher was able to collect his data from the participants and analyze it with Statistical Package for Social Sciences (SPSS). Results of the study, through the descriptive statistics, showed that 16.2% of the participants used at least five social media platforms every day where most of the respondents used three platforms regularly on a daily basis and 72.9% of the participants labeled Facebook as essential part they need during their daily life routine (Hughes, 2018).

Moreover, the multiple regression test showed that 23.4% of the participants' depression, 20% of their anxiety and 16.1% of their stress could be explained because of the number of social media platforms used every day and the time spent on Facebook. At the end, the researcher warned that the constant usage of the social media platforms and networking sites can affect humans' stress, depression and anxiety in different aspects of life like work and education for any person at any age. For that, Hughes (2018) recommended enlarging the sample sizes of the youngsters and adults participants in other future researches (Hughes, 2018).

In addition, he recommended examining the impact of the social media platforms, their frequent usage and the time people spend on using them on their stress, anxiety and depression in topics that concern their education, work and productivity (Hughes, 2018).

The recommendations of Hughes (2018), at the end of his research study, show the need to examine the impact of social media on humans' anxiety in specific topics in education and work through larger samples.

For that, this research has tried determining a statistically significant association, if any, between the social media platforms, like WhatsApp, and students' math timed exams anxiety, a type of anxiety as mentioned in the introduction, in the secondary level.

In the same year, Vahedi and Saiphoo (2018) indicated that smartphones were initially created with similar technology provided for desktop computers and laptops. Through the technology embedded in their small sizes, users were able to call, play games, send messages, access the internet, stay connected with others at distance and use applications that simulate the services of computers' software anywhere at any time. Thus, this generation of smartphones has the same properties of the vintage phones but with more advanced features. Unfortunately, these advanced features drain the time and effort of their users because of their multi-functionalities used by the masses. They are mainly used for connecting, calling and texting, searching for jobs and homes, checking dates, doing online business and staying up to date with local, national and international news to the limit that many people have become addicted to their phones as if their lives depended on them (Vahedi & Saiphoo, 2018).

As the number of smartphones users increased, the number of researches about their effects on humans' health, mentality, productivity and education proliferated. Studies about stress and anxiety have always taken a large space in human researches simply because they could be provoked by imposing phenomena, like the smartphones, and environmental/biological factors. Regarding smartphones as a device that could be negatively associated to humans' anxiety, results about their effects differed from one study to another. Some showed a significant association between smartphones and anxiety while others ended with no significance at all. Through their study, Vahedi and Saiphoo (2018) revealed that the smartphones with a touch screen are significantly associated to humans' anxiety when their usage becomes a problematic situation for their owners. Though, the researchers did not address the rising of anxiety when the smartphones usage becomes a problem for their holders (Vahedi & Saiphoo, 2018).

In addition, the researchers stated that, even-though smartphones are, with respect to statistics, associated to anxiety, they cannot label these phones as a causal for humans' anxiety because they need more experiments and quantitative studies concerning this imposing phenomenon. Finally, the researchers pointed out that the excessive usage of smartphones through their features, applications and social media platforms might have also a negative effect on humans' behavior in work and learning places because using their functionalities and staying connected with others have become a habit and a need they have to satisfy. Nonetheless, even in this case, they cannot consider these phones as causal for the way humans act because of the need to calculate the effect size of the smartphones' magnitude on humans' behavior. To wrap things up, Vahedi and Saiphoo (2018) confirmed the need for more studies on the potential associations between the smartphones and humans' anxiety and behavior to identify the types and the relations that exist between the two sides in key topics related to our work and education (Vahedi & Saiphoo, 2018).

Notwithstanding, unlike Vahedi and Saiphoo (2018) who called for more quantitative studies, this research study aimed at adopting the mixed method approach through its quantitative findings followed by qualitative interpretations. This was done to further analyze and understand the results, and enlighten the teachers about the associations, if any, that exist between the smartphones and students' math timed exams anxiety and behavior in class in the secondary level.

Moving on, social media usage is increasing gradually among citizens and similar to everything born from the womb of technology, it has its positives and negatives. The fast development of technology led to creating many social platforms and networking sites like Facebook, WhatsApp, Instagram and Twitter. Smoothly, these platforms and networking sites found their way to humans' life and became a must to have for many of them. It is easy to notice the imposing power of social media on humans all around the world. People are using their social media platforms and networking sites through their phones and laptops to text, send and receive images and videos while walking on the street, sitting in a coffee shop eating and celebrating. In addition, they are posting the images of their newly born child in hospitals, something that was not common to do more than a decade ago. Anwar, Shah Syed and Ahmad (2018) revealed that the frequent and constant usage of social media is associated to humans' anxiety, depression, sleeping quality and habits, productivity, and thinking abilities. The researchers indicated that people can become addicted to their social media faster than alcohols and cigarettes, especially to WhatsApp, Facebook and Twitter. They also revealed that most people, youth and grownups, have become strongly attached to their social media platforms and networking sites without caring about their effects on their social life, concentration on their surroundings, behavior, ways of thinking and feelings (Anwar et al., 2018).

For their research project, Anwar, Shah Syed and Ahmad (2018) prepared a survey and conducted it through Google Docs. The researchers targeted 40 people aged from ten to over forty because youth are known to be attached to the social media that enables them wasting their time for fun, while many adults give time to their digital life on social media more than their real one. Results of the study revealed that 57.5% of the participants feel uncomfortable in one or two days without using their social media. In addition, 65% agreed that social media is negatively affecting their relationships because they spend too much time using it on the expense of the time they should allocate to their partners. Moreover, 55% of the participants revealed that social media is deeply rooted in their life and that it has become an essential part of their daily life routine. Furthermore, 50% of the respondents admitted that they feel irritated when someone interrupts them while they are using their social media. They even confessed that they prefer not answering anyone while using their social media and that they don't care about what others think about them for doing so. Finally, 57.5% of the participants believed that social media has negatively affected humans' ways of thinking, acting and feeling. Due to the importance of this topic, the researchers called everyone to pay attention about the negative effects of social media on humans. They asked for more future studies to enlighten people about it to solve if possible (Anwar et al., 2018).

In the same year, for her research study, Balalle (2018) targeted one hundred students aged between 18 and 25 in the city of Colombo, the capital Sri Lanka. The researcher distributed a 5 points likert scale survey to these students to examine the effect of social media (the independent variable) on students' educational achievements (the dependent variable). The survey consisted of items about the number of hours spent on social media per day, the reasons behind using it and their exams' scores averages. Results of the study showed that 52% of these students use the social media platforms between 3 and 4 hours per day for entertainment. A small portion of them revealed that they ask each other questions about their college courses when they find themselves stuck. Additionally, results of the study also showed that the daily frequent usage of social media platforms is negatively correlated to students' exams scores averages. The researcher revealed that no researches about the impact of social media on students were conducted in Sri Lanka, which in turn reflects the need to examine the association between social media usage and students in schools and universities(Balalle, 2018).

In the next year, in his research study, Hossain (2019) indicated that the obvious rapid expansion of smartphones among people in general and students in particular impacted different aspects of their lives because of their integration with everyone's daily life routine at home, work, school and university. This new generation of smartphones, favorite to a massive number of people, allows its users to call, message, surf the net, access the social media platforms, use applications and play games at any place, whenever they want with the presence of the internet connection. Even college students started using their smartphones publicly or covertly on road, at home, on campus and in the classroom during the learning sessions despite of being forbidden to do so by the administration. The researcher clarified that the existing strong bond between the students and their smartphones is due to the fact that they spend their leisure time voice calling, playing games, socially networking with others, surfing the internet, watching videos and sending messages. Thus, it is not strange that they use their phones for their entertainment and not for the benefit of their education (Hossain, 2019).

This reality led many educators to believe that smartphones are capable of disrupting students' learning by negatively influencing their content acquisition during the learning session through poor and false understanding because they are distracted all the time; and that these smartphones could be negatively influencing students' inappropriate behavior by talking without permission, sleeping, laughing, failing in their school or university, bullying and even sexting. For his study, Hossain (2019) used a 5-point Likert scale survey to interview 274 students registered in the Bachelor and Masters Degrees, 58% male and 52% females, from various departments in the University of Jahangir Agar. The researcher used a convenient sampling technique in order to investigate the impact of the time spent by students on their smartphones, per week, on their learning (Hossain, 2019).

Results of the study showed that most students spend between ten and forty hours on their smartphones during the week. In addition, results showed that more than 60% of the students admitted that they do not use their smartphones to support their learning, and that their phones interfere with their learning in the classroom and reduce their ability to focus on the content presented on the board because they are busy messaging, calling, using their applications or playing games. Moreover, 50% of the students acknowledged the fact that the current usage of their smartphones is a waste of their time. Though, they admitted that these phones could be used to assist their learning by surfing the internet engines for educational reasons, contacting their teachers or their well-qualified peers for questions, enhancing their poor understanding and rectifying their misconceptions (false understanding) through voice calling or online networking. Furthermore, the majority of the students admitted using their smartphones to access their social media platforms more than they are supposed to in their free time and during their studies. These students also admitted that if they were able to use their smartphones and social media platforms properly by sending lectures' podcasts and sharing information by themselves or with a guidance, then they would for sure be increasing their productivity, serving and enhancing their learning (Hossain, 2019).

Unfortunately, many college students admitted not taking advantage of the internet connection provided by their smartphones through the social media platforms and the applications to ameliorate their learning. Their phones are successfully distracting them, weakening their study habits and deviating their attention from the books to entertainment and even X-rated sites because they prefer to do so. Hossain (2019) showed that a small percent of the students admitted using texting for definitions and information about lectures, and that more than 80% of the participants send and receive messages during the time allocated for their studies just to stay connected with their friends. In addition, the researcher indicated that the inappropriate usage of messaging among college students is also affecting their grammar, because of the way they write their texts by using symbols, internet language and abbreviations. The fact of the matter is that students are supposed to use their phones to read from the rich online literature that can rectify their grammar mistakes and false understanding (misconceptions), and boost their weak acquisition and writing skills of the English language (Hossain, 2019).

On a positive note, Hossain (2019) emphasized on the fact that texting empowers students' collaboration for educational purposes at any time and distance, which in turn creates a proper and common understanding of information and ideas among them, and enables them constructing their knowledge. Unfortunately, this reality has yet to be achieved at a high rate among college students due to the previously mentioned reasons. Even more, results showed that more than 70% of the students use their smartphones to make or receive phone calls during their studies for things that do not serve their education at all. Students keep on checking their phones for calls, missed calls or messages many times while studying even though they know that they are hindering their learning by doing so. Shockingly, most of them admitted being stressed or anxious when they lose their internet connection or when their phones are defected. Results of the study also showed that more than 50% of the students play games, through their smartphones, during their lectures and that most of them play types of entertainment games that do not help their thinking and problem solving abilities in any way. These students acknowledged the fact that they have become obsessed with online games, through their mobiles, and that they constantly strive to take on all challenges and win to satisfy their need of remaining on top even on the expense of their studies. On a positive side, these students confessed misusing their phones' applications, calls, messages, games and social media platforms instead of taking advantage of them. On a noteworthy, due to this ubiquitous and common situation among students everywhere, they suggested that educators and researchers need to create ways that can employ all what have been mentioned above for educational purposes because most of them are ignorant and completely blindsided when it comes to using their smartphones in their learning (Hossain, 2019).

According to the results revealed above, it is clear that many college students were negatively affected by the prosperous development of smartphones. They are draining their time by misusing their phones in a way that hurts their learning and future careers.

Hossain elaborated about the negatives of smartphones on humans' behavior and learning because of the ways they are used. For that matter, his study makes us stop and think about examining the associations, if any, between the smartphones and students' behavior in class and competencies in the word problem solving in mathematics.

2.6. Impact of Math Exams Anxiety on Students

In addition to the aforementioned negatives, anxiety is known to be a major factors playing an essential role in affecting student's academic performance and future achievements. Students who deal with anxiety disorder demonstrate a negative behavior in their studies and learning, which in turn negatively affects their exams' performance and leads them to neglect their assignments and projects (Ehmke, 2018; Killu & Crundwell, 2016)

Math anxiety, a type of anxiety defined as the fear of mathematics and its tasks like the timed exams (Szucs & McLellan, 2019), is a diffused issue that negatively affects students' performance in mathematics and their behavior towards this subject material (Luttenberger et al., 2018).

Many students who suffer from math anxiety, especially those who experience high degrees, freeze up during a math exam or lose many information prior to it. Not to mention that some of them even feel nausea, sweats, panic and fast heart beats before or during the exam (Freeman, 2015).

It is known for a fact that math anxiety surfaces during educational time line and appears to be exclusively to mathematics. It prevails differently among students in classes on all levels, especially in the middle schools and the secondary level (Hill et al., 2016).

Various studies showed that math anxiety is a real phenomenon and an influencer on students' academic performance with its detrimental effects. So, it is important to relate to its sources in order to know how to handle them (Furner & Marinas, 2016).

Math anxiety was first detected and noticed in 1957 among undergraduate students who reacted negatively to arithmetic, a math topic. Researchers at that time thought that it was a case of test anxiety but later on they found out that math anxiety had its own existence and incarnated it as fear from numbers (Dowker, Sarkar & Looi, 2016).

Literature describe math anxiety as a debilitating effect that interferes with numbers manipulation and problems solving, causing a poor academic performance. Students who experience math anxiety are not usually confident about their mathematical abilities. They tend to avoid math by taking the minimum possible number of courses related to it, which in turn limits their choices and options for their future careers (Scarpello, 2007).

As a result of that, some countries are not be able to deliver enough graduates in scientific domains, such as engineering that requires high level of mathematical competencies, which in turn harms the future of any country because scientists, technologists, engineers, and mathematicians strengthen citizenship quality through their technical skills and literacy (Beilock & Maloney, 2015).

Since it was important to uncover some of the reasons that trigger math anxiety, a series of experiments was completed in the United States. Results revealed that, in the human brain, the ventromedial prefrontal cortex (VMPFC) and the amygdala (Figure 12) regulate negative emotions during math exams only. As a result, students' mathematical performance drops more as they become extra anxious (Young, Wu & Menon, 2012).

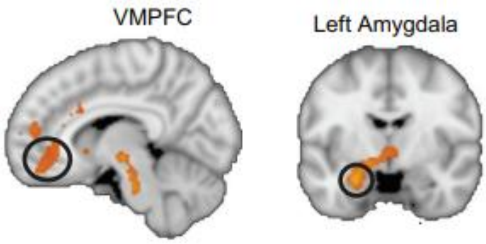


Figure 12 : The Ventromedial Prefrontal Cortex and the Amygdala (Young, Wu & Menon, 2012).

Furthermore, emotions like math anxiety are a fundamental part of the learning environment because they can influence student's behavior in class. They can either enjoy math and invest more effort in it or alienate themselves from it and repel everything related to this subject material. Pekrun's theory on emotions in the classroom proposes that emotions have two basal components: First, how much a student values what he is doing in class. Second, how much the student believes that he has everything under control concerning an upcoming task (Artino, Holmboe & Durning, 2012).

Usually, an individual experiences anxiety when he highly values an upcoming task but keeps feeling that he cannot control it or the elements surrounding it. This feeling could very well plant in his head that mathematics is a complicated subject material to study, which in turns signifies for him that the upcoming math exams cannot be passed successfully (Buckley, 2013).

Previous researches revealed that math anxiety is negatively associated to students' low grades and performance in math exams. Yet, these same researchers found out that not all people who suffer from math anxiety perform at the same level in exams (Lyons & Beilock, 2012).

Math-specific deficits are caused by activities in the brains' right and left hemispheres. These deficits are about students using basic operation symbols (+, -, ×, :), acquiring simple math calculations or strategies, retrieving of previous facts, presenting numbers on an axis, estimating, counting the number of objects, performing correct mental calculation, decoding information placed in a given figure, visualizing and interpreting two and/or three dimensional geometric shapes, and understanding the content of a given math problem to process in the needed step (Karagiannakis, Baccaglini-Frank & Papadatos, 2014).

Usually, students who deal with one or a selection of these math-specific deficits suffer from math anxiety, even at high degrees. Thus, highly math anxious students usually perform poorer than their colleagues. Nonetheless, it is very important to note that some students who are afraid of math exams usually perform at a high level at almost every time. This is due to their mechanism in controlling their fear and reducing it before the actual exam, even a little bit of it, and their high cognitive resources that aid them during this test (Lyons & Beilock, 2012).

Despite the deficits in mathematics and the anxiety regarding math timed exams among a number of students, the deliberate practice is known as one of the better methods used to enhance students' performance (Kee, 2019).

Even more, the deliberate practice is a type of practices that relies on motivation, scaffolding, repetitive and focused practice and that mainly aims at a consistent and steady improvement after identifying student's deficits and struggles. In this type of practice, students start dealing with regular problems and end up with more complex ones (Paukner & Hlas, 2013).

The scaffolding and the interactive features of the WhatsApp platform, that consist of tagging, replying, sending voice notes and images, enabled the researcher to apply the deliberate practice as a technique to identify students' struggles in performing correct calculation steps, understanding the content of a given math problem and applying the adequate strategy.

Locally, in their research, Anouti, Shehayeb and Mchieck (2019) examined the impact of math anxiety on the overall mathematics grades averages of 124 students in the middle and secondary levels in two schools. The researchers used a standardized survey to examine students' math anxiety. The regression analysis and the One-Way-ANOVA test showed that math anxiety is negatively correlated with students' performance in mathematics, through their overall grades averages in all classes. In addition, results of the study revealed that students with high levels of math anxiety perform worse in the exams that their colleagues. The researchers recommended that math teachers should pay more attention to students' anxiety, especially the low achievers in classes because their anxiety might have been affecting their performance. They also recommended other researchers to determine factors that trigger or negatively influence the phenomenon known as math anxiety. In addition, they advised examining the impact of math anxiety on a larger sample of students in different classes and levels (Anouti, Shehayeb & Mchiek, 2019).

Based on the recommendations of Dowker, Sarkar and Looi (2016), and Anouti, Shehayeb and Mchiek (2019), this research was devoted to determining if the smartphones and the social media platforms, like WhatsApp, are neoteric factors associated with students' math timed exams anxiety in the secondary level.

Moving forward from the aforesaid negatives, it is a fact that the massive expansion of social media made it an essential part of humans' needs. Thus, it is normal to highlight, define and detail its spatial point in the Maslow's hierarchy of needs next.

2.7. Social Media Spatial Point in Maslow's Hierarchy of Needs

The original Maslow's hierarchy was designed in 1954 to identify the physiological, safety, belonging, esteem and self-actualization needs of humans (Figure 13) (Fife & Pereira, 2008). Through that hierarchy, Maslow labeled humans' physiological and safety needs as their basic needs, the belongingness and the esteem needs as their psychological ones, and the self-actualization needs as the self-fulfillment ones (Ieranò, 2016).

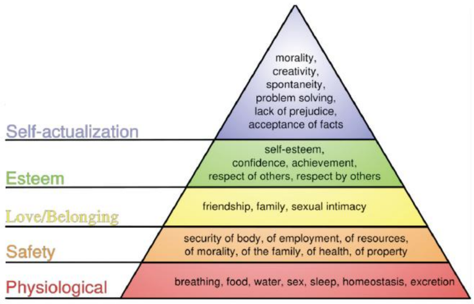


Figure 13: Maslow's Hierarchy of Needs (Fife & Pereira, 2008).

Food, water, stability and a shelter required for living and sleeping represent the physiological needs of humans, and by nature people search for safety when it becomes their dominant need after fulfilling the required ones for the functionality of their body. For humans, safety means that they feel safe from any physical attack, they control things surrounding them, they have stable families, they are in a good health and they are doing well economically. After the satisfaction of the safety needs, belongingness and love come third because most humans fear loneliness and most of them need to have love in their life, so they seek to be accepted and liked by others, and to be a member of a committee or a group if they desire so. After they are accepted by others, the esteem needs come fourth because humans by nature love to be important, useful and respected by others whenever they are. Additionally, they most definitely love to be considered as influential figures by their colleagues, friends and relatives (Fife & Pereira, 2008).

Finally, with the satisfaction of all four needs, the self-actualization needs, which crown the head of the hierarchy, are associated with human's personal peace and morality. His creation and development of knowledge, achievements on the long term from the start till now and the potential accomplishments as he sees them. His inner desire to solve others' problems and benefit the world, acceptance of himself, abilities and the facts of the world surrounding him (Figure 14) (Fife & Pereira, 2008).

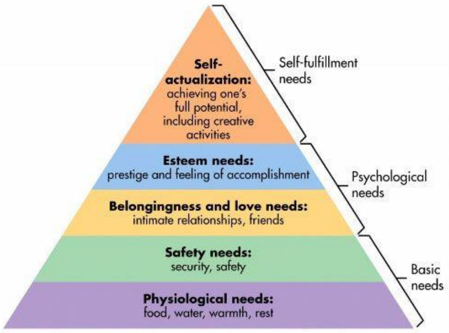


Figure 14 : The Basic, Psychological and Self - fulfillment Needs of Humans (Ieranò, 2016)

Maslow's designed his theory of motivation to explain humans' priorities and wants in life through the hierarchy due to the fact that he always questioned the possible reasons that motivate humans' behavior. He always believed that people are motivated if they have to achieve some needs and if they have to do things that make them feel happy. In addition, he was actually sure that every human being has the internal desire to reach the level of self-actualization in his lifetime. However, for people to reach the highest level of the hierarchy, they have to satisfy their basic and psychological needs from food to water and shelter, to feeling safe, beloved and accepted by a community that makes them feel respected and admired by others. Maslow assured that no human can move on to his complex needs without first satisfying his basic needs to a certain degree, just like with a regular citizen who can settle down with 85% of his needs for food and shelter, 70% of his needs for safety, 50% of his needs for belonging and love, 40% of his needs for respect and admiration, and 10% of his self-accomplishment needs. In addition, he explained that as people successfully satisfy their basic physiological and safety needs, they reach a state where their psychological needs of belonging, love, respect and admiration by their friends, families and peers become the most important for them to achieve; and as they progress even-more, their self-accomplishments start to take over their life (Mawere et al., 2016).

In our current era ruled by technology, Maslow's hierarchy has not become outdated and neglected. On the contrary, it can be transcribed by taking into account the imposing presence of the social media networking among people almost everywhere in the world. Starting from the physiological needs of humans at the bottom of the hierarchy, social media can be excluded from things associated with the body's functionality like food and water but not from the shelter needed to live and sleep under simply because a social media platform like LinkedIn can secure the money required to pay the bills of that shelter. In addition to that, LinkedIn is known to be the best social media platform that suits the safety needs of humans because its professional design is free from any physical threat and those who are employed to work for its company feel that they are secured emotionally and at a good place economically through a long lasting job with a decent pay. Moving forward, the social media platforms companies, like WhatsApp and LinkedIn, support the belonging and esteem needs through their workplace environment. Employees find themselves accepted by members of teams who won't be misjudging or criticizing them. In some cases, through the work environment, they feel that they are at a significant level in the eyes of their organization, respected by their peers and at the right place that suits their skills. Social media companies uphold humans' self-actualization needs by giving their employees a new meaning for life and a purpose for living by fulfilling one of their potentials to work at this technical juggernaut. At this stage, people don't consider themselves as regular employees anymore because they become goaded to invest more in developing their skills to be the champions of the company and the right persons the higher ups should rely on to solve the problems (King, 2016).

Humans' behavior is usually affected by the presence of a certain phenomenon and the environmental/biological factors. Due to that, people try adapting to that environment for the sake of their psychological needs. By their nature, humans are motivated when they socially interact and collaborate for a predetermined purpose; and that alone caused many people to use the recent strive in technology to satisfy their needs by connecting with others and engaging in social interactions and cognitive collaborations to reach their goals (Chan, 2016).

It is a fact that social media invaded the lives of people all over the world without a permission. So, it is natural for it to be associated with their five needs according to Maslow's hierarchy to create its own hierarchy of needs constituted of existence, structure, community building, personal branding, optimization and monetization (Figure 15). In the needs of existence (presence and identity), people want to create their social network profile to satisfy their need to exist in the digital world and have a voice through-which they can express themselves (Antonios, 2010).

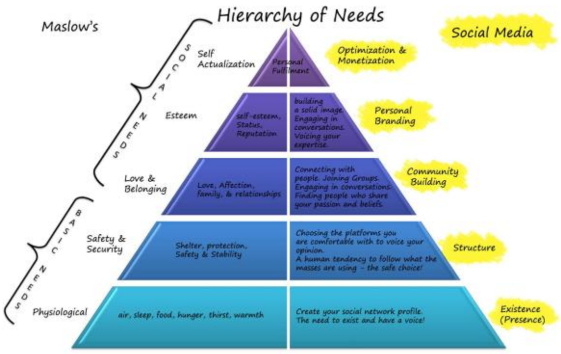


Figure 15: Social Media Hierarchy of Needs (Antonios, 2010).

In the needs of structure, people choose the platforms they feel most comfortable about and the ones most commonly used by the masses to construct their digital image and a voice that expresses their opinions. In the needs of building a community, people connect with each other through the social media platforms, join groups, share content and engage with conversations to find those who have their same passion, opinions and beliefs. In the needs of personal branding, people build a solid image about themselves when they engage in meaningful dialogues by transferring their information and knowledge to others through their expertise, especially in their field of study, which in turn causes them to feel important and admired by the people in this digital world. In the needs of optimization and monetization, people create new digital communities with those who share the same fondness or use old ones to help others achieving their passion in life, which allows them later on creating their unique digital brand that presents them as experts in their domains and tempts others to ask for their help, guidance or abilities in the decisions making (Antonios, 2010).

In this era, social media has become a must for many people who feel the need to exist in a digital world, want to be members of groups, express themselves, share content and reach a point where they can present themselves as experts distinguished from others because of their digital image that reflects their expertise.

The fact that people interact and share content through meaningful dialogues at the third and fourth stages of the hierarchy of needs makes us wonder if social media, like WhatsApp, could be established as a reinforcement instrument for students' performance when they socially interact and collaborate through the internet connection in a way that serves their math thinking and skills.

2.8. The Proper Employment of the Internet Connection in Teaching and Learning

Theoretically speaking, learning theories, such as the cognitivism, Behaviorism, and social constructivism, help the researchers understanding humans' thinking ways and take into consideration their psychological and social status, diversified disciplines, and background of education. Among those theories, The Connectivism and The Online Collaborative Learning theory (OCL), derived from the theory of the from the social constructivism, are learning theories in a digital era that take advantage of the internet connection to facilitate students' learning at a distance and provide them with proper learning environment though online collaboration to enable them constructing their own knowledge. Through the internet connection, students can argue, agree, dissolve barriers, create and gather ideas, organize, discuss and analyze them, and compare their results with others; but despite that, a digital learning environment does not only relies on the students, as teachers' practices and knowledge regarding the contents of the materials they teach are very critical when it comes to making that kind of environment a fruitful successful story. Unfortunately and despite the fact that digital learning environment is much more flexible in space and time than the one associated with classes, it is hard at times, and even impossible at other times, to implement a successful learning environment due to many overwhelming factors. Regardless, any effective online learning framework should be centered on four axles: the community, the knowledge, the learner and the assessment (Picciano 2017).

The community-centeredness is about encouraging students to learn and promoting collaboration, critical inquiries and expectations (Kroll, 2020). The knowledge-centeredness is about introducing beneficial information, new ideas, principles and concepts, especially when they are needed, which in turn enables students building their knowledge instead of simply memorizing data. The learner-centeredness is about the student who becomes responsible for directing the environment while his teacher facilitates his learning (Smith, 2017). Finally, the assessment-centeredness is about teachers creating multiple opportunities for students to achieve the highest standards through on spot feedbacks and reflections (Tyler, Brown, & Miller 2020a).

Practically speaking, the recent revolution of technology had noticeable positive influences on the educational landscape. Many teachers tried to benefit from the technology provided by modifying some of their ways in teaching the content of their subject material and assessing students' performance during the academic semesters. Through this employment, these teachers believed that students would be capable of changing their ways of thinking and adding to them. Not to mention that the employment of technology increases students' self-confidence about their abilities to solve a given or an upcoming task (AL Hila, 2004).

Similarly, according to the exploratory work of this research, some students gained self-confidence and were able to think differently when they saw how their colleagues thought and solved the exercises because of the WhatsApp platform.

Reinforcing students' learning and performance has always been and will forever be the obsession of many teachers. Unfortunately, it is not an easy task to accomplish because of students' different skills and needs. On a positive note, students' knowledge about their answers, whether they were correct or not and the reasons behind it, will encourage them to move on and work on the next task. Nonetheless, delaying students in knowing the results of their answers weakens their enthusiasm to learn better and solve more exercises (AL Hila, 2004).

One of the positive attributes of the WhatsApp platform is that it enables the teacher to provide his feedbacks to the students on the spot. Thus, it could eager them to solve more exercises for a better performance in mathematics.

The Internet, a system initiated to exchange communications, is the product of the technological development. It can be described as a vast store of information. The internet connection enables anyone to reach educational websites and videos, masters and PhD theses, abstracts of scientific researches and articles of journals if they wish to do so. More importantly, the internet connection enables people to reach each other digitally, even at a far distance, to support their learning. In the past, people used the e-mails and messages to enhance their learning (AL Hila, 2004). However, with the type of technology provided by social media, like the WhatsApp platform in this research, their interaction became much stronger with a better internet connection through platforms that enabled them interacting and collaborating online as long as they wished (Asfaha, 2018).

Speaking of employing the internet connection for the service of teaching and learning, what distinguishes it is the fact that its user is not just a receiver. He can interact with others through texts, voices, images and videos, also known as the multimedia. So it should not be strange to realize that combining them for the sake of the learners could produce a better and more attractive learning environment. The appropriate employment of the Internet provides long term learning and leads to the development of creativity, the problem solving strategies, and the scientific thinking skills, like experimenting, evaluating and inquiring. Teachers aware of this should use the internet connection to accomplish their educational objectives. They may use it, with the collaboration of their students, to come up with a creative teaching technique that can aid their teaching and students' learning at once (AL Hila, 2004).

This employment helps providing more than one teaching technique because it provides learning for larger masses and changes the traditional teaching approach. More importantly, it creates classes without walls. Meaning that, students can reach others while sitting inside the classes or the teaching and learning can take place on the outside (AL Hila, 2004), just like with the WhatsApp platform in this research.

When students' thinking skills improve, they are able to come up with more than one effective way to solve a task on hand. The internet connection provides the opportunity for such improvement. However, it depends on whether the learners want to use this connection to improve their skills or not. Here there, the teachers who are interested in improving students' performance have to ask themselves: through the internet connection, is there a way we can use that enables the learners to interact with each other? Is it feasible? Can it be effective? Can it encourage them to collaborate? If found, can its presentation of information, like exercises and content, achieve the set of designed objectives by the teachers? What is the role of the teacher in this case? Would he remain the main provider of information or become more of a facilitator? If the answer is yes and if the learners are willing to collaborate, then the teachers might be prompted to come up with the creative methods and techniques they need to achieve such goals (Quinlan, 1997).

This big question here is: can WhatsApp answer the aforementioned questions? Many researchers endorsed employing social media in favor of teaching and learning. According to them, it has the ability to provide the necessary online interaction and collaboration between the learners themselves and their teachers.

Theoretically, many researchers supported such employment (Ward 2013; Muller 2016). Practically, there were some experiments (Daraei, 2015). Due to that, the ultimate goal of this research was to come up with a unique digital online interaction, through the WhatsApp platform, that could successfully answer the questions mentioned above.

2.9. Educational Technology between Theory and Practice

The word technology was derived from the Greek word "Techne", that means art or skill, the Latin word "Texere", that means synthesis, and the word "Togo" that means science or study. Thus, technology means the science that studies the skills reasonably to construct methods that enable us performing specific tasks. Others define technology as the art that uses all what is provided to produce things that assure humans' comfort and continuity. Thus, it is basically an artistic method that enables us accomplishing our goals. Moving forward to the modern era, the accelerating technological revolution that we live in provided us with methods whose importance was not only limited to the service of humans and their functional practices. Fortunately, it had also an effective role in increasing humans' information and knowledge, and raising the level of their capabilities, competencies and skills. For that, the interest in educational technology started to increase, especially with the increasing number of learners and the need to facilitate learning and teaching as much as possible, clear the dust off the educational process and revolutionize it. As a result, many faculties of education started teaching and training their students on employing technology in the service of education. Educational technology is a systematic process that uses all the available capabilities, both tangible and intangible, like theories and materials, in an effective manner to accomplish the desired work with a high degree of mastery and sufficiency as much as possible (AL Hila, 2004).

Even though many think that educational technology is new, they fail to realize that it is rooted in ancient times. The sophists in Greek took it upon themselves to develop the teaching. They realized that each goal has a specific method to achieve. Teaching methods are part of the educational technology. They are used in the teaching and learning processes with the aim of helping the learners to reach and master specific goals. At that time, the sophists analyzed the teaching methods and formulated the hypotheses resulted from their analysis, just like with nowadays researchers. These sophists are the ancestors of the modern educational technology. They were specialized teachers who analyzed the content, organized the educational subject materials and believed that "Techne" contains the theories, practices and applications they need to constantly develop their educational system. The use of modern methods in education, based on studied principles and researches that have proven their validity by experiments, is called educational technology. In its comprehensive sense, it includes all methods, human resources, devices and regulations that might have been used in specific educational systems or not in order to develop, raise the effectiveness of another educational system and achieve its specified objectives. Meaning that it also uses the approaches of one system to develop another one (AL Hila, 2004).

During the second part of the last twentieth century, many educators were endorsing the educational technology. They truly believed that the proper employment of technology would provide humans with additional knowledge, ease the teaching and learning in classes with a large number of students, improve the image of the school, and permit training teachers, which in turn would develop their skills and positively influence their performance in classes. For the teacher, educational technology helps raising his proficiency and readiness. It changes his role from providing and indoctrinating information to planning, implementing and rectifying misconceptions in learning. It also helps him motivating the learners and overcomes the limits of time and space. For the learner, educational technology diversifies his solving and thinking methods. It pushes him to solve more exercises, adds to his knowledge and enables him to remember things for a longer period of time. Going back in time, during the past centuries, many called for developing the educational system. John Dewey contributed to the educational technology connotation through his own perception about teaching. He questioned the inadequacy of the word to transfer knowledge because the learner might misunderstand it, thus he fails at realizing what it really means. For that, he called for learning through social activism, and by that he laid the foundation stone for the development of the visual aids, a part of the educational technology (AL Hila, 2004), just like the WhatsApp platform in this research.

Speaking of teaching and learning through phones, in his academic article, Adbel Majid (2019), cited in the Arabic references, revealed that during the 70s, the phone technology was considered as the most preeminent method that enabled delivering sounds. Through the years, it was defended during the e-forums as a valid technique and a dynamic model that can deliver training and quality of education. Through this technology, people are able to engage in electronic interactive conversations that take place in synchronic time through data transfer or voice dialogues that could be additionally enhanced with images. Learning through television was once considered worthy for teaching. Students were supposed to learn by listening to pre-taped videos. This idea was doomed to failure because it turned out to be similar to the traditional one direction teaching through which students sit, listen and receive information. Basically, television was unable to deliver the needed interaction many were calling for to change the traditional transmissive teaching approach that ruled the education landscape (Abedl Majid, 2019).

The traditional teaching approach pattern is formed of four elements: the objectives, the content of the subject material, the teacher, and finally the learner (Figure 16). In this approach, the teacher is the main source for information. He is the one who is directly providing the learner with the content of the subject material and its objectives (AL Hila, 2004).

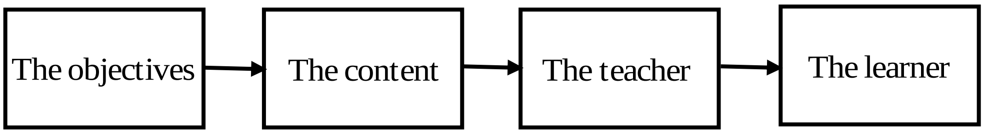


Figure 16 : The Traditional Teaching Approach Pattern (AL Hila, 2004).

A second teaching approach pattern consists of the objectives, the content of the subject material, the teacher and his means, and the learner (Figure 17). In this approach, the teacher is the main source for information who additionally uses the available means to provide the learner with the content and objectives of his material (AL Hila, 2004).

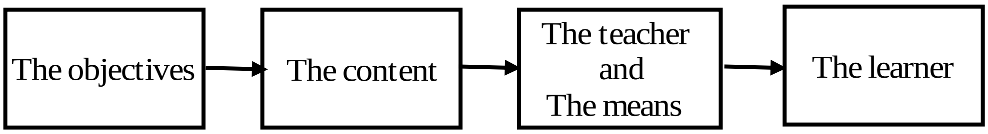


Figure 17 : The Second Teaching Approach Pattern (AL Hila, 2004).

A third teaching approach pattern consists of the objectives, the content of the subject material, the means, the learner, and finally the teacher (Figure 18). In this approach, the objectives, the content and the means are set up in advance. The teacher is the one who uses these means and evaluates them according to the learner's interaction, collaboration and feedback (AL Hila, 2004).

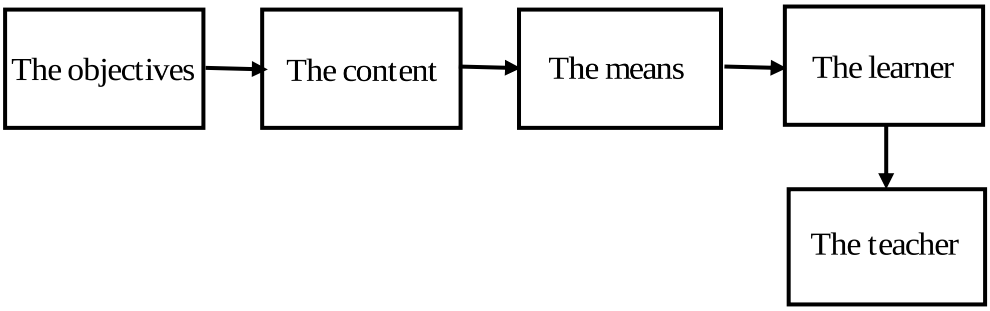


Figure 18 : The Third Teaching Approach Pattern (AL Hila, 2004).

Finally, a fourth teaching approach pattern consists of the objectives, the content, the means, and the learner (Figure 19). The teacher here is just a facilitator. It completely relies on the learner and the means provided in the learning environment.

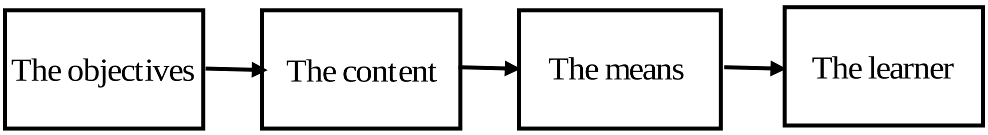


Figure 19 : The Fourth Teaching Approach Pattern (AL Hila, 2004).

This research didn't entirely rely on the teacher, thus the first pattern wasn't used. In addition, it didn't fully rely on the learners, though the teacher became more of a facilitator at the end of some of the experiments, thus the fourth approach wasn't used.

This research was about using a mean set up in advance by the researcher, the WhatsApp platform, to interact and collaborate with the learners. Their feedbacks determined if the WhatsApp could be employed for the benefit of mathematics teaching and learning.

Thus, this research was a combination of the second and third teaching approaches because the researcher collaborated and interacted with the learners through a mean, the WhatsApp platform that was not initially pre-defined for teaching.

Even more, in 1977, Robert Gagné, who is known for his work in educational psychology, declared that the simplest type of learning is the act of responding to a specific stimulus while relying completely on the student to learn on his own is the hardest type (AL Hila, 2004).

On one hand, Gagné's declaration endorses this research in its attempt to motivate the learners to improve their performance through the WhatsApp platform that uses the learner's sight and hearing senses.

On the other hand, teaching is a type of communications that aims at preparing the citizen culturally, educationally and morally to play a positive role in the community in which he lives in. Effective teaching requires selecting and modifying the available means if necessary, or finding new ones through innovation or design. The most effective means are the ones that attract the learner's attention and enable him answering a question and knowing his mistakes. This raises the motivation of the learner and pushes him to continue the learning process; and if these means are not available, the teacher has to come up with one of his own. Luckily, all of the aforesaid can be achieved through means of communication through which the learner can gain skills and information that refine his personality as a future good citizen (AL Hila, 2004).

Here lies the problematic situation of this research. We find ourselves standing in front of the possible potentials of learning through mobiles and questioning if WhatsApp, a social media platform originally developed for entertainment, could be employed for the benefit of mathematics teaching and learning.

2.10. Potentials of the Mobile Learning in Education

During ancient centuries, books were built as the sole medium of education and teachers were seen as the only ones capable of providing others with information. Through the years, things started to change. The concept of education changed many times. Learning started to be built around the social and cognitive constructivism. The construction of knowledge and students' interaction started to become a priority.As technology evolved through time, humanity was introduced to the mobile phones and computers. Theories, like the theory of constructivism, that support integrating technology in education, started to multiply and emphasize on the need to do so. This emphasis prompted many schools and universities to support students' learning through computer desktops, tablets and laptops provided by the modern technology. These technical devices empowered the constructivism learning perspective because they permitted any student to look for information and construct his knowledge (Sharples et al., 2007).

However, even with integrating technology in education, learning theories remained centered on the classroom and locked by its walls; and while fewer educators thought about the possibility of taking education outside the bricks of classes, none of them had the audacity of doing so because sciences at that time was not capable of making it a reality. However, if taking learning outside the walls of the classes was out of the question in the past, it is not strange and abnormal in this era of technology to achieve such vision and link education to the mobile phones. Teaching through mobile phones, also known as the M-learning, is a contemporary students-centered perspective and relatively new to those who are accustomed to the teachers-centered theories. So, at the beginning, it was normal it faced many obstacles that hindered its proper implementation in education (Sharples et al., 2007).

Learners are not stones put in the ground in different places. On the contrary, they are moving on continuously during the day from one place to another shaping their own ideas and engaging with technology through their mobile phones and computers at times. Due to the fact that technology is so ubiquitously popular and used by students at any time and place, learning through mobiles takes advantage of that fact and enables the learners of not only acquiring information but also building knowledge outside the classes and the halls of lectures through online conversation and collaboration (Sharples et al., 2007).

Sharples, Taylor and Vavoula (2007) defined mobile learning as the action of using the mobiles as a medium to learn through social interaction during different circumstances (Sharples et al., 2007). Unfortunately, integrating mobile learning in education is still not easy and it is not a secret that we still need more empirical researches and studies to make the right decisions of how to integrate it (Kiger et al., 2012)

It is believed that mobile phones have the potential to be a great assistant in the learning environment inside and outside the classes, through its internet networking and wireless connection, because of its power in communication (Sung et al., 2016).

Although some qualitative researches were dedicated to examine the effect of integrating the mobile phones in education (BAŞOĞLU & Ömür, 2010; Muhammed, 2014; Saran & Seferoğlu, 2012; Sung et al., 2015), we still lack of quantitative researches studies concerning it. Surprisingly, some teachers in the elementary level and middle schools took it upon themselves and tried to ameliorate their teaching by adopting mobiles as a teaching technique. These teachers were trying to divert their vintage teaching method they have grown accustomed to in order to facilitate students' learning; and for that, they used the phones to surf the net to find new information about the topic presented during the class session. Unfortunately, among the teachers who used the mobile phones for learning, the majority focused on the lower level of Andersons' hierarchy. Mostly, they focused on remembering and understanding. They ignored using the constructivism theory, through social interaction and cognitive collaboration, to enhance students' ability in analyzing, evaluating and possibly creating (Sung et al., 2016).

Even with integrating technology in education, the world still suffers from a big dearth to fill when it comes to integrating the mobile phones in teaching and learning (Sung et al., 2016); and even-though some researchers examined their effect in education, most of their studies were related to the higher education (Frohberg et al., 2009).

Frohberg, Göth and Schwabe (2009) found out that, in some colleges, students used their mobile phones, in selected sessions, to reinforce their learning by looking up for more content about the topic presented in class. These students admitted that doing this motivated them and enhanced their participation in class (Frohberg et al., 2009).

The three researchers revealed that Mark Prensky, an educator and an American writer, described today's college students as *"the digital natives"* who grew up in the thriving age of technology around the world (Frohberg et al., 2009). These students, since high school, are used to multitasking. They can connect, surf the net, text, chat and play video games at almost the same time. Due to that fact, teachers and college instructors should put extra effort to become familiar with their students' digital language to maximize their learning (Corbeil & Valdes-Corbeil, 2007).

The researchers also revealed that Ray Schroeder, the blog editor in the Illinois University at Springfield, assured that mobile learning will take over the teaching and learning process, and students will be able to learn anywhere and everywhere using their mobile phones while climbing mountains, relaxing on a beach or jogging in the streets of a city. Moreover, the researchers showed that Clark Quinn, a professor and author, noted that through mobile learning, students will be free from the need to stay connected to their books, laptops and desktops. Mobile learning will provide them with opportunities to learn anytime, anywhere, and they will be able to interact, through their mobile phones, for what is best for their learning. Finally, they also showed that Ellen Wagner, an expert in the learning techs in higher education, confirmed that we are on the verge of a revolution in education, business and other fields. Why? Because of the mobile phones phenomenon, and no one is immune from it (Frohberg et al., 2009).

In the last century, it was impossible to imagine staying in touch all day. Mobile phones have enabled us to do so; and because this connection is increasing at a fast rate, universities, schools and teachers will have no choice but to integrate the mobile learning in their teaching in the same way they did with the desktop computers and laptops a few years ago. The only difference is that mobile phones provide the much needed interactions and collaborations that can take education to the next level. In recognition of the potential role of mobile phones in education, called for by many researchers, some universities, such as the American University in Washington, the Boston College, Oxford and the Cambridge University have already started using them to support students' learning by enabling them downloading podcasts, audio and videos of current and previous lectures. Fortunately, the role of these mobile phones is not limited to uploading and downloading podcasts. On the contrary, they pave the way for educational collaboration all over the world. Thus, students, with different needs and abilities, in any country and continent, can benefit from the opportunity provided and take advantage of it to support their learning. These mobiles can have major implications on the teaching and learning processes through their never before seen flexibility of communication and connection. They can deliver content and make instructions way easier for the teachers/professors and the students at the same time (Corbeil & Valdes-Corbeil, 2007).

However, these implications need new approaches in the ways of teaching. Teachers need to abandon the vintage macro-teaching perspective, accept the mobile phones as a new phenomenon that supports learning through interaction inside and outside the classes, and adapt to the new learning environment that will revolutionize education. As a result of this drastic change in education, students will be the center of each learning session and the teacher/instructor will become the facilitator. Learning will move on from inside the walls of the classes to the outside through significant global interactions, and students' groups' collaboration will be extremely enhanced. In a digital genuine learning ambience, mobile phones could have positive implications on students' behavior, through social interaction, participation, because they will respond through a proper stimulus provided by the mobile phones, and collaboration, since they will search, collect and share information electronically. In this way, students will value their mobiles as not only entertainment phones, but also as a suitable source of information that supports their learning. After all that was said, we need to ask ourselves if it will take time for students to realize the positive implications of the proper employment of mobiles on their learning and behavior. Will students resist this change in learning causing it to be thrown into oblivion? To answer these questions, Corbeil and Valdes-Corbeil (2007) conducted a survey in the Texas University at Brownsville among 191 graduate and undergraduate students to check what kind of activities they do with their mobile phones and whether they are ready to learning through these devices. Results of their study showed that most students owned mobile phones. However, most of them did not use them in their learning activities. Though, they admitted willing to use them if the faculty afforded accessing the courses through recordings, podcasts, videos or pdf format that could be downloaded through their mobiles. They assured that in no time at all, this act will benefit all students in any place since most of them hold mobile phones in their hands or pockets during their academic or daily activities (Corbeil & Valdes-Corbeil, 2007).

Through the years that followed the study of Corbeil and Valdes-Corbeil (2007), some researchers supported the mobile learning. Researchers like Sarrab, Elgamel and Aldabbas (2012) who assured that mobile learning is here to upgrade the old fashion teaching system and not replace it. It enables students to learn on their own, and through collaboration, by surfing the net for the information they need (Sarrab et al., 2012).

Two years later, In chapter two of their book, Klichowski, Przybyla and Basińska (2014) indicated that while the rapid evolution of technology in this millennium is responsible for changing the methods of worldwide communication, it can also be responsible for facilitating the educational landscape with its imposing presence whose benefits cannot be ignored (Klichowski et al., 2014).

"If you are not having fun, then you are not learning" (DeVito, 1996), a sentence written inside a class in the famous movie Matilda (Klichowski et al., 2014). Here, we have to stop and ask ourselves how modern educational environment could be if learning was integrated with the mobiles that are ubiquitously popular among students at all ages.

The fact of the matter is that 90% of students in Britain, aged between 7 and 11, own and use a smartphone. 52% of children, aged between 5 and 8 years, are capable of using the latest version of the smartphones, whether they were their own property or their parents, while sitting at home.

We have to take advantage of this popularity and realize that these mobiles can enable anyone to learn at any time without time and place boundaries whether he was in his home, on vacation, in a bus/car, waiting for his turn in a bank or in his doctor's office. Why? Simply because it can serve one's educational topics' intuition through its internet accessibility and massive number of variable applications. To reflect on the aforesaid, from an educational standpoint, these mobiles could be used for teaching in subject materials like mathematics. Unfortunately, this reality is still blur for many educators, parents and even the students themselves. We have to really believe that these mobiles are not only useful for students to look for information. Through these mobile, students can interact and collaborate in a way that expands their pool of information, reinforces their poor understanding and rectifies their misconceptions. Realistically, for these mobiles to enhance students' learning in an abstract subject material such as mathematics, we have to have numerous applications that can help developing students' mathematical abilities and competencies at a young age, and platforms for those who are in middle schools and the secondary level. Through these applications and platforms, students can interact, share information, correct their misconceptions of math rules and theorems, and add to their mathematical knowledge (Klichowski et al., 2014).

In the year that followed, Taleb, Ahmadi and Musavi (2015) stated that today's phones bring a different significant aspect for the learning environment. Through their applicability, students can access the information they need and interact in a way that for sure will impose the necessity of innovation for the current approaches to learning. The researchers assured that the current revolution in technology, provided the mobile phones, allows this generation of students to learn at any time anywhere they are through what is known as the M-learning, learning through mobile phones. The M-learning, through online collaboration, can smoothen, support and enforce students' learning even if they are at a distance in dispersed geographic regions. Learners from different continents can share and acquire information, rectify many misconceptions and enhance their own and others' understanding of the content of any subject material, such as the mathematics here in this study, unlike books and computers that just deliver them information and nothing more (Taleb et al., 2015).

Taleb, Ahmadi and Musavi (2015) ensured that the proper implications of the M-learning can result in improving students' participation in class, focus in the problem solving in mathematics and memory. Why? Simply because, unlike any other technology, students can move their learning from the class to anywhere they see fit. The researchers pointed out that the current mobiles have the ability to make learning much easier for many students, especially in rigid materials such as mathematics. In addition, they wagered that, by time, because of the socially interactive experience that can only be provided by these mobiles, students can learn how to investigate the time they spend on their phones to cement their learning. Why mathematics specifically? Well, because, according to them, it is a subject material applied in all sciences, helps humans to think better and enhances their abilities to solve problems during their daily life routine. In mathematics, students are required to understand abstract concepts and use them in math related tasks; and while it is not easy for everyone to do so, the technology, provided by laptops and tablets, is capable of approaching some of the abstract concepts to many students through its multidimensional graphical functionalities. However, this approach does not reinforce students' learning, motivation and self-trust the same way that social interaction does for them through the mobile phones features (Taleb et al., 2015).

The researchers proclaimed that even-though the E-learning, through the electronic screens such as laptops and tablets, has proven to be successful in improving the learning environment in classes, the M-learning could be more successful if given the same chance because of its additional consistent communication characteristic. Teachers can play a vital role in supporting the M-learning through online interaction with their students and add to their learning outside the walls of their classes. The researchers also claimed that the M-learning is adequate in enhancing students' performance in mathematics, especially the low achievers and the ones who were at a risk of failing an upcoming math exams. It can ameliorate their mathematical performance through better understanding of the subject material. For their research study, Taleb, Ahmadi and Musavi (2014) questioned whether or not the mobile learning can motivate students in learning mathematics and diversify their methods to solve math. The researchers selected 329 mathematics secondary teachers (45.9% males and 54.1% females) among 2352 teachers. They developed their own 5-point likert scale survey to identify the views of math teachers concerning the effect of the mobile learning on students' mathematical learning, specify mobile learning functionality in increasing students' motivation to learn mathematics and measure the effect of the mobile learning in diversifying students' methods to solve math. After validating the survey and examining its reliability, the researchers used the descriptive statistics to calculate the mean and the standard deviation of each item, the One Sample T-test and the ANOVA test. According to teachers' view, results of the study showed that mobile learning can have a positive impact on students' motivation to learn mathematics as well as a positive influence on diversifying the proposed methods for students to use to train and solve math exercises. In addition, results of the study also showed that learning mathematics through mobiles is independent of teachers' teaching experience and educational background of their subject material, which proposes that math teachers, at all ages of different expertise, can use these phones for the benefit of students' math learning (Taleb et al., 2015).

One year later, In his interview John Traxler (2016), the Professor of Digital Learning at the Institute of Education in the University of Wolverhampton in England, revealed that people always ask him about the future of mobiles in education since he is considered as one of the pioneers who called for integrating mobile phones in the learning environment. Unfortunately, the professor indicated that mobile learning is such a hard topic for us to completely cover because researches about it are in a need of enormous funding that were not sufficiently provided since the year 2008 due to the economic decline that negatively affected the money sources devoted to the mobile learning research studies. Traxler (2016), stated that educators and researchers have to look to mobiles sustainable learning from different perspectives. Many teachers could prohibit employing mobiles in their teaching because the mobile learning supports the students-centered perspective, something not all teachers can accept and embrace. In addition, many believe that the world of mobile phones is a complete chaos if it is not properly contained and managed. In addition to that belief, most studies about integrating mobile phones with the learning environment were limited. So, everyone has to look outside the box that holds the thoughts he is accustomed to and work with everyone else in order for this new phenomenon to really revolutionize the educational system. Practically, integrating mobile phones in teaching and learning is not just to prove that things have changed. On the contrary, it is about students reaching sustainable learning and the unprecedented chances, provided by these mobiles, that teachers need to hold on to facilitate their instructing and students' learning. Shockingly, even-though modern students are expert in technology, they need a *"Digital Critical Literacy"* about the usage of the phones. They have to be taught how to use their mobiles for the benefit of their learning, distinguish accurate from false online information and maybe contribute to what might serve others' education. Add to that, there is still a huge problem in integrating mobile learning in the educational system. Mobile learning still needs well designed experiments with significant results to support its case. Many keep on asking if mobile learning can positively affect students' behavior and if they can digitally interact in a way that enhances their learning. These questions clearly reflect why mobile learning is still a problematic situation and in need for true researches' results that can impose its presence in education (Traxler, 2016).

It is clear that the M-learning has yet to take its right place in the teaching and learning process. Mobile phones have yet to be considered as an adequate medium for students to use to boost their learning, rectify their misconceptions and construct their knowledge in different subject materials.

Locally, in their research study, El Rouadi and Anouti (2019) examined math teachers' knowledge and usage of the M-learning in Lebanon. Through an online survey, the researchers were able to form a sample of 467 math teachers who lived and taught in Beirut, Mount Lebanon, Bekaa, South and North. The researchers were interested in estimating the percent of the math teachers who knew about the mobile learning. In addition, among those who knew about it, they also tried estimating the percent of those who used it in teaching mathematics. Moreover, they investigated if the highest academic degree earned by a math teacher was associated with his knowledge of the mobile learning. Finally, among those who knew about it, they also investigated if the highest academic degree earned by a math teacher was associated with his usage of mobiles in teaching mathematics. Results of the study revealed that 82.9% of the participants, 387 out of the 467, had never heard about the M-learning. Results also revealed that only 26.25% of the 80 teachers who were aware of the mobile learning used it in teaching mathematics. These percent, in turn, reflect the weak knowledge and usage of the mobile learning in a sample of mathematics teachers in Lebanon. Moreover, results of the study of El Rouadi and Anouti (2019) revealed that 64.4% of the teachers, 300 out of 467, held a bachelor degree/a diploma in mathematics. They also showed that, even-though only 13.1% of the participants, 58 teachers, were holding a master's degree in education/didactics of mathematics, 33 out of these 58 teachers were aware of the M-learning. The highest number of math teachers who were aware of the mobile learning were holding a master's degree in education/didactics of mathematics. The Chi-square test, supported this result by showing that there is a statistically significant association between math teachers' highest academic degree and their knowledge of the mobile learning. Finally, result of the Chi-square test showed that is no significant association between the highest academic degree of the teacher and his usage of the mobile learning. The researchers called for more experiments to determine reasons behind the lack of usage of the mobile learning in teaching mathematics (EL Rouadi & Anouti, 2019).

The aforementioned articles and researches ensured the need for more experiments that can identify the M-learning as the new phenomenon in teaching and learning. This void shows the research problematic situation and cements the need to examine the potentials of incorporating the smartphones and the social media platforms, like WhatsApp, in the service of students' math learning and performance via their online interaction and collaboration, which seems to be provided by the mobile learning.

2.11. Potentials of Incorporating Smartphones and Social Media in Education

Dunn (2011) assured that social media allows students to collaborate with each other, even if they were at a far distance, in projects, homework and assignments. In addition, he was certain that it can aid them in rectifying their misconceptions and enhancing their poor understanding. Even-more, it allows them to express their thoughts and become familiar with the role of technology in learning, an essential and useful part in their future careers. Regarding the teachers, Dunn (2011) believed that social media presents them with the opportunity to post activities, upcoming school events, tasks and digital online presentations to support students' learning in any subject material (Dunn, 2011).

These assumptions were also previously supported by Greenhow (2011) who indicated that social media platforms can be used in supporting students' learning and achieving many educational objectives. How is that possible? Simply because social media, through its online interaction service, can provide unusual learning opportunities that ease on students' learning process (Greenhow, 2011).

Two years later, in his presentation, Ward (2013) revealed that people look shocked when they are told that social media can be incorporated into the teaching and learning experience. Why is that? Well simply because of the digital illiteracy, people are not aware that not only this can actually happen but also social media can be taught as a formal course in classes at universities. This downside reality comes to no surprise. The majority of people, including school teachers and university professors, think social media should not be taught in courses in the first place and integrated in the teaching and learning process because it was originally created for personal entertainment and amusement, and nothing more. Nonetheless, on a bright side note, Ward (2013) revealed that, while he was teaching at a scholarship program, the sponsors wanted to know what he was doing with their money and demanded that he blogs about it and report back. The professor succumbed to their will and started blogging about what he is doing. Due to that, colleagues, friends and families were able to take notice and see what he and his students were doing. To his surprise, this blogging led to students getting jobs offers, more opportunities and scholarships. This new experience drove the professor to ask for a similar one in his classrooms. Unfortunately, his request was rejected by the university, where he teaches. Why? Simply because according to their rules, students cannot bring their phones, laptops and tablets to classes; and if they do, then they have to shut them off so they won't be able to play games or check their Facebook. The university truly believed that traditional teaching, through-which students sit and listen to what the instructor is saying, is the most successful perspective for education. The request was rejected by the administration, even though, according to a recent study about the internet, things have changed and people nowadays are not getting their news from the original newspapers sources as they used to do. 70% of people on Facebook are staying up-to-date about almost anything happening locally and internationally thanks to links shared by their friends and families. The fact is that, through social media, people are bombarded with a high level of information every day (Ward, 2013).

83% of people cannot find the information they saved, on purpose or not, on their smartphone 72 hours ago. Sometimes, people have to search for it for a long time due to the massive amount of news and info that is pouring on them day by day. This is mostly common to many, except for a person who is highly organized and with enough skills to surf his way in between. This reality shows that social media can be used as a way to deliver content. So why are we not incorporating it in classes? To make things grayer, according to that same study, people in the past used to sit to watch television and listen to the radio intently, whereas now 80% of them are multitasking while doing so. People are using their phones while watching or listening to something. Not to mention that more than 80% of young adults, aged from 18 to 24, are doing the same. We have to recognize this new change and adapt to it, something that media and journalism corporations are doing so but not schools and universities. chools and universities insist on keeping the classroom environment as it is without realizing that the current classroom looks very similar to the one that existed more than one hundred years ago. Nowadays, in most educational institutions, students are asked to just listen to the teacher in class. No interaction is allowed, no communication and no content sharing. Most administrations do not realize that there are opportunities and benefits for education in social media more than one can imagine, even more than there are negatives. Despite what was just mentioned, not all universities at higher education are completely ignoring teaching social media courses or integrating it in their educational systems. Some are trying to keep up with that speedy change that is imposing itself on the world outside their classes. In some way, they realized that the small and large enterprises are no longer interested in hiring someone according to what he was taught in class. They are looking for someone who can be adaptive, agile, able to learn in a continuous way and ready for new small or major changes that can affect him and his job environment. Enterprises are still selling products, but the ways of presenting them to customers in this century have clearly changed. What's frightening is that the teachers, instructors, educators and principals are causing their students a serious problem by not integrating social media into the learning environment because they do not want to recognize this change (Ward, 2013).

In this century, students are supposed to be able to connect with each other and their teachers smoothly to gain skills, like the communication skills, that are most important for life after classes in these day. One of the positive things about integrating social media with education is that it allows the teacher and the students to keep up with this rapid change. If the teachers are not doing so, then they are similar to kids on bicycles who deliver newspapers or those who lived in the last century and expected students to learn by sitting down and listening to the radio. Not only this incorporation has its benefits on education, but it also has a positive impact on economy. A study revealed that the economy can brisk up by 1.3 trillion dollar if the organizations and educational institutions change the way they interact and share information with their respective teams, and convert to the social communications technology to improve everyone's communication skills. This verifies that there is a worldwide demand of digital and social media professional skills. Unfortunately, many students fail to acquire it due to their illiteracy. Not because of themselves, but because they were not taught or talked about using social media as a professional communication and collaboration instrument in their schools and most likely in their universities. As a consequence, if thirteen thousands jobs were available out there, many students would fail in fulfilling the digital and social media skills set requirement for employment, even if it was an accounting job. Why? Because the employee is expected to have good communication skills, through social media, to be capable of engaging with other business partners or consumers. What's truly shocking about it is that even-though these enterprises are asking for social media skills for employments, 50% of them are having troubles filling those jobs because of not so many people possessing these qualities. Thus, only those who are taught to use their social media to enhance their learning and communication skills, and know how to demonstrate them, will be able to go out there and get the opportunities offered by the companies. In reality, many of these companies are not ashamed announcing that they would prefer hiring a higher level player of the worldwide game Warcraft than a Harvard graduate with an MBA degree. The information is out there for the students to reach to benefit from. Time should be invested in supporting and boosting their communication skills through social media. Education and higher education are destined to disruption if they don't realize the change out there and embrace it. They have to start leading this innovation starting from their classrooms to create opportunities for their students later on (Ward, 2013).

For that, teachers, principals and deans have to start looking at the classrooms in the past century, and the current ones, and admit that nothing has really changed. They still have the teacher and the students, as the audience, listening to the topic presented in a closed session with active boards replacing the all-time classic black or white boards. They have to admit the fact that social media enables students interacting with each other and their teachers, enhancing the discussion, improving their communication and sharing content with others at a distance, who, in turn can benefit from their information and knowledge. Through social interaction, prior to the session, students can come up with examples about their current lesson, ones that even the teacher didn't think about, and bring them to discuss and enrich their data base of information. Thus, they themselves become responsible for creating a content in the class that is no more sole driven by the teacher, because, through social media, they are empowered to connect and be engaged with their peers or others outside the classroom. Not to mention that teachers can integrate themselves, contribute and share with their experience through online discussion. There are no time and place limitations for social media. It allows the discussion to be continued after classes during any day of the entire week. Though, in an important note, Ward (2013) admitted that we need several experiments to make the social media experience work properly inside and outside the classrooms, among students and teachers. By time, if it works, students will be looking at their social media differently. They will cherish it as the dynamic model that enhances their learning and increases their productivity. When we achieve that, learning and innovation will take place, students will actually become more competitive and they will increase their contribution without their teachers prompting them (Ward, 2013).

Three years later, on the same pace, in his lecture, Muller (2016), discussed the past, present and future of education, and the role of technology in evolving the whole educational system. According to Muller (2016), dozens of teachers are spreading videos globally on YouTube sharing their ideas and knowledge in sciences, technology and mathematics with everyone. Their only purpose is enriching others' education as much as possible through the facilities provided by the prosperous recent technology of this digital era. What is interesting about this situation is that the people who are spreading these educational videos on YouTube are not major universities nor educational institutions. They are regular individuals who took it upon themselves to do it because they are convinced of sharing their knowledge with the worldwide audience for no financial benefits and mandatory reasons. They are simply doing it because they love it and for some reason they are finding an audience. This step is the beginning of a change in the way of the current education so that it shocks our obsolete educational system on the long term. Unfortunately, it is not going to revolutionize it. One may ask why? To answer that, Muller (2016) had to quote the famous American inventor Thomas Edison who in 1922 said that motion pictures are going to revolutionize education in the coming years and eradicate the schools' textbooks. Yet, almost 100 years later motions pictures have clearly affected our lives by revolutionizing entertainment but failed in replacing the books in schools, maybe due to their large income in cinematic theaters that is more important to the producers than changing the education landscape (Muller, 2016).

Moving forward to the 1930s, people believed that the radio would be the proper device to revolutionize education because teachers could be replaced by radios in classes during the teaching process. This idea attracted governments who were looking for reducing the cost of education while at the same time keeping it efficient. Sadly, it went into oblivion because they were unable to apply it. Moving to the 1950s, the television was put in front as the device that was going to revolutionize the educational system because of its natural attraction. People thought that students would learn better by watching a pre-taped lecture as opposed to the live one; and for that, many studies were conducted. The results of the studies showed no significant difference because in reality we are just supporting the learning environment and not actually revamping it by mixing it up with technology. Moving forward to the 1980s, people thought they were up to something with the presence of computers because they thought that they differ from motion pictures, radios and televisions. They truly believed that they found the missing piece they needed to take education into the next level (Muller, 2016).

Unfortunately, they were able to develop the computers in an amazing way through better programming and software that had massive incomes for the enterprises, but not the educational system. What is the most surprising is that many educational institutions think that they are one level up from others, and that they are revolutionizing the education by using technology in their system. The future is not about using technology in education. On the contrary, it is about integrating them in a way that engages students with the subject material and smoothens their collaboration inside the classroom and outside it. One hundred years ago, classes consisted of tables, chairs, a board, students and teachers, while classes currently consist of the same elements with the exception of the black board that was replaced in some classes with an active board that only simplifies the way of delivering information to students. This reality forces us to ask ourselves if this is the inertia of education and if it is impossible for us to move forward past the current situation. To answer that, first we have to know that education is not about transferring information from the teachers to the students or from the books to their heads because students and education are not a commodity that we have to benefit from like in the business field. Simply, this is not the way our brains work. In fact, brains work through interaction with our friends and families by telling and sharing stories, ideas and information; and through them, we form individual memories that compose and shape our understanding and our skills development. This means that education is a social process that works best through cognitive efforts just like with the presence of a trustworthy teacher who supports his students and engages them in way that makes them feel they have to study for themselves and not for anyone else. Thus, in reality, transforming education is not about teachers using technical tools, nor is it making students watch online courses. This transformation symbolizes the evolution of education and not its revolution. Its core and foundation of change is none other than the social interaction and collaborative learning between students and teachers, and between students themselves in a digital complex environment through the features of the social media platforms that support the demands of such environment (Muller, 2016).

Through his lecture assumptions, Muller requested all teachers to start using the social media platforms for the benefit of students' learning and shed the light on the beneficial aspects of these platforms in education. The calls and assumptions of Dunn (2011), Greenhow (2011), Ward (2013) and Muller (2016) are a cornerstone for the problematic situation of our research because they support our quest in employing the WhatsApp platform to reinforce students' math performance. Though, it is essential to identify teachers' perspectives and perceptions first about this topic in the next section.

2.12. Teachers' Perspectives and Perceptions on the Impact of Employing Social Media in Education

Social media enables students to interact with each other and their teachers at any time through three dimensions: by texting, sending notes, images and voices, and using visual videos. Some of the social media platforms and networking sites are perfect for students to collaborate for the benefit of their learning by discussing and exchanging information, concepts and rules with others. Unfortunately, most students are unable of using social media for learning simply because they don't know how to do it and because they were never taught about it. That is why most students use social media for entertainment and personal purposes only. Employing social media in education does not only concern the students, but also concerns the teachers and their teaching methods/techniques in this digital era. Unlike the past generation of educators, some are now trying to take advantage of the current unmatched technology in a way that can positively influence the learning environment. In the past years, some researchers took it seriously and started investigating the positive effect of social media on education (Abdelraheem & Ahmed, 2015).

Andrade Manuel, Castro, and Ferreira (2012) examined the impact of social media, through Twitter, on 122 master's degree students at the Catholic University of Portuguese. Through a Twitter hashtag, these students asked questions, answered others' queries and voted for the proper solution. At the end of the activity, these students admitted that they felt that their abilities for paying attention, memorizing, problem solving and implementing solutions improved significantly. In addition, they acknowledged the fact that they interacted with each other and their teachers in a much better way than they usually do. For that, the researchers recommended replicating the study with other samples of students at different levels and implementing more structured activities that can show the benefits of social media in education (Andrade Manuel et al., 2012).

Moreover, the powerful and imposing presence of social media led Ishtaiwa and Dukmak (2013) to investigate, through a semi-structured interview, pre-service teachers' perception about employing the wiki and blog applications in enhancing students' learning. Most of these teachers admitted that the proper employment can facilitate students' learning, interaction and collaboration; and through it, they can even develop new critical thinking skills (Ishtaiwa & Dukmak, 2013).

One year later, Bryer and Zavattaro (2014) defined social media as the technology that enables social interaction and cements humans' collaboration and deliberation (Bryer & Zavattaro, 2014). In addition, Abdelraheem and Ahmed (2015) assured that the integration of social media in education can facilitate the teaching and learning process and positively influence students' learning and collaboration. For their study, Abdelraheem and Ahmed (2015) investigated social media usage, if any, by the faculty members of the Sudanese University. In addition, the researchers tried determining the benefits and the barriers of the social media usage in education as seen by these members. At the beginning, Abdelraheem and Ahmed (2015) were thinking that the faculty would encourage its members to use social media in teaching because of the rapid development of technology and its massive expansion. Unfortunately, those who were using social media in teaching were driven by their own beliefs about its benefits and not by anything else. Abdelraheem and Ahmed (2015) indicated that even-though social media personal usage has grown immensely over the past years, teachers remained hesitant and slow in employing it in teaching and learning. These teachers believed that social media is too risky and inappropriate to use as a teaching technique because of its ability to distract students' attention at any time and reduce their face to face communication skills. In addition, many of them admitted that, even-though social media might have high potentials in education, they are unable of employing it in their teaching because they lack proper constructed activities, confidence, training, enough knowledge and the time needed to be prepared for it. Through the literature, the researchers constructed their own likert scale survey. After revising, modifying, validating and examining the survey's reliability through the Cronbach alpha value, the researchers sent their survey through the internet to 65 members in the same university to fill it and send it back by mail. The researchers then collected all answers and used the SPSS for the analysis. Through descriptive statistics, the researchers found out that most faculty members rarely use social media in their teaching through texts, voices or videos. However, some members revealed that they use social media to communicate with peers because of their wider experience in the academic courses (Abdelraheem & Ahmed, 2015).

Moreover, through the t-test, results of the study revealed that there is a statistically significant difference between the gender of the members and social media usage. Results of the t-test also revealed that among those who used social media in teaching and believed that it is a valuable asset for them, males averaged higher than the females. In addition, results unveiled that there is a significant difference in the averages between members' specialty and their social media usage. The researchers indicated that those who teach social sciences usually tend to use social media in their teaching more than their colleagues who teach subject materials like mathematics. On the other hand, the researchers found no statistical difference between the academic ranks of faculty members and their social media usage. The researchers considered it normal because employing social media in education is relatively new to instructors whatever their ranks were. Even-more, results showed that there was no significant difference between the ages of the faculty members and their social media usage. The researchers were not surprised about it simply because social media can be used by people of all ages (Abdelraheem & Ahmed, 2015).

In the same year, Grant, Tamim, Brown, Sweeney and Ferguson (2015) indicated that smartphones have become ubiquitously used by students. The researchers stated that even-though mobile learning is supported by some educators, many schools principals prohibit using smartphones in schools or integrating them in their educational system because they truly believe that these phones disrupt students' behavior, attention and ability to learn (Grant et al., 2015).

Their act contradicts with many researchers, like Gikas (2011) who assured that integrating smartphones in education, through connectivity, supports students' engagement to learn, provides collaboration and enables genuine learning through discussions and communications with cognitive efforts (Gikas, 2011).

Despite this confirmation, employing smartphones for the service of students' learning in the secondary level is still slow for many reasons. Some schools have banned them from their campuses because they believe that they can easily disrupt students' behavior and squander their attention. In addition to that, even-though many teachers recognized the importance on integrating technology in education, they are still avoiding integrating it in their teaching because they lack the skills and time to prepare for it. Unfortunately, these teachers are not trying to change and they are proceeding with their traditional teaching methods. Grant, Tamim, Brown, Sweeney and Ferguson (2015) tried interviewing teachers who use mobile phones and laptops in their teaching. Due to the limitations of the study, and through criterion sampling, the researchers only found nine teachers to interview about usage of technical devices in teaching and the barriers that prevent others from employing mobiles in the service of students' learning. The researchers found that, among these teachers, eight used the I-Pad for teaching, some of which were using it for the first time, while only one teacher used his I-Phone to record and document students' behavior and learning deficits through an application. These teachers revealed that the lack of speedy internet and the absence of knowledge about using technology in teaching are the most common barriers to face (Grant et al., 2015).

Fortunately, over the years, people noticed that the recent prosperity of technology opened the gates for everyone around the world to become connected with their beloved ones and partners in work according to their choosing. In addition to that, the internet has become so rich with legit websites that provide massive and diversified information, almost about any topic in the world, available for educational benefits. Recently, technology has presented humanity to the social media platforms. These platforms are famous for positively or negatively affecting nearly everyone in the world according to the ways they are used; and while businessmen are using them to seal their deals and to add to their connections, the majority of teachers are still refusing using social media in education. Many reasons lay behind this. Some teachers believe that incorporating social media might hinders their teaching. Others are unable of integrating it in their lessons due to their lack of experience and activities. The fact that students know about social media more than their teachers makes the latter believe that the power is in the hands of the learners, something they don't feel good about. Now, while teachers might be right in their opinions, they must not forget that social media has imposed its presence on society and, with the proper employment, its enormous growth might improve the quality of teaching in schools because of its interaction features that can positively influence the process of teaching and learning (Orlanda-Ventayen & Magno-Ventayen, 2017).

Though, it all depends on teachers' conviction about the role of social media in the educational system in general and in their teaching specifically. Orlanda-Ventayen and Magno-Ventayen (2017) indicated that social media is the fruit of technology that enables its users exchanging information, pictures and videos, in addition to the online interaction provided by its diversified list of platforms and networking sites like Facebook, WhatsApp, Twitter, etc. Even-though all in the aforementioned are true, one has to ask himself about the spatial point of social media in education and how it can serve the latter. This question caught the attention of many researchers and provoked their interest. They set their sight on examining the level of usage of the social media interaction features in educational purposes by the teachers. In a digital age, such as the current one, learners can benefit from the connectivity feature because it provides them with the opportunity to log in, at any time and from any place, and spread or access information much faster than looking for it in a book. Sadly, while this might be true, recent studies showed that people are fascinated by their social media and that they are using them for their personal purposes and not their education (Orlanda-Ventayen & Magno-Ventayen, 2017).

Like most people, students were also affected by the imposing presence of social media and its digital reality. In a case like this, teachers should not be limited by the didactic in classes. On the contrary, they should play an essential role in showing their students the benefits of using social media for their education and how to learn from it. They should encourage their students to construct and increase their knowledge through the social media platforms and sites. It is amazing to know that the number of social media users has grown from 0.97 to 2.77 billion from the year 2010 till the year 2019 (Terfehr & Lindhof, 2019). The increasing numbers clearly demonstrate the powerful and consistent growth of using social media among people, including students. For that, researchers have to start examining the current usage of social media by teachers and its employment in their teaching practices, if any. In higher education, it is not a secret that many universities adapted to using social media in their system through their instructors in lectures, unlike the primary level, the middle schools and the secondary level that have yet to embrace it in their educational systems. Many teachers at the elementary level reject employing social media in their teaching, even-though some researchers indicated that it could be very useful to them because of the rich and massive size of information reached through its platforms, like LinkedIn that provides daily articles and researches about teaching and learning at this stage. To cement the belief of employing social media in education, studies revealed that the interaction features of the Facebook and its functionality encourage students in higher education in the Philippine to participate online to improve their learning. If teachers ever decide to use social media in their practices, this alone can help them changing their traditional teaching methods and techniques for what is best for their students (Orlanda-Ventayen & Magno-Ventayen, 2017).

For their research about the possibilities of employing social media in teaching, Orlanda-Ventayen and Magno-Ventayen (2017) targeted forty five teachers in the secondary level who were teaching while at the same time pursuing higher education through their masters and doctoral studies in the educational management field. A field of study that contributes to the development of new teaching methods and techniques that usually enlighten teachers and students about the importance of collaboration in the process of teaching and learning. Through the 5-point likert scale survey that provides valuable info, the researchers aimed at determining teachers' acceptance and perceptions about using social media in teaching and learning. The researchers were interested in doing so because the findings could enable them later on determining ways that can motivate teachers to collaborate with their students outside the walls of the classes. Results of the study showed that these teachers believed that social media could be useful for projects and online discussion. In addition, it could be extremely useful for students through a one-on-one or online group collaboration and interaction with their peers and teachers. Concerning accepting using social media in their teaching, most of these teachers agreed about it. They were aware of its importance because they were using their social media to download online courses for their studies. Though, they emphasized on the need to find creative ways for using social media for it to be really vital in education (Orlanda-Ventayen & Magno-Ventayen, 2017).

In the same year, Albalawi (2017) tried determining mathematics teachers' different perceptions about using the social media as a teaching technique, based on their gender, level of experience, and the grade level they teach. The researcher indicated that, in the last century, new learning perspectives were introduced in order to support students' learning and transform their role from passive to active. They intended to change the traditional macro teaching environment, through-which the teacher takes the leading role in the classroom and becomes the sole provider of information. Enter the internet connection. Many believed it to be the one responsible for creating many opportunities for those who desire to learn, increase their knowledge and share information with others in different countries and continents. The fact of the matter is, even-though the internet is very popular among people in this modern era, its usage is still limited in many schools and universities worldwide, especially for teachers who still prefer using the traditional teaching method and avoiding any tech devices that can be associated with the learning environment. The modern mobile phone supported with a strong internet connection, the smartphones, could very well help improving the teaching and learning process. However, changes in the way teachers and principals think about it should be made to give it the opportunity to justify itself as a successful teaching and learning instrument. Teachers and students alike should collaborate to transform the learning environment into a friendly and productive one. These mobiles are beneficial for teaching and learning at any time and from anywhere outside the classes due to their mobility and flexibility. This alone gives the smartphones a chance to find their way into the educational system, specifically for the scientific material such as mathematics. As a result, students, by their own-selves, will be able to engage and collaborate in productive online groups discussions (Albalawi, 2017).

Remarkably, it is true that teachers themselves use their smartphones and social media platforms in their home because this technology has broken in almost every house in the world. However, many of them are against using them in their teaching because these phones and platforms affect the traditional teaching ways they have become accustomed to using for many years. Thus, they completely reject using them in the class and outside it. What is ridiculous about it, is that students nowadays are concerned with their social media and smartphones more than the topic presented in class. So, instead of opposing this integration, teachers can use it as an attraction that can serve students' learning especially in subject materials like mathematics, a topic not that favorite to study for many students. Deeply and accurately, Albalawi (2017) was interested in knowing the degree of using the social media platforms by mathematics teachers, their perceptions about its usefulness and uselessness, and whether there are significant differences between social media usage, teachers' experience and the grade level which they teach. For that, the researcher designed an online survey to collect his data. After validating the survey by experts in the field of the study, the researcher spread it online. Later on, he received the answers of 142 mathematics teachers, organized the data and analyzed it. Results of the study revealed that there was a huge gap between the proper employment of social media and teachers' perceptions. Except on rare occasions, many of them forbade their students to interact with them through social media to acquire more information about math topics (Albalawi, 2017).

Results also showed that usage of social media in teaching is not a trending among mathematics teachers because most of them were uncertain about the spatial point of these platforms with respect to teaching mathematics. Finally, results showed a significant difference between math teachers' perceptions and their gender, but no statistical significant difference between social media usage, teachers' experience and the grade level which they teach. The most important thing about this study was the fact that it exposed the ignorance of many math teachers about how social media platforms can help students solve mathematical problems; and even-though, many of them admitted that smartphones and social media could make a real difference in the learning environment, they have yet to know how or from where to start (Albalawi, 2017).

Locally, El Naim and Anouty (2019) tried assessing math teachers' perceptions about the social media negatives and its potential positives on students' learning in mathematics in the secondary level. The researchers constructed their own online 5 point likert scale survey. The survey constituted of 14 items, 7 items were concerned with the negatives and 7 items with the positives. The survey was validated by seven experts of different academic degrees: Bachelor, teaching diploma, a master's and a PhD. The researchers piloted the survey to examine its reliability. After confirming that it was reliable, they sent it online and through it they were able to collect the answers of 350 secondary teachers in Lebanon. The researchers were interested in determining teachers' perceptions about the negatives of social media on students' learning, critical thinking and problem solving processes according to the way it was used by them. In addition, the researchers were also interested in determining teachers' perceptions about students losing interest in doing their homework on their own and if they are depending nowadays on their social media to copy it (El Rouadi & Anouti, 2019).

Moreover, the researchers assessed teachers' perceptions about the positive potentials of social media on students' learning in a harsh subject material like mathematics. Finally, they examined if math teachers, males and females, thought in the same way about the social media negatives and positives. Results revealed that most math teachers accused social media of wasting students' time that should be dedicated to their studies. They also accused it of damaging their mathematical understanding, critical thinking, knowledge and their ability to acquire math information. Additionally, 90% of these teachers confirmed that many students nowadays copy their assignments in mathematics through their social media and make no effort in their studies. Furthermore, results of El Naim & Anouty (2019) showed that less than 50% of the math teachers of the sample, 46.9% in average, believed that social media has positive potentials on students' learning in an abstract material like mathematics. Most of these teachers, almost 83.7% of them, believed that, through social media, students can exchange information with each other and that it can provide them with learning resources. However, the social media positives stopped here as most of them rejected believing that it can motivate their students to study more mathematics and help increasing their knowledge and confidence in mathematical tasks. In addition, 63.4% refused believing that students' cognitive communication skills could be improved thanks to their social media. Finally, results also showed that most teachers, males and females, agree about their perceptions on the aforesaid social media negatives and positives (El Rouadi & Anouti, 2019).

Results of this section showed that we need more experiments about the positives of social media. There is a need to create activities that can cement its role in education and change teachers' perceptions about it. Despite its weak role in education, some researchers experimented employing social media for the benefit of students' learning, participation, motivation and satisfaction as detailed in the next section.

2.13. Eclectic Researches on the Positive attributes of Employing Social Media on Students' Learning

In their paper, presented at the International Life Learning Conference, Ng and Abdol-Latif (2011) assured that social media can be quite effective in aiding students' learning at universities. It enables them to collaborate, share information, discuss rules and theories, and understand many concepts and facts in a better way, which in turn ameliorates their abilities in solving problems in mathematics. The writers revealed that mathematics is a difficult material that represents a challenge for most students, even for adults because of their past negative encounters. For that, they aimed at examining the impact of using social networking, through Weblog and Facebook, on teaching a rigid subject material such as mathematics in higher education. The study was implemented on students in the Open University Malaysia (OUM) who were working adults, with families to take care of, and who were at least five years late to enroll in a university after school. So, these students were already low achievers in mathematics in schools or have forgotten the mathematics they were taught years ago. Ng and Abdol-Latif (2011) indicated that these students attended two hours lectures in the university campus for four times per semester and that the instructors provided them with information about different topics in mathematics. Unfortunately, these hours were not enough for them to pass the courses because they needed more time and examples due to their enormous dearth of math rules, concepts and theorems caused by their lengthy absence. So, solutions had to be presented to enhance their mathematical learning. One of the solutions presented by the University was discussions through an online forum. The forum was meant to extend their learning beyond the walls of the classes and lecture halls. The university was under the impression that through their flexibility and ease of use, Facebook and Weblog would allow mathematics teachers to post online videos and PowerPoint presentations that can support their students' learning. In addition, they can answer their questions through easily created online groups. Hence, students can learn more from anywhere outside the university at any time through online collaboration (Ng & Abdol-Latif, 2011).

Ng and Abdol-Latif (2011) revealed that smartphones are expanding among people like fire in the bushes and that the social networking sites, like Facebook, Twitter, LinkedIn and Weblog, are ubiquitous among students in universities and very popular to use. The reality that at least 85% of students use them to communicate within or outside the university forces anyone to question the level of damage in students' studies caused by the time spent on social media. On the bright side, the researchers also revealed that an online debate showed that 64% of the respondents thought that social media can have a positive influence on education through collaboration and that it can extend students' learning outside the walls of the classes even if they were at a distance. Using an adequate design, teachers can integrate social media in their teaching techniques and benefit from its many advantages. To support students' mathematical learning, Ng and Abdol-Latif (2011) used four social media networking sites: Blog, to post notes related to topics of mathematics. YouTube, to upload videos related to the topics that were posted on Blog. SlideShare, for presentations, and Facebook to create a group that notifies all of its members about new postings in Blog. The researchers targeted students who completed one semester in the Open University Malaysia (OUM) and had courses in Statistics and the Management Mathematics. Exercises were posted on the Facebook group and students were requested to send their answers in two weeks. Later on, these students were provided by the tutor's solutions through online videos (Ng & Abdol-Latif, 2011).

At the end of the study, the researchers sent an electronic survey of sixty three items to 100 students to examine if their social media participation had any effect on: their intrinsic motivation, satisfaction and sense of community, which, in turn, could have influenced their commitment to continue their studies. Sixty eight students (28 males and 40 females) answered the electronic survey. Results revealed that students' number of hours spent on using social media impacted their intrinsic motivation, satisfaction, sense of community and commitment to continue their studies. More importantly, results showed that those who participated more in the social media experiment were motivated and committed to continue their studies more than those who participated for less amount of time (Ng & Abdol-Latif, 2011).

Four years later, El-Badawy and Hashem (2015) emphasized on the fact that schools should start employing social media in enhancing students' learning. They revealed that even-though many students use Wikipedia, Google and YouTube for educational purposes, schools must not settle down with it and should take learning into the next level by integrating social media in education. The researchers indicated that social media networking sites and platforms have strongly captured students' attention. Due to that, the researchers stated that teachers can make sure that students can receive the best possible learning by taking advantage of their infatuation about social media and employ it in education. For their research, El-Badawy and Hashem (2015) distributed their survey to 111 students aged between fourteen and nineteen. The researchers were interested in measuring the frequent usage of the social media platforms by these students. For that, the researchers used a Likert scale survey that tackled the daily number of hours spent by the students on social media, the internet and the reasons behind them. Results of the study showed that these students rely on the internet in their studies when they need to and that they spend between one and six hours per day on their social media platforms for entertainment mostly. Concerning using social media in enhancing their learning, 15% of the students indicated that they use YouTube because it presents them with educational videos that are beneficial for their subject materials (El-Badawy & Hashem, 2015b).

The results also showed that these students are doing so on their own and not according to their teachers' instructions. Finally, the results revealed that only 3% of them are using social media in their school work, like projects and homework, simply because schools are neglecting employing social media in their educational systems. The researchers encouraged schools to employ social media in their educational systems and assured them that the 3% using it in school work can become 50%, and even more, when students realize that their learning is enhancing through social connection outside the classes. The researchers pointed out that instead of students searching for information on the internet and watching the YouTube videos, they can learn better by interacting and engaging with their peers and teachers through the social media platforms. The researchers assured that social media has many potentials and its usage is not limited by the way it is currently used. Social media is not about uploading educational videos nor looking for information. On the contrary, it is about sharing and discussing information to enhance students' learning and fill their gaps in any content of a subject material. Based on the aforesaid, El-Badawy and Hashem (2015) advised schools to invest the social media features in education and come up, through it, with something that can support students' learning and change their view about these platforms and networking sites (El-Badawy & Hashem, 2015b).

In the same year, in her research study, Daraei (2015) examined the impact of Facebook on students' satisfaction in the context of learning mathematics through social media instead of the traditional usual way. The researcher assured that learning occurs through social interaction and information inquiry. For that, the researcher formed two groups, each of 20 students in grade ten. The first group, the control group, was taught through the traditional teaching method while the second group, the experimental group, was taught through Facebook. In addition, the researcher created a 5-point Likert scale survey and used it at the beginning and the end of the experiment to investigate students' opinions and satisfaction regarding learning in an online environment compared to the one they grew accustomed to during the passing years. Daraei (2015) indicated that smartphones and social media platforms became so ubiquitous among people all around the world. They embraced different aspects in our jobs, social and personal lives on a daily basis, whether it was for the better or worse, to the limit that they became a need for many during their lifetime routine (Daraei, 2015).

However, this vigorous integration is yet to be proven useful in education because many teachers in schools are still avoiding using the smartphones and the social media platforms as a teaching technique in their teaching methods. Yet, they are still relying on their teacher-centered perspective, even though Facebook, a social media platform and networking site, was first created as a website for social networking among students in higher education and was extended for many educational purposes, through its features, among students in universities. Daraei (2015) revealed that many students in higher education finish their courses with high marks without being fully satisfied with the knowledge they gained through these courses. This reality tickled many educators to start asking about what is needed for a richer learning environment and whether the social media platforms and networking sites, like the Facebook, could help satisfy the hunger of those who were not completely satisfied with their learning at the end of the course. Additionally, the researcher divulged about the fact that Facebook could provide students better learning opportunities. Through this networking site, students can contact those who have interest in the same topic of study and eager to learn more for the benefit of their education. In this way, they can create pages about different courses in their field of study and share their contacts with more information, wider discussions and feedbacks given from their peers (Daraei, 2015).

Due to these facts, the researcher investigated the impact of using Facebook, a social media networking site, as an educational instrument, on students' satisfaction and learning in grade ten. First, for her study, the researcher chose chapters in polynomials, irrational numbers, factorization, absolute value, trigonometry, quadratic and exponential equations and inequalities. Then, she selected 40 students in grade ten, from a randomly chosen high school, who were divided into one control and one experimental group, each of 20 students. In her next step, she managed to assess students' satisfaction about learning virtually through social media. Students in the experimental group, the group whose students were subject to learning through Facebook, completed at the beginning then at the end of the experiment a 5-point Likert scale survey of 19 items that was validated by educators in her field of study. The survey items were completed twice by the students in the experimental group, first at the beginning and then at the end of the study. Results of her study, through the descriptive analysis of the mean and the standard deviation, revealed that usage of Facebook, in education, positively impacted students' learning and satisfaction. Why? Because they were able to share ideas with others and gain some of the information they were lacking under a more fruitful virtual learning environment (Daraei, 2015).

The results of this study is an empowerment for the problematic situation of this research. According to the literature in this dissertation, many teachers neglect using social media in their teaching because they believe it negatively affects students' behavior and hinders their performance by wasting their time and weakening their concentration and understanding in subject materials.

Despite that, at the end of her experiment, Daraei (2015) recommended employing social media, through the smartphones, for the benefit of students' learning in higher education, the secondary level and middle schools if possible (Daraei, 2015).

Three years later, Balalle (2018) assured that, in this digital era, there is a need to determine ways to integrate technology in education and determine its effect on students' academic achievements, simply because this generation is comfortable with the tech approaches more than those who were sitting at their seats decades ago. Teachers have to realize that nowadays students are tomorrow's leaders and they should be well educated with contemporary teaching methods and techniques that suit the world they are living in. Thus, because the future is all about technology, teachers have to take advantage of its prosperity and employ it for the service of students' learning. Regarding employing social media in education, teachers are divided into two parties. The first party sees that the macro teaching method remains the best for students' learning, while the second one realizes how beneficial social media can be for the learning environment (Balalle, 2018).

Many people believe that social media platforms are online communication forms only created to enable people expressing their opinions publicly. This is not true, as many are not aware that social media allows students to communicate with each other and/or their teachers, through its platforms, in a way that enhances their learning (Balalle, 2018). Not to forget that this kind of interaction is a need for humans' learning, including students (Pardo, 2013).

The fact of the matter is, it is not a secret that social media platforms/networking sites have their pros and cons. In education, social media has many positive attributes and negatives that cannot be ignored. Through a smooth process provided by the social media features, students can interact, transfer information, share knowledge, exchange ideas and learn new things related to any subject material. In addition, it provides students with an effective global learning experience by learning from different sources, like well qualified peers and teachers. Bhoite, Patil and Patil (2019) revealed that the post graduate students, who constituted the sample of their study, mostly use WhatsApp more than Facebook, Instagram, LinkedIn, Twitter and Snapchat. These students admitted that they use their social media looking for educational purposes in addition to entertainment, staying up-to-date with the worldwide news and in contact with their friends. These post graduate students assured that social media is very useful in education. It enables them sending and receiving information, and understanding lectures in a better way from different sources to create knowledge. In their opinion, social media should be seriously considered as the new academic learning approach (Bhoite et al., 2019).

Locally, El Rouadi and Anouti (2019) took it one notch up and examined teaching a mathematical lesson in a general sciences class in the third year secondary. The researchers were interested in creating an online mathematical workspace, based on interaction and collaboration, through-which students would be taught the whole lesson. The experiment was constructed based on the community of inquiry model, through-which the researchers specified the social, cognitive and teaching presences. The social presence was about having students online to create a cohesive group through inter-personal relationships and collaboration. The cognitive presence was about students acquiring new meanings, dealing with new definitions, relating ideas, applying new formulas and constructing knowledge. Finally, the teaching presence was about the design through-which the teacher would guide his students and facilitate their learning in a new environment. In this presence, the teacher would motivate his students, define new topics for them and share with them the new meanings of the lesson on hand. The researchers were also interested in determining the percent of students who believed that the teacher has a significant role in turning this type of online teaching into a success story and those who accepted studying another math lesson through the WhatsApp platform (EL Rouadi & Anouti, 2020b).

The 23 students of different skills and needs, who formed the sample of the study, were selected through the purposive sampling technique of heterogeneous type. The researchers were successfully capable of teaching the lesson "metric relations in a triangle" to the students of the sample using the deliberate practice (Kee, 2019). At the end of the interaction and collaboration, 22 students agreed that this lesson can be taught to other students through WhatsApp, 19 students (82.6%) were able to solve the exercises sent by the researchers and 19 students (82.6%) agreed that other math lessons can be taught through the same platform. Moreover, results of the study also revealed that 95.6% of the students (4.3% agreed and 91.3% strongly agreed) emphasized on the importance of the role of the math teacher in the experiment, while 85.9% (72.9% agreed and 13% strongly agreed) accepted studying another math lesson through WhatsApp. Furthermore, the researchers revealed that even-though many mathematics lessons and objectives were alleviated in 2014 by the ministry of education and higher education, there was still not enough time in class for students to properly understand the content given and adequately solve the exercises assigned. For that, the researchers recommended using the deliberate practice through extra sheets provided by social media to support students' math learning. They also recommended to examine the impact of interacting and collaborating, through social media, on students' math learning in other lessons (EL Rouadi & Anouti, 2020b).

The previously mentioned researches in this section make us wonder about the possibilities of integrating the technology, provided by the social media platforms and networking sites, in teaching mathematics and the results coming out of it.

Is teaching mathematics through online interaction and collaboration possible and fruitful in all classes and levels? Where does the didactics of mathematics, through the tasks and difficulties, stand in a digital learning environment provided by social media?

2.14. Didactics of Mathematics in a Digital Dynamic Learning Environment

To answer the aforementioned questions, first we need to know that in the educational field, didactics, a set of teaching theories, is commonly known as the science that enhances one's ability in teaching. It is defined as the science that solves teaching and tasks issues in schools in all classes and levels. Thus, it is basically the science that investigates the relation between teaching, its tasks and issues. Didactics of mathematics is known to be a branch of didactics. However, many articulate that it has its own logic, structure and way of thinking because of the privacy of mathematics among other subject materials, as lots of people consider it rigid and abstract (Blažková, 2013).

Many researchers define the didactics of mathematics as the studies in math education, while others prefer to denote it as a human science because it takes into account, during the analysis, the development of the human side. In the 60s and 70s, didactics of mathematics was all about the subject material and the development of the curriculum. Later on, its focus diverted, the learner and the teacher became the main interest for many researchers. Developing teaching and learning became the focus to ease the process of teaching and make mathematics understandable to the learners as much as possible (Straesser, 2007).

Nowadays, didactics of mathematics is all about focusing on the students and the teachers. It emphasizes on determining the spatial points of the learners and their teachers during the process of learning and teaching mathematics to solve its tasks (Blažková, 2013).

In the 90s, didactics of mathematics was redefined as the science that spreads knowledge in mathematics to make it useful for humans' institutions, just like in the case of understanding the functionality of the electronic devices through trigonometry, graphs and diagrams; and because of its significance, many started asking about what the didactics of mathematics can offer to not only math education but also to teachers' training. Thus, it is clear that the didactics of mathematics is constituted of three elements, mathematics, the subject material itself, the learner and the teacher, the human side, who represent three vertices of the didactic triangle (Figure 20) (Straesser, 2007).

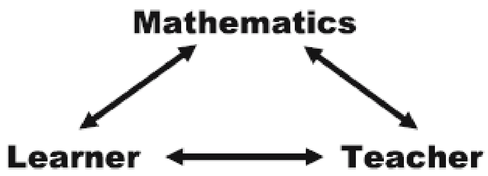


Figure 20 : Didactics Triangle (Straesser, 2007).

Teaching mathematics is formed of two words, teaching and mathematics. The word mathematics is associated with the content of the subject material, while the word teaching is related to the set of activities prepared by the teacher. Mathematics alone is an abstract subject material that requires proper understanding, while its teaching is the way of reducing this rigid image, just like in the case when we have to come up with real life examples that can approach math to the minds of the masses. Didactics of mathematics is the link that fill the gap that exists between teaching and mathematics. It can provide teachers with techniques that ease students' mathematical learning and enable them a better understanding of the math content, rules and theorems. Moreover, didactics of mathematics is extremely beneficial for high expertise teachers who suffer from a daily problem because they lack the teaching techniques that enable them delivering the math content in a way that suits most students. More importantly, the role of didactics of mathematics is not only limited to coming up with new teaching techniques. On the contrary, it can revamp the content of the curriculum and fill in the gaps between the levels. Meaning that, it can make sure that students in the elementary, intermediate and secondary levels have the same understanding about basic math concepts, like the difference between the square root and the square number. This might be absurd to address but make no mistake about it that many students in different levels do not understand why the square root of 64 is 8 while the square of -8 is 64. Mathematics teachers' main criterion was and will always be about the ways they approach to their students and how they can make math understandable as much as possible. That alone is not an easy task to accomplish as students are individually distinguished from each other because of their different skills and needs. A successful mathematics teacher is the one who succeeds in determining ways that reduce the abstract image of math sculpted in the heads of the learners by their colleagues, friends or family members. He is the one capable of respecting students' different personalities and assessing their cognitive processes, in thinking, remembering and paying attention (Salazar, 2019) during their math learning. Thus, for a successful math education, teachers' aim should be about creating an emotional bond, between mathematics and the students, that shapes up the learners' personalities and makes them care about this subject material (Blažková, 2013).

In his master's thesis, Anouti (2018) found out that there is a statistically significant relation between students' math anxiety and teachers' practices, like respecting students' personalities and skills, providing them with feedbacks, motivating them and creating an effective communication between themselves and their students. Results of the study revealed that the teacher plays an effective role in making students love or dislike mathematics. Thus creating an emotional bond through convenient practices can aid student' mathematical learning in school (Anouti, 2018).

In another important fact, while many teachers still believe that students repeating the proof and solving the exercises more than one time after school is the most reliable way to get better in math, others truly believe that students who discover the information on their own, through the constructivism approach, are the ones who can remember them on the long term. This debate has yet to be settled because teaching mathematics differs due to the different personalities, skills and needs of the learners. It is commonly known that teaching mathematics is not an easy task to accomplish because of the nature of the subject material itself. To make it clear, a successful teaching of mathematics is about making students using their math knowledge when they need to do so and developing their calculation processes, thinking, reasoning and collaboration during a problem solving. It is also about modeling mathematics with real life situations and coming up with effective teaching techniques through tools that facilitate students' math learning and cement their understanding as much as possible. Till nowadays, many still ask about the role of mathematics in life. They consider math as a useless subject material that cannot be used in real life. Unfortunately, these individuals do not realize that math is integrated in all other subject materials. Math is the one subject material that keeps on giving to physics, chemistry and biology because of its accuracy even with its rigid image seen and hated by many (Blažková, 2013).

In the teaching processes there are two teaching methods. The verbal method, based on the teacher-centered "transmission" approach that depends on lecturing and dialogues, and the proficiency-practical method, based on the student-centered "constructivism" approach that depends on exploration, experimentation and manipulation. The teacher is the one who should reduce the hardness and rigidity of mathematics, and make it more practical. For that, he should balance between using the verbal and proficiency-practical methods according to how he sees fit so that his students can properly acquire information and skills to constitute their math knowledge. At the same time, he should make sure that his students' competencies are developing and that they will be reaching a point where they can make adequate decisions concerning a math problem. In addition, he is the one who should motivate his students to embrace math as a school material that supports their logic thinking. More importantly, he is supposed to be the one who enables them not only knowing how to solve a math problem but also why they act and think in this way during the context of solving. Many math teachers endorse the classic traditional teaching through which they transfer their knowledge to the learners by lecturing them in a dominant learning environment. In this case, students are supposed to understand and later on remember everything detailed by the teacher during the learning session (Blažková, 2013).

In a learning environment based on the constructivism approach and supported by some teachers, the roles are switched. Students are the dominant and they construct their knowledge by discovering information and facts on their own or with the help of their teachers. In this case, students are also supposed to understand and later on remember the information discovered through the predetermined activities. These two approaches should not be considered as contrasting to each other. On the contrary, teachers should know when to use the approach that suits the lesson on hand. They should know when to interfere and when they should let students work on their own. While many teachers oppose students working on their own, many endorse it as a way that enables the learners to discover their own mistakes, reduce them and rectify their misconceptions. Students might succeed in solving a math problem on their own; and if not, they will benefit from their teachers' instructions at a later stage (Blažková, 2013).

In this case, thinking about a math exercise alone at first and failing in solving it gives the students the opportunity to better understand it later on with the help of their teachers' instructions. By doing so, teachers combine the two approaches in a way that benefits their students. Further, just like with math exercises formed of notations, expressions and numbers, it is really hard for many students in the word problem solving to read a math text and transcript it into math expressions and equations. It is hard for many learners to understand the content of a given math word problem and its questions. Some students might even mix the answers because they did not adequately understand the question. In these cases, both the teachers and students have to work through verbal communication to identify the latters' gaps in transforming the given of a math content into equations and symbols (Blažková, 2013).

Furthermore, in order to have a better understanding of mathematics teaching and its learning, we need to have a better look at their human activities inside and outside the classroom. Students' activity in class is represented by the way they participate and write; and according to them, their math learning affects their activity that develops when they successfully complete a mathematical task on a regular basis because accomplishing the assigned math tasks is the main goal for many students. Even-though some students do not operate, write or speak in class, they are able to fulfill their tasks. Unfortunately, it is not easy to justify this type of activity and it is not generally possible to justify students' activity simply because it differs from one student to another. On the other side, teachers' activity should be dedicated to benefit students' math learning. Unfortunately, many of them prioritize delivering the content on the expense of students' proper learning. In the didactics of mathematics, students' learning does not only depend on the quality of teachers' activity in class, in the way they interact with them and their choices in presenting the task. It also depends on students' own work in their assigned math tasks, just like in the case of Robert (2012) who indicated that students' knowledge acquirement in math and the nature of some mathematical tasks can be changed with the usage of technology. The case of drawing a curve through a software that enables students determining if they were successfully capable of accomplishing the math task on hand or not is a proper example of that. Moreover, to better understand students' learning, it is a must for teachers to know if their students have exercised the same task repetitively or not. Why? Simply because this way of act positively influences their process in learning and enables them mastering similar tasks. Based on that, it is obvious that the relationship between teachers' activity and students' own one in math classes is a complex issue, especially in the way teachers manage their classes and present students with the tasks through an ordered way that can help their learning and add to their knowledge. This is why, through training sessions or researches, teachers should always work on enriching and modifying their activities, reasoning their choices and ways of presenting the topics/tasks in class, and identifying students' different activities in the classroom in a better way (Robert, 2012).

Why teachers should do that? Because unlike many professions, like engineering, teachers are professionals assigned to deal directly with humans, students in this case. They mostly accomplish their didactical goals through their activities, content resources, knowledge, competences, practices, teaching and learning processes. In addition to that, one must not to forget the restrains, or the freedom, teachers face in the context of teaching set up by the educational system of the school. Now while this is the role of the teacher, it is always important to remember the essential role of developing teachers' skills and their subject material competences during their pre or actual service. In all subject materials, like mathematics, professional training is widely seen as a way of enforcing the trainees' knowledge development and skills. Similarly, in the didactics of mathematics, it is very important to keep on developing teachers' practices and expanding their concepts and methods of teaching for a better dynamic learning environment (Rogalski, 2005).

In the didactics of mathematics, technology is known to positively influence teaching and creating a dynamic learning environment. Teaching mathematics is not only limited to textbooks, pencils, papers and blackboards. Teachers have to realize that technology is here and can provide them with many software and devices that enable them facilitating students' math learning, just like those that can draw curves and geometric shapes, and calculate logarithmic values. In the past, there have always been different opinions, discussions, suggestions and ideas about using technology in teaching mathematics. Some teachers were supportive while others were skeptical about it or ultimately against it because they believed that a proper employment of technology in teaching mathematics required knowledge about the software/devices they mostly lacked. Though, despite different opinions, integrating technology in education will always be one of the main focuses in the didactics of mathematics, its development and researches (Biehler et al., 2002).

In 1992, in the United States of America, the development of technology impacted that of the curriculum. Discussions started to rise about the goals, the processes of teaching and learning, the content, the assessment methods because technology was capable of representing graphs and symbols, and computing numerical calculations, something that was not possible in the past. In the didactics of mathematics, usage of technology is not only limited to making things easier for students. It is also about reorganizing their acquired information. Technology has the power to positively affect students' learning because it presents them with new opportunities to learn better. Additionally, it also presents the developers of the curriculum with the opportunity to change the tasks and the ways of teaching, learning and assessment. In a digital dynamic learning environment, students are active and engaged in the problem solving process. In this case, the teacher is the one providing the students with the problems or letting them choose the problems by themselves. Though, in all cases, the teacher is the one discussing solutions for the problems with the students, but at the same time he is gradually shifting the responsibility to them through their frequent and constant participation (Biehler et al., 2002).

The Socratic Method, considered as a constructivist approach for learning, is a cooperative argumentative discussion that stimulates ones' critical thinking through questions and answers. This method is known to help students' learning by rectifying their misconceptions, reorganizing their knowledge and growing their higher order thinking skills (Lam, 2011).

Many consider the environment, resulted from integrating technology in teaching and learning, as an "Enhanced Socratic Mode". It combines the interaction between the students and their teacher with the digital environment provided by technology, which in turn gives the learners themselves the chance to properly build their knowledge and relate things to each other (Biehler et al., 2002).

In addition, a learning environment, supported by technology, can create the type of interaction that stimulates students through the interpersonal collaboration provided by this digital environment (Biehler et al., 2002).

According to Skemp's theory, teaching mathematics can be done in two ways. The first way is about the instrumental understanding through which students are indoctrinated what to do in different mathematical situations without actually being aware of what they are doing. In this case students always need guidance when they face new math situations to be solved. The second way is about relational understanding through which students understand the construction and relationships of math issues. The way of teaching mathematics is very useful when students are concerned with what they are solving, how to further relate the ideas, the selected solutions, the process and the destination they are looking for (Bailey, 2016).

It is generally agreed that learning mathematics is not the type of sport loved by many, and above that it requires active participation from the learner. A digital learning environment extends Skemp's theory and supports students' relational understanding through the interpersonal mode of interaction that stimulates the participants. This type of interaction created by this kind of learning environment positively influences the learning of students in mathematics when the latter becomes different thanks to the technology that can change students' mental action in understanding and processing information (Biehler et al., 2002).

All of the aforementioned support the researcher's case in reinforcing students' math performance through the technology provided by the WhatsApp platform. Why? Because according to the literature of the dissertation, there is a need to investigate if social media, like the WhatsApp platform here, with a convenient employment, can to create a digital learning environment through which students interact and collaborate online with each other and their teachers.

Additionally, we have to ask if the learning environment can be changed or have we reached its inertia? For that, it is important to examine if such employment can add to the list of teachers' techniques in a way that helps them and the learners.

2.15. The Role of Ergonomics in Teaching

To answer that, first we need to understand that education is a complex and continuous process. It is not only limited to presenting the content in the classroom to the students. On the contrary, it is also about the status of the environment in which the completion of the tasks, the teaching and learning take place. The environment should allow for an efficient collaboration between the teacher and his students. It can become more dynamic and appropriate when it is supported by software and hardware devices that contribute to students' learning, mend some of their problems in the subject material and help them in better understanding of the presented topic (Zunjic et al., 2015).

Ergonomics is a study that reflects how humans work in their environment such as the office, bank, school and classroom. It is a full package of knowledge about the ability of humans, the tools, the systems and the machines of diversified designs, the environment, the fitting person and the task associated to him (Michael, 2002).

It is no secret that modern technology is presenting the world with advanced and sophisticated machines day in and day out to the limit that we may start questioning ourselves about the status of men and machines. It is also a fact that ergonomics is a science that studies, describes and interprets the interaction between two parties, men and machines, in order to refine the product of the machines to make them easier to use for humans. So, in simple words, ergonomics intends to examine and understand men and women's behavior and mental activity to find ways that enable adapting machines to human characteristics in order to improve their usefulness and the situation in which men and women work, which in turn may ameliorate their performance and production. Similar to didactics, ergonomics is also a field of researches. It not about someone inviting a learner and questioning him about his actions to see why he is or isn't fitting in his learning environment. It is about that same person getting himself into the environment to see what is really happening there and the factors influencing the learner. So, it is proper to say that ergonomics is not about setting laws, it is about improving what makes humans act and feel better in their work or learning sessions (Raby et al., 2003).

For that, ergonomics can contribute to the educational system and its quality by modifying the process of teaching and learning according to students' capabilities in remembering, analyzing and reasoning through techniques based on theories or usage of devices that allow them acquiring and using their knowledge when it is necessary, enhancing their skills and developing new ones to use in practice and tasks (Zunjic et al., 2015).

In nowadays modern technology, it is a rare case to find the phone numbers of companies through advertisements as most of them prefer to list their official website as a reference for more information. This reality reflects the imposing presence of the internet and its impact in the way citizens of societies seek information, search for new homes or better schools for their children, publish announcements and pay their bills. Not to mention that the internet found its way to children as almost 90% of young kids at the age of five start accessing the internet through diverse devices (Harvey et al., 2004).

Cognitive ergonomics, a branch of ergonomics, is a set of models and practices. Its main goal is ensuring proper interaction between the needs, the abilities and the limits of humans through their perceptions, ability to pay attention, long and short term memory, environment, work demands and productivity by overlapping with many factors, just like teachers' interaction with technology in a learning environment (Kalakoski, 2016).

Thus, cognitive ergonomics' main goal is to reach a better understanding of humans' abilities so that their interaction with technology can become more effective (Harvey et al., 2004).

Based on that, cognitive ergonomics might help finding out why a math teacher uses his social media in teaching, even to a limited extent, while his colleague isn't doing so. In addition, it might help making teachers' usage of the social media platforms, just like the WhatsApp in this research, more effective in teaching mathematics to students through online interaction, especially those who do not know how or are not used to employing social media in teaching and learning.

Moving forward, humans' cognition is the process of a mental action that occurs when they start thinking and gaining new knowledge about new things through experience (Hogan & Hogan, 2019). It is very important when designing a good software or a device to look into the cognition of the people to better understand how they reason and behave when they interact with a tool in a technological environment (Norman, 1986).

In nowadays, social media has imposed its presence among humans as its number of users is increasing from one year to another; and despite the fact that many people uses their social media to remain socially connected, the constant need for these platforms and networking sites could very well impact our cognitive skills negatively and/or positively. Negatively speaking, it could affect our cognitive skills associated with planning, adequate performing and fast processing. Even more, it could alter and detriment our ability for divided attention because of our frequent switching from one application to another and our constant checking of our smartphones, thus we become less focused and more confused behaviorally during decision-making. Positively speaking, it could enhance the performance of our visual memory and aid our ability to recall. Even more, it could increase the activities of our neural regions associated with our attention and social cognition (The Wealth Advisor contributor, 2021).

The aforementioned in the paragraphs above is very important and essential to remember because the social media platforms were not originally designed for teaching. They were essentially designed to provide humans with the quality entertainment they need at any place and time through communication (Brown, 2019).

This, in turn, clears up the image as to how people behave with their social media and reminds us that this research is employing a social media platform, WhatsApp, designed basically for humans' entertainment in teaching and learning mathematics

Even more, according to Donald Norman (1986), when people have to interact with a technological tool, for the proper completion of their tasks, they tend to imagine how to interact with it, how it works, what they need to do and use to achieve their desired output through it, and what they have to do when things are not going well with it as they desire (Norman, 1986).

Thus, people create internally their own subjective models that can aid or hinder their interaction with the electronic tools and software (Norman, 1986).

Based on that, in one hand, it is no strange that many math teachers still object using the social media platforms or any technical device in their teaching. We tend to think that they might have created their own subjective model that hindered their interaction with technology even if it was for the benefit of their students' learning (El Rouadi & Anouti, 2019).

On the other hand, humans usually rely on their cognitive resources and motor abilities to control the tool while using it through processing to reach the desired outcome of their task; and the more they learn, the better they become (Koubek et al., 2003).

Thus, math teachers might become better in employing the social media platforms, such as WhatsApp in this research, through constant practice if they wish to do so or when it is understood, through cognitive ergonomics, why and how they are willing to do so, which in turn might ameliorate their students' performance. By employing social media in the benefit of students' math learning, teachers might come up with their own mathematical workspace models designed for different topics such as probability, calculus, complex numbers and geometry. These models might be beneficial for themselves, their colleagues and the students. Though, the elephant in the room is about understanding what are the mathematical workspace models, their role and how to construct them according to the students' needs and the math topic presented in front of them.

2.16. The Mathematical Workspace Models

Philosophy of mathematics is a section in the philosophy concerned with the meaning of mathematics and the nature of the abstract objects (Balaguer, 2019), although it has no exact definition among mathematicians or those who are expert in its philosophy (Kuzniak, Tanguay & Elia, 2016).

However, mathematics is commonly known as the problem solving activity that developed because of abstract topics such as space and numbers through reasoning and rational intuition (Khan 2015; Ziegler & Loos, 2010).

Mathematics is also about discovering and justifying contexts in different fields such as geometry, numerical processes and words problem solving. More importantly, it is highly valuable for researchers in mathematics to pass the development of their knowledge, inventions and researches findings, just like in the case of this research study, to the community of teachers to utilize them in a learning environment that enables students to be more active and capable of constructing their own mathematical knowledge. The diversity of the mathematical themes, like algebra, geometry, problem solving, arithmetic, statistics and probability, is because of its necessity to solve many problems in different fields such as physics, chemistry and space sciences. In the fields of sciences, mathematics makes it possible for us to understand the relationships between objects with geometrical shapes and properly measure the distance for space rockets launching or landing (Kuzniak, Tanguay & Elia, 2016).

Just like in the movie *"Hidden Figures"* when the employees at the NASA, agency of the national aeronautics and space administration, had to go back to their math books and use ancient formulas to figure out the exact coordinates of the landing point that would enable the astronaut to land successfully without any damages (Melfi, 2016).

Therefore, it is clear that the value in the need for mathematics lies in the consistency of the development of its epistemological dimension to serve other fields of studies even more. Meaning that, the more the researchers know about mathematics the better other areas of sciences benefit from it (Kuzniak, Tanguay & Elia, 2016).

According to Kuzniak (2011), humans' brain is constituted of two planes, also called dimensions, the epistemological and cognitive planes. The epistemological plane is associated with the meanings, definitions, formulas, rules and theorems. The cognitive plane concerns with one's ability/skill to read, visualize, remember, construct, pay attention, reason and prove in topics such as geometry and word problem solving (Kuzniak, 2011).

Even-though Kuzniak (2011) assured that the more we feed the epistemological plane the better the cognitive plane becomes (Kuzniak, 2011), the mathematical work does not mainly depend on the development of its epistemological dimension only. Humans who work on widely developing the mathematical epistemological dimension require a cognitive ability, related to such activity, that enables them dealing with such level of knowledge because not all people have the same abilities (Kuzniak, Tanguay & Elia, 2016).

Moving on to students in schools. The renovation of mathematical education, initiated in the seventies as a response to the reform of modern mathematics in topics like probability and sequences, and the calls to abandon the traditional teaching put students' learning in the front seat of concerns of the educational system. According to that renovation and those consistent calls, students were no longer supposed to absorb content like they were used to for years. They were entitled to start searching, building and organizing their own information and knowledge just like a mathematical researcher. By time, focusing on student's learning created two completely different aspects. The first aspect concerned with student's work in a learning environment through his teachers' assessments and homework. The second aspect concerned with ensuring that the student was capable of effectively producing a work of mathematical nature, like a research in a math topic. Avoiding considering math as a timeless scientific material disconnected from society and real life is one of the major aspects in the philosophy of mathematics. This is why the development of mathematics in the modern era, in the problem solving, through the years resulted in two contexts (Kuzniak, 2011).

The first context, called the instrumental context, concerns the instruments and conditions that allow for knowledge discovery and concepts development through problem solving. The second context, considered as a societal context, works by focusing students on finding, presenting, justifying and applying a result through a research in front of others, which in turn may help other students to better understand mathematics. Through classic teaching, students are passive in class and work as receivers of information, while according to the previously mentioned contexts students should be active in acquiring and constructing their own knowledge. So, based on that, it is obvious that these two contexts conflict with the traditional teaching method (Kuzniak, 2011).

Why, for some, the traditional teaching method is not adequate for teaching mathematics? Simply because there has always been a gap in understanding what is expected from a student in math and what he or she is capable of achieving in reality. This gap is due to either a weakness in his mathematical epistemological level or in his cognitive abilities. The first weakness might be caused by a lack of mathematical knowledge in symbols, properties, formulas, concepts, theorems and rules. The second might be caused by a shortage in his mathematical abilities in calculating, applying, analyzing, interpreting, connecting and decision making, even-though they could be reinforced to a certain extent through practice (Kuzniak, Tanguay & Elia, 2016).

The statement of Kuzniak, Tanguay and Elia (2016) clearly cemented the ultimate goal of this research whose intention was reinforcing students' math performance through Bruner's scaffolding and the deliberate practice provided by the WhatsApp platform.

Understanding the abstract concepts of mathematics requires a look at the results of the work elaborated by mathematicians. These results reflect a better comprehending of the nature and content of mathematics (Kuzniak, Nechache & Drouhard, 2016).

This might be hard to understand at first. To clear the image, it is enough to mention the work of the famous mathematician Bernhard Riemann who worked on finding a linkage between the analytical and complex planes (Cajori, 2013).

He was capable of finding a path that enabled him associating the two planes through the complex logarithmic function of base e (Cajori, 2013). His findings are extremely beneficial because of the importance of complex numbers in engineering, technology and science (Govers, 2019)

Moving forward, problem solving is known to occupy a fundamental part in mathematics and enable linking the epistemological and cognitive planes. This topic is very important because it is known to add to students' epistemological level, develop their cognitive abilities and allow them to acquire new techniques and skills to reach a higher mathematical thinking (Kuzniak, Tanguay & Elia, 2016).

Style is a particular way of presenting the epistemology, through verification (Kennon, 2012), by embodying it and giving it a definite meaning. Nonetheless, the mathematical style differs from other styles of scientific materials, such as the experimental style in a laboratory. Why? Simply because the rigid nature of math topics is mostly considered vague and confusing for many people. To lessen that abstract image for students, the mathematical workspace concept (MWS) was developed to set up a path that leads to students' coherent achievements in mathematics. It operates in a way that allows constructing a solid and cohesive math work through organizing and developing students' mathematical knowledge. The mathematical workspace (MWS) takes an essential part in approaching math to students through its models via its diversified activities. Though, its models in geometry, words problem solving, analysis, etc…, should take into consideration the time, the contexts of teaching, the tools available to use for the mathematical tasks and activities in order to develop a coherent mathematical work (Kuzniak, Nechache & Drouhard, 2016).

In addition, in the mathematical workspace, the context of problem solving requires varied skills to be properly solved. Thus, in the problem solving exercises, assigning students in groups is favorable, because it enables them to compare different reasoning methods, which results in a higher probability for an adequate solution of the exercise on hand (Pascal, 2017).

In the mathematical workspace there is not one and only one model of learning. The activities vary in a way that teachers can assure that students are developing a well-defined and built work of mathematics. Its concept is based on students diversifying their ways of thinking, organizing their methods of solutions, and not only one method, for a common mathematical problem to make sure that their work at the end is the one expected. So, the mathematical workspace (MWS) could be really meaningful to students if the teachers use different and diverse activities that can facilitate and support their math learning (Kuzniak, Tanguay & Elia, 2016).

The main goal of the didactics of mathematics is enforcing students' math ability by acquiring a mathematical knowledge that enables them succeeding in different contexts such as the one of the problem solving. Not to forget that students are able to move on to other types of exercises the moment they properly understand what is presented in front of them (Monaghan, 2016).

The pedagogical approach of the mathematical workspace (MWS) must include assigning students to individual or group work and additional exercises associated to the current topic in mathematics inside or outside the class through personal or collaborative researches. In a mathematical workspace, practicing more exercises allows students to integrate and implement what they already know with more complex exercises, which in turn positively influences their individual, or team, research work and the development of their reasoning abilities, especially in the word problem exercises. As a result of this mathematical workspace, teachers may know how to diversify their written and oral assessment tools (Pascal, 2017).

In addition, it is essential for the teachers to stay in touch with the researches dedicated to addressing the development of software that can serve students' math thinking and reasoning to use them in a mathematical workspace model. All of the aforementioned is highly important for us to know and understand because the optimal aim of teaching is creating a true relationship between the epistemological and cognitive planes to enable students achieving an efficient mathematical work at the end of the teaching. Moreover, the mathematical workspace (MWS) models are designed to not only present students with new mathematical topics but also experience and implement new teaching strategies, through groups or individually, and analyze their mathematical work through progress; and although it is not easy constructing an efficient mathematical workspace (MWS) that assesses or analyzes students' work, a well-designed one can expose students' gaps in their construction of mathematical meanings. Even though most mathematical workspace models are associated with the content of Probability, Geometry, Statistics, Sequences and Analysis, the Probability word problems (Probability Formula, 2019) and the Statistics are two mathematical topics mostly related to real life situations. For that, implementing more mathematical workspace studies related to them could ease students' learning in such topics. Speaking of easing students' learning in math topics, learning through the information and communication technologies (ICT) is a well advised activity to use in different mathematical domains in a functional mathematical workspace (MWS). This technology enables students to propose different solutions and opinions about a mathematical problem, which in turn creates a coherent mathematical work by the students. As a result, this work can reflect from one domain to another and allow students to use this coherence in other mathematical domains (Kuzniak, Tanguay & Elia, 2016).

In addition to the above, assessing students' work is usually associated to their performance and progress. However, assessing students' mathematical work is a complex topic because of the nature of the interactive and collaborative relationships that exist between students and teachers. Students' skills and beliefs about mathematics, and the ways of teaching may help contributing to their learning or failure in math, especially in the secondary level where mathematics becomes loaded with more theories, rules and concepts. So, in this case, teachers should work on constructing MWS models that aid students' in properly constructing their mathematical meanings (Kuzniak, Nechache & Drouhard, 2016).

In summary, constructing a successful mathematical workspace (MWS) model to present students with a new topic or assess their math work cements the importance of teachers' didactics of mathematics during pre and actual service. During their pre-service when their knowledge is developed by faculties of education and during their actual service through self or formal professional training that enables them staying up-to-date with the latest researches in education; and since knowledge is not constant, the process of learning has to be always changing and teaching must surpass the foundations of the traditional teaching methods (Boudersa, 2016).

Based on the aforementioned, through Engstrom's system of activities, the scaffolding of Bruner and the deliberate practice that supports students' mathematical performance through extra sheets, the researcher has introduced a new mathematical workspace (MWS) model by employing WhatsApp, through smartphones, for the benefit of students' math performance in the problem solving and communication domain.

The word problem solving and communication domain revolves on students' understanding of the given content, remembering their acquired information, analyzing, interpreting, validating, searching for a proper solution for a given task on hand and taking decisions, which is what mathematics is all about.

Through the interaction features of the WhatsApp platform, and online collaborative learning, students had to start from understanding the given content and end up with taking decisions through the list of math word problem exercises that gradually changed from typical to more complex ones.

In between all of that we have to ask ourselves about the spatial points of teachers and students in this digital era. In this current era, should the professor behave in the same way that his predecessors did in previous times? Should his way of interaction with his students be similar to the one that existed in the old times? Is today's generation of students similar to the ones before? Speaking of students and teachers in a digital era ruled by technology, we have to ask ourselves: is this change affecting students' behavior? What do we want from the students? The teachers? What kind of teachers we want? Is it still possible to rely on the paper textbook as the main source of knowledge for the student and the teacher, or it is a mean to which we can add to? (EL Rouadi, 2005).

2.17. The Spatial Points of the Teachers and Students in a Digital Era

To answer the aforementioned questions, nowadays teachers have to realize that as technology evolves by time, students' behavior, attention and learning change. Students have not remained focused because of the never before seen digital screens popping up on a daily basis. Almost two centuries ago, in 1831 to be precise, Michael

Faraday constructed the first small generator capable of producing electricity. Tens of years later, it became the center of the power that runs everything in life from lights in the streets, to computers in companies, machines in factories, planes and every electrical tool in the house. As a result, the daily life routine of humans changed dramatically and they became adapted to living with electricity everywhere in the world to the limit they think that it is abnormal nowadays to be disconnected from electricity. This reality clearly shows that as things change in the world, people change in return. An important fact for teachers to take notice about. Students are also changing in many aspects of their personalities and studies by time due to the thriving technology. So, teachers have to adapt to the current situation and find ways to mingle themselves in it (Brown, 2002).

Similar to the way electricity changed the world and humanity, the internet connection could be the one responsible for changing the landscape of education all around the world. This connection is not only available to provide the people with online shopping and e-mails. It is here to provide them with a massive mine of information that can be transmitted from any person for the benefit of all. Unfortunately, till now, when it comes to education, no one adequately knows how the internet connection can take control of the educational system and revolutionize it completely. As challenging as this might be, it is essential to stay on track with experimenting the role of the internet connection in education to prove its ability in reinventing the educational field and creating a modern education that suits this digital era and the ones that follow. Students in schools and universities represent the future of any nation. Though, nowadays students differ from those who were sitting at the same seats a decade ago. The current era is not the same as the previous one. Students in this digital age cannot be treated and taught similar to their predecessors. Why? Because every aspect of their future life will be surrounded with technology and they should know how to deal with it in a way that serves their learning and the demands of their future careers. The presence of the internet does not only present the opportunity for humans to write and read from a computer or a cellphone. It is up to them to know how to serve their literacy by making their own selves a literacy reference through constant acquirement of information provided by the Web that has become a digital library available for anyone at almost any time and place (Brown, 2002).

Since the World Wide Web has become so loaded with information, then it is normal for the internet and education to be intertwined in a way that serves students' learning. Sadly, due to that quantum of information, students have to know how to successfully navigate through the complex digital world and extract exactly what they need to learn from. Through the internet, learning can become dynamic because students can socially interact through cognitive efforts that allow them acquiring information, creating knowledge and ameliorating their learning. To make it clear, creating knowledge is about the "know-what" and the "know-how" that manifest the useful information in the practices of work and skills. Meaning that, the knowledge is about knowing facts and how to use them to achieve something in an effective or efficient way. Thus, knowledge is about acquiring filtered information and making it useful in practices just like when students know how to retrieve previously acquired information to solve an exercise. So, people, just like students, must not just memorize acquired information from any source. They have to take advantage of that and create more knowledge for themselves that can positively influence their work and study (Brown, 2002).

Moving forward in years, in this digital era, learners must figure out how to empower their leaning by not only seeking information but also collaborating with others in learning experiences (Chasse, 2017). Unfortunately, while students are dealing with the positive and negative effects of technology on their learning, according to how they opt to use, many teachers are still far from transforming their teaching to a digital experience. Shockingly, they are still teaching students using methods tailored years ago that have become obsolete with the presence and prosperity of modern technology (Perdue, 2018).

It is not accurate to prepare our students for their future, of more developed technology, while most teachers feel compelled for using technology in their teaching simply because they didn't grow up with it when they were students and their traditional teaching methods and techniques have been successful for many years. In a situation like this, it is not right to ask them to abandon their methods and techniques, and move forward with teaching in a digital environment. However, in an important note, between where the teachers stand currently and where they should be, and despite some teachers lacking the knowledge about using technology and incorporating it in their teaching practices, many of them understand the fact that technology, with proper employment, can be used to enhance students' learning (Perdue, 2018).

It will take real efforts to bring education into the world of technology and digital environment because many teachers cannot adapt to them on their own and leave behind their teaching methods. That is why experts in the field of professional development should be assigned to define students' perspectives about learning in a digital age, enlighten the teachers about the positives that technology can bring to education and develop their abilities to properly create a digital learning environment. By doing so, teachers can rest assure that they are facilitating students' learning and progress through collaborative learning spaces that allow the learners to take the lead role in the learning experience (Perdue, 2018).

Raby, Baille, Bressoux and Chapelle (2003) previously mentioned that, similar to didactics, ergonomics is also a field of research. It is about a person getting himself into the environment to see what is really happening there and the factors influencing the learner. So, it not a surprise that assigning experts in the field of professional development to create a digital learning environment cements the role of ergonomics in teaching and learning (Raby et al., 2003).

Over and above, in a clearer and wider image about the spatial points of teachers and students in this digital era, in his journal article, Salameh (2018), indicated that the era of technology did not begin in the 21st century. In reality, it started with the invention of printing, developed gradually by the years and reached its peak at the beginning of this century. The development of technology through the years had its impact on the educational landscape. At the end of the seventies, personal computers found their way to schools and classes because many were asking for changes in the traditional teaching methods. Many educators and researchers were fully behind inserting these computers into the educational system. Though, many parents questioned the ability of employing them in the service of the teaching and learning process because of the lack of educational software relevant to the curriculum (Salameh, 2018).

For that, many worldwide researches were conducted to reach better methods of employing the personal computers in the teaching and learning process (Salameh, 2018).

At the beginning of the 21st century, integrating the accelerated technology with education required some tangible transformations in the educational system by those who were responsible for it. Trainers found themselves forced to present the teachers, in their workshops, with contemporary technical teaching mediators so they can stay in line with the modern technology of the digital era. Nonetheless, true changes in education were not limited to the role of the trainers in the workshops. Real transformations required transitioning from the textbook and the teacher, as the sole learning resources, to the multi-resources learning (Salameh, 2018).

Most students were required to move on from memorizing facts and concepts to inquiring, thinking and developing skills under the supervision of the teacher. They had to move on from learning in closed environment to learning in open and flexible environment that can respond to their needs and enable them becoming active instead of being passive. In addition, these transformations required moving on from the traditional teaching approach. From a weak one way direction learning to developing skills, and from thinking in one way to diversifying their ways by seeing and understanding how others think and solve due to the multi-direction interactive learning. These transformations required moving from the inertia in the educational system to flexibility. From graduating similar learners to graduating leaners of different identities. From the lower bound of education to quality and workmanship in education and training (Salameh, 2018).

From dazzling technology to professional development through it; and finally, from assessing based on grades to assessment based on real life problem solving exercises. The aforementioned transformations require a deeper look at the elements of the educational system and some radical changes in the learning objectives and strategies by making learning available to anyone, anyplace at any time, taking into consideration the different needs of the learners and diversifying the learning strategies like the electronic or cooperative learning. After all of that, we have to ask ourselves: how do we achieve what we want? Our goal is employing the recent prosperous technology in the service of education, and to reach that goal, first, we have to rely on successful experiments in the educational field, through researches, capable of aiding us constructing an effective modern era curriculum and saving time, money and effort wasted in random experiments. In addition, we have to define the reasons behind integrating technology in the educational field in the first place and make sure that this integration is a normal extension of the teaching methods. Moreover, we have to be aware that the teachers should be well-prepared and willing to using this technology to aid the learners in solving problems, acquiring skills and information, and constructing their knowledge. Salameh (2018) enlightened on the benefits of integrating technology in education to create a digital complex learning environment through-which the learners benefit from the technology to acquire new skills and concepts. In addition, he emphasized on the need for more experiments in the educational field to use as genuine learning technique for any modern curriculum (Salameh, 2018).

This research study has taken notice of this emphasis and examined the impact of employing technology, through the interactive features of the WhatsApp platform and the online collaboration, on students' mathematical performance to come up with a technique that might be beneficial for the teaching and learning axis.

The big questions we have to ask: are other teachers and students willing to do the same just like the researcher here and the students who participated for the benefit of their performance and this study? Can the teachers who grew up with the old fashioned way of teaching accept the fact that technology has invaded the educational landscape, thus they have to embrace it for the benefit of their students and their image as highly successful teachers?

Can the students in different levels and classes realize that social media is not only about having fun time? Can they recognize it as a possible learning instrument? Can they balance its usage between fun and learning?

Mishra (2009) assured that, one day, the mobile learning will take control of the educational landscape. Courses will be delivered entirely through the mobile technology. Students' performance will improve thanks to it and more people in different continents will be able to pursue their learning because of the technology provided by the mobiles. Mishra (2009) indicated that the entire world has gone mobile, meaning that most people use mobiles and many of them are literally associated to them. In addition, she assured that, through the developing technology, mobiles will become the toolkit of education and people will become more sophisticated. Moreover, she was certain that the learners could benefit from their phones even-more by reaching others in different regions of the world and collaborating with them. These mobiles can introduce new opportunities to learn and break down the barriers for those who seek more knowledge. More importantly, students are not the only ones related to changes in the ways of learning. Teachers are also in the same box. They have to accept the fact that their teaching methods are on the verge of facing radical changes and they have to start working on developing new environments through the rapid technology provided by these mobiles (Mishra, 2009).

To add to the aforementioned, Naismith, Lonsdale, Vavoula and Sharples (2004), before Mishra (2009), assured that mobile learning promotes collaboration among students through social interaction outside the usual learning environment and assists both students and teachers (Naismith et al., 2004).

Not to mention that even before them all, Squire and Jenkins (2002) stated that students can interact and collaborate by exchanging information in a synchronic time or not. Meaning that, they can send and receive data at the same time or they can send it for others to check at a later time (Klopfer et al., 2002).

Add to all of that, Maniar, Bennett, Hand and Allan (2008), and Doolittle and Mariano (2008) emphasized that students' learning can be supported, individually and according to their needs, by the technology of the mobiles (Doolittle & Mariano, 2008; Maniar et al., 2008).

Teachers can integrate the mobiles in their teaching methods by examining students' needs first, designing a model, implementing it and evaluating the results at the end (Doolittle & Mariano, 2008; Maniar et al., 2008).

That being said, in the 21st century, both teachers and students are responsible for leading the change we desperately need in education. Teachers and students have to be creative and they are required to be skilled in interacting, communicating, collaborating and thinking critically when it comes to facilitating the processes of teaching and learning of any educational system. Teaching and learning in this era of technology should not be locked inside the walls of the classes. Teachers and students should be active outside the time allocated for the teaching and learning process by the school. More importantly, teachers and students have to realize that they are presented with a magnificent gift, the internet connection through which they can send and receive images, videos, articles and voices that make learning more attractive by emphasizing on activism through collaboration (Tafakur et al., 2020).

By creating a model that combines the aforementioned elements, the learners will be forced to be active more than their teachers. They will find themselves outside the shell of the traditional teaching approach they grew accustomed to and their problem solving abilities might change for the better. A flipped classroom is one of models that uses the previously mentioned elements. It basically focuses on the lower level of Anderson's taxonomy, especially remembering and understanding. Teachers wisely select the type of activities that serve that level and ease students' learning outside the classroom. With the proper employment of this learning experiment and engagement of students, this type of model can escalate in Anderson's taxonomy and ameliorate their performance by increasing their quiver of information to overcome some of the obstacles they face during their school day (Tafakur et al., 2020).

If the flipped classroom is a model designed to ease students' learning outside the classes, then what forbids reinforcing their performance in a subject material like mathematics through the social media platforms and networking sites, like the whatsApp platform here, during a synchronic or non-synchronic time outside the school?

A well designed social media model could lead to better results for students. Nonetheless though, in addition to remembering and understanding, this model might be able to enhance students' abilities in analyzing, evaluating and maybe creating.

Going back to Maniar, Bennett, Hand and Allan (2008), and Doolittle and Mariano (2008), it is noted that they pointed out at that time that students can mix the entertainment presented by the mobile technology with their learning; and even-though it might require teachers developing special efforts and strategies, they assured that students will find themselves mingling studying with recreation (Doolittle & Mariano, 2008; Maniar et al., 2008).

Years later, in the midst of the technological revolution, we find ourselves in an era completely different than the ones before. In nowadays, social media is in control of the world. In this era, people use its platforms and networking sites for their work, personal life and leisure. Not only that, but those who try avoiding it are perceived as outdated humans. Modern students are used to having fun with their social media. It is an important part of their life. Though, they have to realize that it can ease their learning through its features. Basically, not only students are the ones associated with social media, their teachers hold the responsibility to keep up with the continuous and fast changes, and find ways to integrate social media in their teaching methods. Through it, they can make learning a real fun for students. Subject materials could become more understandable for students. Teachers can reach their students outside the class through the social media and help ameliorating their performance (Legas, 2019).

Through the literature, fun has been recognized as an important factor in humans' learning (Lucardie, 2014). Why? Simply because learning is hard and challenging for many learners (Barrett, 2005).

Having fun while learning might not be an easy idea to digest. Nonetheless, learning should be fun and it can be truly effective if it is. Additionally, in this era of technology, it should not be hard to learn and have fun at the same time (Denny, 2017).

This is not a suspicious talk. Neuroscience studies showed that the level of oxygen in the brain increases when we enjoy learning. Add to that, the human brain tells us that at most times learning stops when we stop having fun or enjoying it (Willis, 2007).

How can technology help bringing fun into learning? Mobile learning is one of the many options that comes to mind (Denny, 2017).

Sadly, many teachers are still hesitated about penetrating students' online universe. They have to get out of their shell, be open minded and realize that social media is the best instrument provided for them to implement the online learning, the inevitable future of learning. If students have fun with their social media at almost all time, then why not the teachers use this fact for their advantage, adapt to it and reach out their students in a way that helps their learning? Additionally, on a positive note, students react in a very positive way when they find out that their teachers are interested in using modern tools they are accustomed to use, like social media, and integrate it in the process of teaching and learning. To reach this reality, teachers have to be daring in doing so. Of course, many teachers in the world might be using social media in numerous ways. However, very few of them are known to be doing a great job in making social media viral and vital for the benefit of students' learning (Wade, 2020).

Here we have to ask ourselves, despite the tryst of changing the educational landscape through technology during the passing years, have the teachers embraced the mobile learning? Are they still hesitant about embracing change?

In the process of teacher's education, it is highly valued to come up with policies and practicalities designed specifically to enrich him with the knowledge, attitude, behavior and skills that enable him performing in a more effective way in class or outside it. Unfortunately, in spite of the many schools of education, developing teachers' education has been met, and still is, with many criticism. Why is that? Well because many of them failed reaching the level and place through which they can refute criticisms (Howey & Wideen, 2001).

Criticisms for not abandoning the traditional teaching perspective for the benefit of increasing their interaction with students of different skills and needs, prioritizing students' success in learning on the content of their subject material (Howey & Wideen, 2001), or not embracing the process of devolution, by which the teacher transfers his role to the student who becomes responsible for solving an exercise and he himself accepts the consequences of such transfer (Reuter et al., 2014).

Teachers' dearth in the "culture competence" is one of the many factors that contribute to teachers' inability of redesigning their teaching methods. Many of them don't usually have the complete knowledge about the background of each of their students and they did not have the chance to observe them in previous classes. Thus, they don't modify their methods according to the needs and skills of their students (Shudak, 2010).

Bruner was always supportive of organizing the world for the child in a way that assures their success in learning. For him, the social interaction between a child and an adult is necessary in the context of culture; and for that, he proposed the concept of shoring, a guardianship interaction through speech, through which the adult gets the child to solve an exercise that he cannot solve on his own (Metz, 2017).

Conversely, have the students valued their mobiles as a learning instrument? After years of spreading among people at high rates and the introduction of social media, are we capable of identifying the spatial point of the mobile technology with respect to students, teachers and Bruner's concept of shoring?

Bruner believed that students build their newly acquired knowledge on top of the previous one and that proper learning ultimately leads to their "learning how to learn" (El Rouadi & Al Husni, 2014). Meaning that, students connect ideas and learn one concept after the other in a way that allows them figuring out when to use them, why and how they fit the bigger picture (Pillai, 2016). Problem solving is the type of exercises that involves students applying their math knowledge to reach a predetermined goal (Xenofontos & Andrews, 2014). Through it, they connect ideas and use many concepts to reach the proper solution. More importantly, it improves their abilities in diversifying their ways of solution, selecting an appropriate strategy and implementing it to find the correct answer (Aydoğdu & Ayaz, 2008).

In a positive note, students, more specifically those who are in the secondary level, are usually interested in solving problems. However, these problems should be related to the real world (Author, 2017). The fact that problem solving is fundamental for students' learning and considered as a significant medium for their mathematical learning, makes it essential for educators to focus on it when constructing a math curriculum (Aydoğdu & Ayaz, 2008). Students' learning is like a cone, just like with Edgar Dale's cone of learning (Figure 21). The more they learn the wider this cone becomes (Anderson, 2019; Zander, 2013).

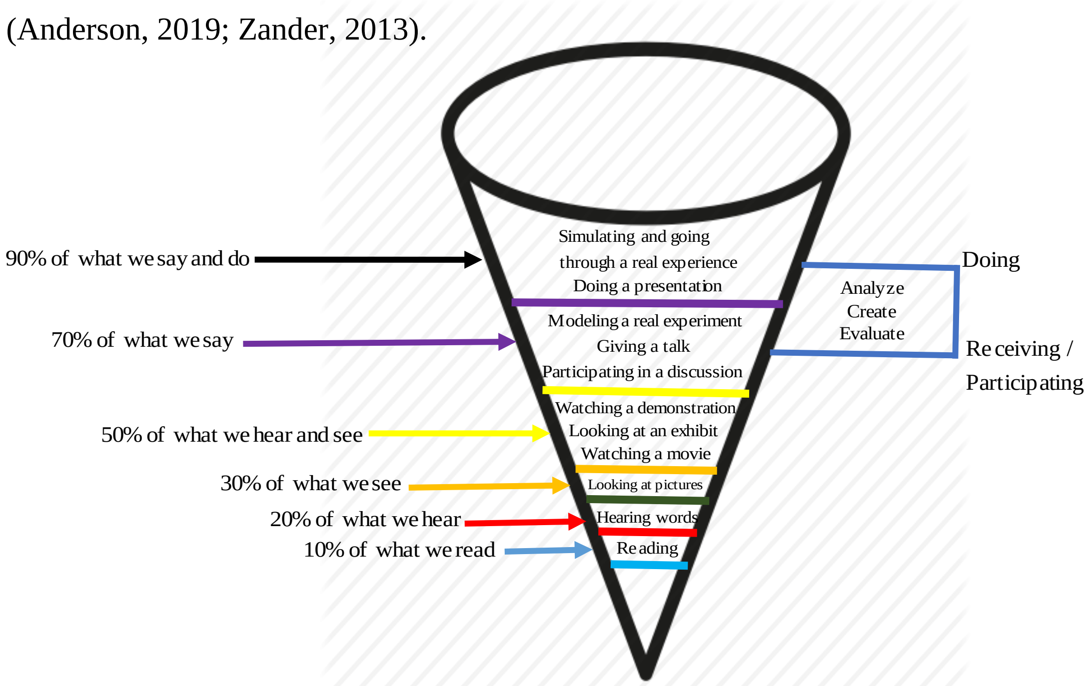


Figure 21: Edgar Dale's Cone of Learning (Anderson, 2019; Zander, 2013).

According to Edgar Dale's cone of learning, after two weeks, humans tend to remember 10% of what they have previously read, 20% of what they have recently heard and 30% of what they have lately seen. In this case they are passive. Surprisingly, after two weeks, humans tend to remember 70% of what they have recently said, analyzed and evaluated in a participated discussion, and 90% of what they have experienced (Anderson, 2019; Zander, 2013).

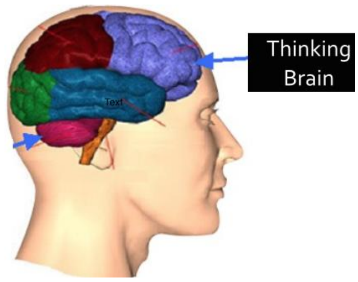
These percent show the importance of discussing, participating and experiencing through which people analyze, evaluate and create. So, indirectly, they endorse employing the social media features in math teaching and learning through which students have to remember, understand, apply, analyze, evaluate and create, if possible, according to Anderson's taxonomy.

Speaking of Andersons' taxonomy, it is essential for us to understand that the humans' mind is a flexible tool capable of growing over the years and has nearly 100 billion neurons (Ego, 2020).

Despite that, it is protected with filters that prevent it from overloading because it is not designed to acquire all of the information we use or deal with during our day (Willis, 2015).

The prefrontal cortex, also known as the thinking brain (Figure 22) (Long, 2014), occupies 17% of the brain. It is associated with the process of information and the way we consciously reflect to it.

The reactive part, also known as the emotional brain (Figure 23) (Kaya, 2018), holds the remaining 83% and is responsible to the way we quickly and unconsciously react (Willis, 2015).



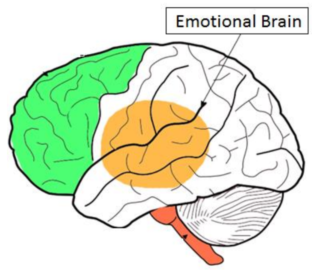


Figure 22 : The Thinking Brain (Long 2014). Figure 23 : The Emotional Brain (Kaya, 2018).

Three considerable elements control the way information enter the brain. The first one is the Reticular Activating System (RAS), also known as the gatekeeper. It is situated at the lower back of the brain, (Figure 24) (Alexander, 2015), and responsible for filtering the data we receive. Focusing on the information enables it to pass through the gatekeeper and reach the prefrontal cortex, while feeling overwhelmed allows the reactive part to take over and throw everything we experience into oblivion. The second one is the Limbic system associated with humans' behavior, emotions and memory (Figure 25) (Dutta, 2018).

After passing through the gate keeper, the information travel to the center of the brain for evaluation by specific neural networking systems; and if they are evaluated as "useful", then they are stored in our memory. The third, final and most important part is the transmitter dopamine. This chemical neurotransmitter helps sending signals and is extremely crucial to the process of information in the brain. The more we feel good and enjoy an experience, the more our brain pumps out dopamine that activates even more neurons in the brain, which in turn enhances our attention, spurs our memory and actives the functionalities of our prefrontal cortex (Willis, 2015).

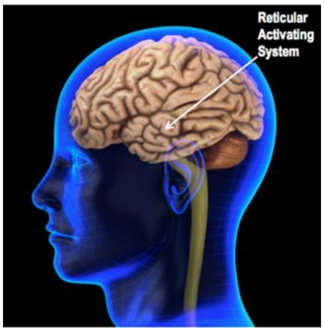


Figure 24: The Reticular Activating System (Alexander 2015).

Figure 25: The Limbic System (Dutta, 2018).

The foregoing mentioned is extremely essential for this study, as it is possible that students feel good and have fun while they learn through the social media experiment.

Learning plays a major role in altering and developing the brain. This is done with every brainstorming or exciting new experience that stimulates memory and increases its capacity. Add to that, the more the process/experiment is repeated, the more efficient the brain becomes. It is noticeable that this enrichment retracts unless it is constantly stimulated, meaning that tedious sessions have no room here, and the type of environment that spurs all senses must replace it (Ego, 2020).

Researches showed that adequate teaching triggers students' awareness, and if the human brain is responsible for the revolution in technology, then it is better to invest it in developing the educational system in a way that leads to developing people who are capable of thinking and using their mental capabilities. Fortunately, this can happen by providing an educational environment that stimulates thinking, cooperation and collaboration among students, and the more students collaborate in this environment, the more responsible, organized and innovative they become (Al-Haroun, 2009).

When it comes to social media, it is clear that researchers are divided into two parties. The first one warns about the negatives of the social media and the smartphones with a touch screen on different aspects of our life, like education, social life and work.

The second one elaborates about the positive impactful implications of the proper employment of social media on the educational environment. These teachers keep on calling for more experiments to cement its role in teaching and learning, and some of them even went out and examined its impact in their own way.

Despite that, based on literature and generally speaking, it seems that both teachers and students are still in a blur when it comes to using/integrating social media in teaching and learning.

Many teachers are still objecting leaving their traditional methods in favor for modern ones, while students are still mesmerized with their smartphones and social media features because they only care about spending quality time having fun.

Calls for integrating social media in education are still going on. Is it possible to reach a point at which we are able of merging fun with learning through social media? Can it be given the right chance to change the future of the educational landscape and its environment or the problematic situation it has been facing consistently over the past years, and still is, will prohibit this from happening?

Only genuine researches, teachers' will for change, and students' collaboration and evaluation of their social media as a true learning instrument will show if this is possible.

Chapter 3: Epistemology and Methodology

3.1. Paradigm of the Research

A paradigm is a set of ideas, beliefs and ways of thinking. More precisely, it is a collection of accepted assumptions related by common logic to a certain topic (Kay Wong, 2014).

These assumptions pave the way and set up the direction for the researcher to select his research methods that allow him to investigate properly according to his objectives (Kay Wong, 2014).

Thus, it is important for any researcher to identify and adopt an adequate paradigm when addressing issues and phenomena in social sciences (Kay Wong, 2014).

Moreover, there are many paradigms like the postpositivist, the constructivist, the pragmatic, the transformative and many others. For each paradigm, there are four philosophical assumptions: the ontology, the epistemology, the axiology and the methodology (Mertens, 2015).

Reality about connectivism is a debatable issue. Like other learning theories, it has its cons despite its beneficial aspects (Şahin, 2012).

In the pragmatic approach, reality is not one and has many interpretations, the focus is on the stated problem (Brierley, 2017).

The researcher is not restricted and more flexible to answer his research questions through mixed quantitative and qualitative methods. He can be objective at times, by deciding not to interact with his subject, and subjective in other times, by deciding to interact with it to build up realities (Brierley, 2017).

Thus, first, because realities about the negatives of the social media platforms and smartphones, and their employment in education are not naïve and have many interpretations (Ontology), knowledge is in relation with the actual problematic situation (Epistemology) and values are gained from the actual problematic situation (Axiology).

Second, because of the humans' social interaction unpredictability, seeking a better understanding prevents the researchers from knowing in advance when to participate and when to notice (Hine, 2005).

Thirdly and lastly, since only a mixed method approach can properly create a framework to better explain the impact of social media features on education (Elavsky et al., 2011) (Methodology), the researcher has adopted the pragmatic paradigm that supports the mixed methods usage in collecting and analyzing data for better inferences drawn from the study quantitative findings and qualitative results.

3.2. Design of the Study

This study was classified as a mixed sequential explanatory QUAN-qual design “descriptive quantitative followed by a qualitative data collection” (Nicolau et al., 2017). It has analyzed the data collected from the survey and quantified variations through the Statistical Package for the Social Sciences (SPSS) software, where participants (students in the secondary level in this research) are generally self-measured once.

In addition, in its problematic situation, SPSS was also used to examine students' mathematical performance in the word problem solution domain at the end of each experiment to determine the statistically significant differences, if any.

Later, based on the results of the survey and the experiment, two math coordinators and three principals were interviewed to better understand the findings of the QUAN design.

These interviews allowed the researcher to properly analyze and interpret based on his QUAN results (Creswell & Plano Clark, 2007), with three intentions:

The first one was examining the statistically significant associations, if any, between the smartphones and the social media platforms, and students’ math timed exams anxiety, behavior in class and competencies in the word problem in the secondary level.

The second one was studying the impact of employing WhatsApp, via its interaction features and collaboration, on students’ performance, through their grades, in the problem solving and communication domain by examining the statistically significant differences, if any, between the averages of the experimental and control groups.

Finally, the third intention was elaborating on the theoretical and practical implementations of this research study, and recommending them for other researches, whether there were statistically significant associations and differences or not, and the possible reasons that led to these findings.

3.3. Study Population and Sample Size

In the first phase of the study the researcher determined the list of the secondary public and private schools that follow the Lebanese curriculum through the Center for Educational Researches and Development (CRDP) (CRDP, 2019) and confirmed it by the ministry of education and higher education.

In addition, the researcher determined the study population size by compiling the numbers provided by the administration of each public and private school that follow the Lebanese curriculum in Beirut and accepted participating in the study.

In the school year 2019-2020, 4 285 students were registered in Beirut public secondary schools. 3 510 students were registered in the secondary private schools that follow the Lebanese curriculum and accepted participating in the study. Meaning that the study population was constituted of 7 795 students in total.

A confidence level of 95% means that the researcher can be 95% sure of his results. The larger the sample size becomes, the better the responses reflect the population of interest (Siegle, 2019).

Additionally, the smaller the margin error gets, the more the researcher can be confident in his results if his survey is multiply repeated with different samples by other researchers (Siegle, 2019).

Based on the stratified random sampling technique in the first phase of the study, the researcher selected 17.5% of the secondary students from each of the secondary public schools, a total of 750 out of 4 285, and 17.5% of those from each of the private schools that follow the Lebanese curriculum and accepted participating in the study, a total of 615 out of 3 510, for a total sample size of 1 365 out of 7 795 at the confidence interval of 95% and a margin error of 2.41% (Cohen et al., 2020).

	Number of students	Selected percent	Number of selected students
Public schools	4285	17.5%	750
Private schools	3510	17.5%	615
Total	7795	17.5%	1365

Lastly, with the headmasters' assistance (principals and deputies), surveys were distributed evenly between classes as much as possible.

In its problematic situation, through the purposive sampling technique, 149 secondary students in Beirut public and private schools were selected, among which 27 volunteering students, to examine the impact of employing WhatsApp on their mathematical performance in the problem solving and communication domain.

3.4. Sampling Technique

Sampling techniques are methods usually used in drawing samples from a population under study in a way that enables the researchers determining, accepting or rejecting their constructed hypotheses (Frerichs, 2008).

The stratified sampling technique is a method used to divide the designated population into two or more non-interlocking subgroups, also called strata, of same proportion. In a significantly heterogeneous population, this type of technique is commonly used when the researcher intends constructing a representative sample from the randomly diversified strata to draw his conclusions (Hayes & Westfall, 2020).

Since the population of the study that consists of 7795 secondary students is heterogeneous, because of students' different skills and needs, and since it can be divided into non-interlocking strata of same proportion, then the researcher has opted to use the stratified sampling technique to construct a representative sample 1365 secondary students to fill the study's validated and modified 5-point likert scale survey.

Moreover, a subjective sampling technique, mostly known as purposive sampling technique, is a non- probability sampling technique. With prior knowledge of the purpose of the research, this technique is used to select heterogeneous participants suitable for a specific study to provide insights about a certain examination or phenomenon (Crossman, 2019).

In principle, students cannot learn at the same pace. They cannot establish knowledge and extract pre acquired information when they solve a problem at the same rate (H. Jones, 2015).

Since the 149 heterogeneous secondary students who examined the impact of employing the WhatsApp platform for the benefit of their mathematical performance weren't capable of learning at the same pace, establishing knowledge, and solving a given problem at the same rate, then, for those reasons, the purposive sampling techniques was suitable to implement the 11 non-randomized WhatsApp experiments.

3.5. Subject Selection

Piaget is considered as the Guru in cognitive studies, the way people think, learn how to develop their thinking, reason and solve problems (Monaghan, 2016). He believed that the progression of knowledge is the result of constructions formed by the learner (Wood et al., 2011).

Piaget established four stages of learning during a learner's development and denoted the fourth stage as the formal operational stage of adolescent students from age 12 and up (Wood et al., 2011).

At this stage, students should be aware of using their time in what benefits their education, capable of using math symbols, understanding, analyzing, evaluating mathematical situations, finding a solution and making a decision as they grow and advance in classes (Wood et al., 2011).

Additionally, teachers should provide their students with visual aids through models and tools, facilitate learning, assemble groups in complex situations and present them with problems that require them logical and analytical thinking (Wood et al., 2011).

Based on the aforementioned, the researcher has targeted learners of age 14 to 18 in the secondary level in private and public schools in Beirut and examined the statistically significant associations, if any, between the smartphones and the social media platforms, and students' math timed exams anxiety, behavior in class and competencies in the word problem solving domain. Additionally, in its problematic situation, the researcher has targeted students in the secondary level and examined the impact of employing the WhatsApp platform on their mathematical performance in the problem solving and communication domain.

3.6. Instruments

To examine the associations between the smartphones with a touch screen and social media, like WhatsApp and others, and students' math timed exams anxiety, behavior in class and competencies in the word problem solving in the secondary level, the researcher has constructed a survey of modified items based on the literature.

The survey was comprised of seven sections. The first section contained students consent to participate in the study. The second was concerned with students' general information. The third was formed of 8 items, the fourth of 8 items, the fifth of 7 items, the sixth of 8 items and the seventh of 10 items.

Each of these items was divided into five areas according to the 5-point likert scale where the numerical value 1 stood for strongly disagree, 2 for disagree, 3 for undecided, 4 for agree and 5 for strongly agree.

For the first independent variable, the smartphones with a touch screen, the researcher has constructed each of his items and modified them based on the thesis of Strickland (2014), at the University of Central Florida, the research study Vahedi and Saiphoo (2018), Ryerson University, and the research study of Hossain (2019), Jahangirnagar University as shown below. These items were used for each of the first, second and third research questions and hypotheses.

- Item 1: Strickland (2014), Vahedi and Saiphoo (2018), and Hossain (2019).
- Item 2: Strickland (2014), Vahedi and Saiphoo (2018), and Hossain (2019).

- Item 3: Hossain (2019), Vahedi and Saiphoo (2018), and Hossain (2019).
- Item 4: Hossain (2019), Vahedi and Saiphoo (2018), and Hossain (2019).
- Item 5: Hossain (2019), Vahedi and Saiphoo (2018), and Hossain (2019).
- Item 6: Hossain (2019), Vahedi and Saiphoo (2018), and Hossain (2019).
- Item 7: Hossain (2019), Vahedi and Saiphoo (2018), and Hossain (2019).
- Item 8: Strickland (2014), Vahedi and Saiphoo (2018), and Hossain (2019).

For the second independent variable, social media, like WhatsApp and others, the researcher has constructed each of his items and modified them based on the dissertation of Schulz (2015), The University of Delaware, the Bachelor thesis of Hughes (2018), The Dublin Business School, Anwar, Shah and Ahmad (2018), Government College University, the research study of El Rouadi and Anouti (2019), and the research study of Hossain (2019), The Jahangirnagar University as shown below. These items were used for each of the fourth, fifth and sixth research questions and hypotheses

- Item 1: Schulz (2015), Hughes (2018), Galer (2018), El Rouadi and Anouti (2019), and Hossain (2019).
- Item 2: Hughes (2018), Anwar, Shah and Ahmad (2018), and Hossain (2019).
- Item 3: Hughes (2018), Anwar, Shah and Ahmad (2018) and Hossain (2019).
- Item 4: Hughes (2018) and Anwar, Shah and Ahmad (2018).
- Item 5: Hughes (2018), El Rouadi and Anouti (2019), and Hossain (2019).
- Item 6: Hughes (2018) and Hossain (2019).
- Item 7: Hughes (2018), Anwar, Shah and Ahmad (2018), and Hossain (2019).
- Item 8: Hughes (2018), Anwar, Shah and Ahmad (2018), and Hossain (2019).

For the first dependent variable, students' math timed exams anxiety, the researcher has constructed each of his items and modified them based on the dissertation of May (2009), Georgia University, the dissertation of Adeyemi (2015), The University of Windsor, the paper for the master's degree of Carvalho (2015), The University of Toronto, and the unpublished master's thesis of Anouti (2018) as shown below. These items were used for each of the first and fourth research questions and hypotheses.

- Item 1: May (2009), Carvalho (2015), Adeyemi (2015), Anouti (2018).
- Item 2: May (2009), Carvalho (2015), Anouti (2018).
- Item 3: May (2009), Anouti (2018).
- Item 4: Carvalho (2015), Anouti (2018).

- Item 5: Anouti (2018).
- Item 6: May (2009), Anouti (2018).
- Item 7: May (2009), Anouti (2018).

For the second dependent variable, students' behavior in class, the researcher has constructed each of his items and modified them based on the book of Sullivan, Johnson, Conway, Owens, Taddeo and Carmel (2012), The University of South Australia, the research study of Al Hilo, Jrej, Korkomaz and Yousef (2018) as cited in the Arabic references, The Lebanese University, the research study of Akram and Kumar (2018), The Government Degree College Mendhar, the research study of El Rouadi and Anouti (2019), the research of Hossain (2019), The Jahangirnagar University, and the student behavior survey of Groesbeck, The Teachers Pay Teachers Website (2019) as shown below. These items were used for each of the second and fifth research questions and hypotheses.

- Item 1: Al Hilo, Jrej, Korkomaz and Yousef (2018), and Hossain (2019).
- Item 2: Hossain (2019), El Rouadi and Anouti (2019), and Groesbeck (2019).
- Item 3: Hossain (2019), El Rouadi and Anouti (2019), and Groesbeck (2019), Bhoite, Patil and Patil (2019).
- Item 4: Akram and Kumar (2018), El Rouadi and Anouti (2019), and Groesbeck (2019).
- Item 5: Al Hilo, Jrej, Korkomaz and Yousef (2018), and Hossain (2019).
- Item 6: Al Hilo, Jrej, Korkomaz and Yousef (2018), and Groesbeck (2019).
- Item 7: Akram and Kumar (2018), El Rouadi and Anouti (2019), and Groesbeck (2019).
- Item 8: Akram and Kumar (2018), El Rouadi and Anouti (2019), and Groesbeck (2019).

For the third dependent variable, students' competencies in the word problem solving in mathematics, the researcher has adopted their items based on the table of competencies in the word problem solving in the secondary level as determined by the official mathematical guide of evaluation, pages 163, 173 and 193, published by the Lebanese Educational Center for Research and Development (CRDP) as shown below. These items were used for each of the third and sixth research questions and hypotheses.

- Item 1: Frayha (2000).

- Item 2: Frayha (2000).
- Item 3: Frayha (2000).
- Item 4: Frayha (2000).
- Item 5: Frayha (2000).
- Item 6: Frayha (2000).
- Item 7: Frayha (2000).
- Item 8: Frayha (2000).
- Item 9: Frayha (2000).
- Item 10: Frayha (2000).

The survey, formed of the aforementioned modified items, was used to investigate the statistically significant associations, if any, between the smartphones with a touch screen, through time drained, messages, video and voice calls, games, internet surfing and applications, and the social media platforms, and students' math timed exams anxiety, behavior in class and competencies in word problem solving in 18 secondary public and 31 secondary private schools that followed the Lebanese curriculum in Beirut.

Additionally, the survey was translated to the Arabic language to suit the students who are taught mathematics in French in their classes. More importantly, in studies, steps are needed to follow when an instrument, like a survey, is translated to another language to preserve its validation (Sperber, 2004)

A teacher with a master's degree translated this survey to the Arabic language after which its content was validated by the director of the dissertation and its language was checked by a PhD student in the final step.

In the second phase of the study, to answer the problematic research question and examine the seventh hypothesis, the researcher has employed WhatsApp, via its interaction features and online collaboration, to reinforce students' performance, through their grades, if possible, in the problem solving and communication domain in mathematics in the secondary level.

3.7. Tables of Alignment

Linkage of the Smartphones with a Touch Screen Items to the Research Questions

The table below is linked with the first, second and third research questions. Its items were constructed to examine the associations between the smartphones with a touch screen and students' math timed exams anxiety, behavior in class and competencies in word problem solving in the secondary level in private and public schools in Beirut.

Question	First research question	Second research question	Third research question
I spend more than two hours using my smartphone every day.	X	X	X
I use my smartphone to send and receive messages.	X	X	X
I use my smartphone to surf the internet.	X	X	X
I use my smartphone to access my social media platforms and applications.	X	X	X
I use my smartphone to play games like Fortnite and PUBG.	X	X	X
I use my smartphone to watch all kinds of videos.	X	X	X
I use my smartphone to call others.	X	X	X
I check my smartphone day and night even if there were no notifications/ conversations.	X	X	X

Linkage of the Social Media Platforms, like WhatsApp and others, Items to the Research Questions

The table below is linked with the fourth, fifth and sixth research questions. Its items were constructed to examine the associations between the social media platforms, like WhatsApp and others, and students' math timed exams anxiety, behavior in class and competencies in word problem solving in the secondary level in private and public schools in Beirut.

Question	Fourth research question	Fifth research question	Sixth research question
I use my social media platforms, like WhatsApp and others for more than two hours every day.	X	X	X
Social media platforms, like WhatsApp and others, have become part of my daily routine activity.	X	X	X
I always feel that I need to check my social media platforms, like WhatsApp and others, every then and now.	X	X	X
I would feel sorrows if they shut down the social media platforms, like WhatsApp and others, even for a short period of time.	X	X	X
I can neglect studying and doing my homework in favor of using my social media, like WhatsApp and others.	X	X	X

I always stay connected with my friends thanks to my social media platforms, like WhatsApp and others.	X	X	X
I use my social media, like WhatsApp and others, to chat, blog and comment.	X	X	X
I use my social media, like WhatsApp and others, to send and receive images and videos.	X	X	X

Linkage of Students' Math Timed Exams Anxiety Items to the Research Questions

The table below is linked with the first and fourth research questions. Its items were constructed to examine students' math timed exams anxiety in the secondary level in private and public schools in Beirut.

Question	First research question	Fourth research question
I cannot focus on anything before my math exam.	X	X
Usually, I am anxious when I start the math exam.	X	X
Usually, I'm not relaxed during math exams.	X	X
During math exams, I feel unable of thinking and recalling things, and I forget what I am supposed to do.	X	X
During a math exam, I panic if I wasn't able to remember the required equation(s), rule(s) or formula(s)	X	X

During math exams, I find myself saying "I can succeed".	X	X
After I submit the math exam paper to the teacher, I start paying attention to my mistakes and knowing answers to questions I left.	X	X

Linkage of Students' Behavior in Class Items to the Research Questions

The table below is linked with the second and fifth research questions. Its items were constructed to examine students' behavior in class in the secondary level in private and public schools in Beirut.

Question	Second research question	Fifth research question
Sometimes I talk to my classmates even without my teacher's permission.	X	X
I avoid doing the tasks assigned during the class.	X	X
It is ok for me to copy my homework from my friend using my social media and present it to my teacher.	X	X
I might sleep during my learning sessions.	X	X
Sometimes I laugh in class even if the teacher is explaining our lesson.	X	X
I argue with my teachers even if I am mistaken.	X	X
Sometimes I don't concentrate in classes.	X	X
Sometimes I don't pay attention to the lessons displayed on the board in class.	X	X

Linkage of Students' Competencies in Mathematical Word Problems Items to the Research Questions

The table below is linked with the third and sixth research questions. Its items were constructed to examine students' competencies in word problem solving in the secondary level in private and public schools in Beirut.

Question	Third research question	Sixth research question
I cannot plan and organize the given content of a math word problem like probability, numerical sequences, interest and economic functions	X	X
I fail to analyze a math word problem exercise.	X	X
I know how to translate the content of a word problem into math equations.	X	X
I fail at extracting relevant information from the content of a math word problem solving exercise.	X	X
I can explain in details the given of math word problems solving exercise.	X	X
I can shift from one mode of representation to another in the same math word problem solving exercise.	X	X
I cannot choose the adequate model to solve a math word problem solving exercise.	X	X
I can validate the results of a math word problem solving exercise.	X	X
Usually, I fail in interpreting the results of a math word problem solving exercise.	X	X
I have a good mathematical reasoning in the math word problem solving exercise.	X	X

Note that, the first nine items in the table above were used to investigate students' competencies in the problem solving and communication domain in the secondary level in private and public schools in Beirut, while the tenth item was only used in setting up recommendations for future researches.

3.8. The Survey's Validity

For validity, prior to being distributed to students in schools, the survey of modified items, each associated with a reference or more as previously shown, was presented to two assistant professors in the Lebanese University.

These assistant professors, experts in the field of higher education, have checked the accuracy of each of the survey items and modified the language of some of them to become clearer to students, especially those who are not proficient in the English language.

3.9. The Survey's Reliability

For items' reliability and to address the research study's consistency (Ursachi et al., 2015), the Cronbach alpha was calculated through the software Statistical Package for the Social Sciences (SPSS).

For that, the researcher has randomly piloted the survey among twenty students in the secondary level who were taught in a secondary public school and a secondary private school in Beirut.

None of these twenty students participated in the implementation of the study later on and were randomly selected as follows: 4 students from grade ten, 4 students from grade eleven scientific, 4 students from grade eleven humanities/economics, 4 students from grade twelve economics and sociology, and 4 students from grade twelve life sciences/general sciences.

Reliability Statistics

Values / Factor	Cronbach's Alpha	Number of Items
Smartphones with a Touch Screen Items	0.787	8
Social Media Platforms, like WhatsApp and Others Items	0.794	8
Math Timed Exams Anxiety Items	0.772	7

Students' Behavior in Class Items	0.918	8
Students' Competencies in the Word Problem Solving Domain in Mathematics	0.800	10

Results have showed values of alpha greater than 0.7 for the smartphones with a touch screen (0.787), the social media platforms, like WhatsApp and others (0.794), math timed exams anxiety (0.772), students' behavior in class (0.918) and students' competencies in the word problem solving domain in mathematics (0.800).

These Alfa values have indicated an excellent consistency in measurement with an excellent correlation between the items of students' behavior in class, and a good consistency in measurement with a good correlation between the items of each of the four other factors, which in turn indicated that this survey was reliable.

Additionally, for items' reliability and to address the research study's consistency (Ursachi et al., 2015), the Cronbach alpha was also calculated through the software Statistical Package for the Social Sciences at the end of the first phase of the study.

Reliability Statistics

Values / Factor	Cronbach's Alpha	Number of Items
Smartphones with a Touch Screen	0.730	8
Social Media Platforms, like WhatsApp and Others Items	0.805	8
Math Timed Exams Anxiety Items	0.769	7
Students' Behavior in Class Items	0.877	8
Students' Competencies in the Word Problem Solving Domain in Mathematics	0.907	10

Results have showed values of alpha greater than 0.7 for the smartphones with a touch screen (0.730), the social media platforms, like WhatsApp and others (0.805), math timed exams anxiety (0.769), students' behavior in class (0.877) and students' competencies in the word problem solving domain in mathematics (0.907).

These Alfa values have indicated an excellent consistency in measurement with an excellent correlation between the items of students' competencies in the word problem solving domain in mathematics and a good consistency in measurement with a good correlation between the items of each of the four other factors, which in turn indicated that this survey was reliable.

3.10. Procedures

3.10.1. data collection. In the first phase of the study, to spread the validated survey of modified items in the English and Arabic languages (Appendices B and C) among students in public schools, a request was applied on the sixteenth of October 2019 (Appendix D) to the general director of education and higher education to enter the campuses of each of the eighteen secondary public schools in Beirut. For two months, the request kept on transferring from one department to another before being sealed with the acceptance

On the sixteenth of December 2019, the researcher received the acceptance under the condition of providing the General Directorate of Education with the research results after its completion (Appendices E and F).

Additionally, between the mid of November and the end of December 2019, the researcher received formal acceptance from the principals of 31 private secondary schools in Beirut, out of 42 that follow the Lebanese curriculum, to distribute the survey among their students in the secondary level (Appendices G to AK).

Finally, on the sixteenth of January 2020, the researcher received acceptance from the ethics committee to distribute the survey among students in the secondary private and public schools in Beirut after submitting a request on a previous date (Appendix AL).

Between the seventeenth of January and the first of March 2020, the researcher collected his data by first distributing the surveys among the students of 49 distinct schools, 18 private and 31 public secondary schools, and then gathering their answers.

In all, the researcher collected the answers of 750 secondary students out of 4285 in 18 public schools and 615 secondary students out of 3510 in 31 private schools that followed the Lebanese curriculum for a total of 1365 out of 7795 secondary students.

In the second phase of the study that concerns the problematic situation, the researcher collected his data through students' grades at the end of each the eleven experiments. These experiments enabled the researcher to determine the grades of 149 students in the secondary level, which in turn allowed him to examine the impact of employing the WhatsApp platform on their performance in the secondary level.

3.10.2. experiment of the study. A controlled experiment is usually conducted in a well-controlled environment. In this type of experiments, only one factor is variable and the researcher has the ability to precise the time and the participants. More precisely, an experimental group is put against one control group, or more, with many factors common among them with the exception of the examined variable (Helmenstine, 2019).

In this study, the control and experiment groups had same or near grades averages in mathematics and teachers of same skills. Additionally, students' performance in the problem solving and communication domain in the secondary level in this study was the independent variable.

Moreover, the researcher has adopted the nonrandomized posttest/pretest-posttest control group design to evaluate the effect of the intervention (James, 2020), employment of the WhatsApp platform on students' mathematical performance in the problem solving and communication domain in the secondary level in this study.

More precisely, after signing the participation consent by the delegate (Appendix AM), students' performance was assessed through their grades.

This experiment was adopted to compare the performance of the students in the experimental group with themselves, prior and after the intervention, and their performance with those in the control groups after the intervention.

3.10.3. data analysis. The survey data in the first phase of the study and results of the eleven experiments in the second were collected, coded and analyzed through the statistical programs package for the social sciences (SPSS).

3.11. Research Interview

Interviewing is the most common used technique in researches. It involves verbal communication between the researcher and the people working in the field of the studied subject to better understand the data collected (Jamshed, 2014; Mathers et al., 2002; Valenzuela & Shrivastava, 2002). It is particularly useful for the subject studied because of the participants' experience in the field of the study. Thus, the researcher can pursue in-depth answers and information (McNamara, 1999).

Interviews can be unstructured, semi or in depth structured. Unstructured interviews do not have pre-planned set of questions. They resemble conversations more than formal interviews. In this type of interviews, interviewees open up and express their opinions in their own ways without even adequately understanding the questions or their meanings (Windsor, 2016).

Semi or in depth structured interviews are built on pre-set open-ended questions to cover a duration of 30 minutes to more than an hour. They are widely employed by different professional researches because the interviewees can give them more depth and detailed answers (Keller & Conradin, 2017).

Semi or in depth structured interviews can be described as a two way focused communication with many advantages. The interviewee can function as an extension tool for validity. He can express his views in his own terms and enhance the set of questions by helping the researcher changing the order of the questions and/or adjusting it based on his knowledge in the field of the study (Keller & Conradin, 2017).

This type of interview allows the respondents to discuss sensitive topics easily without fear. Thus, it provides in-depth information and a reliable comparable data, and confirms what is already known with justifications. More importantly, it may enlighten on new points that might enrich the study (Keller & Conradin, 2017).

3.11.1. planning of semi-structured/in-depth interviews. Thorough planning of a good semi-structured interview includes pre-set of questions about the study, the number of interviews and identification of the respondents/interviewees (Laforest, 2009).

The researcher has to contact each of the designated respondents in advance, explain to each of them the goal of the interview and obtain their permission for an interview (Keller & Conradin, 2017).

The researcher and the respondents have to agree on where and when the interview will be done. He has to contact them again later on to confirm the date and the place of the interview (Keller & Conradin, 2017).

Additionally, he has to write down what is going to be said at the beginning of the interview concerning the study and its purpose, prepare a pre-set of questions, take the interview sheet along with the consent form (Appendices AAA and AAB), sign it, attach it with the answers' sheet, and write a concluding statement at the end of the interview (Keller & Conradin, 2017).

3.11.2. interviews questions. To complete the study and based on the results of the survey and the eleven experiments, the researcher has prepared five questions for the semi structured/in-depth interview with three schools principals and two mathematics coordinators who hold masters and PhDs degrees.

1. According to the results of the validated survey, there is a statistical significant association between each of the smartphones and the social media platforms, like WhatsApp and others, and students' math timed exams anxiety in Beirut secondary private and public schools.
   24.9% of students' math timed exams anxiety could be explained by their smartphones and social media platforms.
   Based on your experience in teaching in the secondary level, do these findings reflect the way students react to math timed exams? If yes or no, then why?

2. According to the results of the validated survey, there is a statistical significant association between each of the smartphones and the social media platforms, like WhatsApp and others, and students' behavior in Beirut secondary private and public schools. 36% of students' behavior in class could be explained by their smartphones and social media platforms.
   Based on your experience in teaching in the secondary level, do these findings reflect the way students behave in class? If yes or no, then why?

3. According to the results of the validated survey, there is a statistical significant association between each of the smartphones and the social media platforms, like WhatsApp and others, and students' competencies in the word problem solving in Beirut secondary private and public schools.
   Many participants admitted not being able to plan, organize, translate, extract, explain, choose the adequate model, validate and interpret. 25.6% of these competencies in the word problem solving could be explained by their smartphones and social media platforms.
   Based on your experience in teaching in the secondary level, do these findings reflect students' competencies in the word problem solving? If yes or no, then why?

4. With the exception of some cases, students' performance in the experimental group differed statistically and significantly than students' performance in each of the control groups in the problem solving and communication domain.

In your opinion, what factors had their input in this achievement? Can this experiment be replicated successfully by other students and teachers? If yes or no, then why?

5. Do you think that social media can be integrated in the upcoming advanced curriculum? If yes or no, then why?

3.12. Justifying Usage of Cronbach's Alpha for Reliability

The researcher has tested the reliability through Cronbach's Alpha value because it measures the consistency of the research results and reveals if the research has properly accomplished its designated and predicted aims. In addition, if a study is reliable it could be used to help aiding and improving issues (Loyal, 2016).

3.13. Justifying Usage of the Descriptive and Inferential Statistics for the Smartphones, Social Media and Students' Math Timed Exams Anxiety, Behavior in Class and Competencies in the Word Problem Solving Domain in Mathematics

The researcher has used the descriptive statistics frequencies and percent to describe the basic features of the data collected for the study because it provides summaries about the sample and describes what the data is formed off (Trochim, 2006).

The mode of each item represents the most frequent value appearing, which in turn signifies students' most frequent answer. In addition to the frequencies and percent, the researcher has used the mode due to the fact that it is considered the most appropriate measure to be used in a 5-points Likert scale survey (Sauro, 2016).

Finally, the researcher has used the inferential statistics because it describes what is happening with the data collected and enables him concluding and judging the sample representing the studied population (Trochim, 2006).

3.14. Justifying Usage of the Pearson's Chi-Square Test

The chi-squares test is used to test the associations between categorical variables (Lani & Moran, 2020). The researcher has adopted the Pearson's chi-square for the study to test any possible association between each of the independent variables (IV), the smartphones with a touch screen and the social media platforms, like WhatsApp and others, and each of the dependent variables (DV), students' math timed exams anxiety, behavior in class and competencies in the word problem solving and communication domain in mathematics.

3.15. Justifying Usage of the Multiple Regression Analysis

The multiple regression analysis is a strong technique used to explain the association between one dependent variable and multiple independent variables, also called predictors (Lani & Moran, 2020a).

The researcher has adopted the multiple regression analysis for this study to examine the association and the correlation between each of the dependent variables (DV), students' math timed exams anxiety, behavior in class and competencies in the word problem solving domain in mathematics, and each of the two independent variables (IV), the smartphones with a touch screen and the social media platforms, like WhatsApp and others.

Moreover, the multiple regression analysis was used to determine the percent that explains each of students' math timed exams anxiety, behavior in class and competencies in the word problem solving domain in mathematics by the smartphones with a touch screen and the social media platforms, like WhatsApp and others.

3.16. Justifying Usage of the Normal Distribution (Test of Normality)

In statistics, normal distribution is regarded as the most significant one because it best fits many life phenomena, like scores (Frost, 2020) and a requirement for the t-test (Burhanna, 2020). Additionally, for a sample size less than 50, the Shapiro-Wilk Test is used to test the normality of the data collected (Lund & Lund, 2018).
For that, prior to every t-test, the researcher has determined students' grades normal distribution for each of the experimental and control groups at the end of each experiment.

3.17. Justifying Usage of the Paired t-Test

The paired t-test, also called the dependent t-test, is used to compare two means of the same person or group (Burhanna, 2020). Since these means can represent measurements of an intervention, then the researcher has used the paired t-test to compare the mean of the students at the end of the WhatsApp experiment with their overall yearly grade average or their performance in other math topics.

3.18. Justifying Usage of the Independent Samples t-Test

The independent samples t-test, also called unpaired t-test, is used to compare the means of two, or more, independent given groups. These groups have no influence on each other and none of their subjects can be common (Burhanna, 2020). The researcher has used the independent samples t-test to compare students' grades in different classes. More precisely, to compare the grades of the students in each of the experimental groups with those of students in each of the control groups.

Chapter 4: Results

In this chapter, the data collected from the modified and validated survey and the eleven WhatsApp experiments was reported, analyzed and discussed.

Descriptive Statistics on the Secondary Schools that participated in the First Phase of the Study

Table 1: Frequencies and Percent of the Secondary Schools

Participated Secondary Schools According to their Type		
	Frequency	Percent
Secondary Public schools	18	36.73%
Secondary Private schools	31	63.27%
Total	49	100%

According to table 1, in the first phase of the study, 18 secondary public and 31 secondary private schools participated in the process of distributing the survey among a number of their students in the secondary level.

The frequencies have showed that there were more secondary private schools participating in the study than public schools. This is due to the presence of only 18 secondary public schools in Beirut, all of which participated in filling the modified and validated survey during the implementation of the first phase of the study.

Descriptive Statistics on the Secondary Students in the First Phase of the Study

Table 2: Frequencies of the Secondary Students Who Filled the Survey

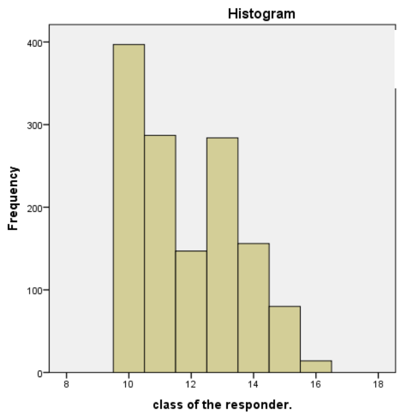
Frequencies of the Secondary Students			
	Public schools	Private schools	Total
First Year Secondary	235	162	397
Second Year Scientific	120	167	287

Second Year Secondary Humanities /Economics	72	75	147
Third Year Secondary economics and Sociology	192	92	284
Third Year Secondary Life Sciences	80	76	156
Third Year Secondary General Sciences	48	32	80
Third Year Secondary Humanities	3	11	14
Total	750	615	1365

The above table has showed that the first year secondary students were the most involved in filling the survey.

They were followed by students in the second year scientific, third year secondary economics and sociology, life sciences, second year secondary humanities/economics, third year general sciences and humanities.

Chart: Secondary Students' Frequency Histogram



The frequency histogram above has showed that there were more students in the first year secondary than any other classes, and this is due to the number of students who passed the grade nine official exam in the year before. More importantly, it showed that more students were registered in the third year secondary economics and sociology than those in each of the other three sections.

Table 3: Percent of the Secondary Students

Percent of the Secondary Students		
	Public schools	Private schools
First Year Secondary	31.33%	26.34%
Second Year Secondary Humanities /Economics	16%	27.15%
Second Year Scientific	9.6%	12.19%
Third Year Secondary economics and Sociology	25.6%	14.96%
Third Year Secondary Life Sciences	10.67%	12.36%
Third Year Secondary General Sciences	6.4%	5.2%
Third Year Secondary Humanities	0.4%	1.8%
Total	100%	100%

The table above showed the percent of students who participated in filling the survey. These percent are the result of the number of participants in filling the survey.

Descriptive Statistics for the Smartphones with a Touch Screen, the Social Media Platforms, like WhatsApp and Others, Students' Math Timed Exams Anxiety, and Students' Competencies in the Word Problem Solving Domain in Mathematics

Table 4: Frequencies and Percent of the Smartphones with a Touch Screen

	Frequency and Percent				
Smartphones with a Touch Screen	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
I spend more than two hours using my smartphone every day.	(43, 3.2%)	(94, 6.9%)	(55, 4.0%)	(511, 37.4%)	(662, 48.5%)
I use my smartphone to send and receive messages.	(9, 0.7%)	(31, 2.3%)	(22, 1.6%)	(557, 40.8%)	(746, 54.7%)
I use my smartphone to surf the internet.	(5, 0.4%)	(15, 1.1%)	(27, 2.0%)	(592, 43.4%)	(726, 53.2%)
I use my smartphone to access my social media platforms and applications.	(13, 1.0%)	(36, 2.6%)	(49, 3.6%)	(589, 43.2%)	(678, 49.7%)
I use my smartphone to play games like Fortnite and PUBG.	(528, 38.7%)	(284, 20.8%)	(88, 6.4%)	(268, 19.6%)	(197, 14.4%)
I use my smartphone to	(58, 4.2%)	(158, 11.6%)	(155, 11.4%)	(573, 42.0%)	(421, 30.8%)

watch all kinds of videos.					
I use my smartphone to call others.	(7, 0.5%)	(31, 2.3%)	(36, 2.6%)	(574, 42.1%)	(717, 52.5%)
I check the readiness of my smartphone day and night even if there were no notifications/ conversations.	(42, 3.1%)	(145, 10.6%)	(180, 13.2%)	(536, 39.3%)	(461, 33.8%)

According to table 4, 1 174 students (85.9%), 511 and 662, spend more than two hours using their smartphones every day, 137 (10.1%), 43 and 94 do not do so, while 55 students (4%) are undecided. 1 303 students (95.5%), 557 and 746, use their smartphones to send and receive messages, only 40 students (3%), 9 and 31 do not do so, while only 22 students (1.6%) are undecided.

Additionally, 1 318 students (96.6%), 592 and 726, use their smartphones to surf the internet, only 20 students (1.5%), 9 and 31 do not do so, while only 27 students (2%) are undecided. 1 276 students (92.9%), 589 and 678, use their smartphones to access their social media platforms and applications, only 49 students (3.6%), 13 and 36 do not do so, while only 49 students (3.6%) are undecided.

Even more, 465 students (34%), 268 and 197 use their smartphones to play games like Fotnite and PUBG, 812 students (59.5%), 528 and 284 do not do so, while only 88 students (6.4%) are undecided. 994 students (72.8%), 573 and 421 use their smartphones to watch all kinds of movies, 216 students (15.8%), 58 and 158 do not do so, while 155 students (11.4%) are undecided.

1 291 students (94.6%), 574 and 717 use their smartphones to call others, only 38 students (2.8%), 7 and 31, do not do so, while only 36 students (2.6%) are undecided. Finally. 997 students (73.1%), 536 and 461 check the readiness of their smartphones day

and night even if there were no notifications/conversations, 187 students (13.7%), 42 and 145 do not do so, while 180 students (13.2%) are undecided

These frequencies and percent showed the strong bonding between the smartphones with a touch screen and the secondary students of the representative sample. Most students use their smartphones for more than two hours to send and receive messages, access their social media platforms and applications, watch all kinds of movies, call others and check their readiness day and night even if it was necessary to do so.

Though, it is notable that the fifth item is the weakest one used by the students as only 34% of the participants use their smartphones to play games like Fortnite and PUBG.

This could be due to the fact that these are games with intensive graphics that require powerful smartphones. Thus not all phones are capable of delivering these games with the great resolution they need (Jonnalagadda & Lagage, 2020)

Table 5: Frequencies and Percent of the Social Media Platforms, like WhatsApp and Others

	Frequency and Percent				
Social Media Platforms, like WhatsApp and Others	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
I use my social media platforms, like WhatsApp and others for more than two hours every day.	(49, 3.6%)	(123, 9.0%)	(78, 5.7%)	(540, 39.6%)	(575, 42.1%)
Social media platforms, like WhatsApp and others, have become part of my daily routine activity.	(25, 1.8%)	(86, 6.3%)	(76, 5.6%)	(579, 42.4%)	(598, 43.8%)

I always feel that I need to check my social media platforms, like WhatsApp and others, every then and now.	(42, 3.1%)	(150, 11.0%)	(136, 10.0%)	(566, 41.5%)	(471, 34.5%)
I would feel sorrows if they shut down the social media platforms, like WhatsApp and others, even for a short period of time.	(145, 10.6%)	(276, 20.2%)	(139, 10.2%)	(517, 37.9%)	(288, 21.1%)
I can neglect studying and doing my homework in favor of using my social media, like WhatsApp and others.	(438, 32.1%)	(313, 22.9%)	(154, 11.3%)	(320, 23.4%)	(140, 10.3%)
I always stay connected with my friends thanks to my social media platforms, like WhatsApp and others.	(17, 1.2%)	(59, 4.3%)	(70, 5.1%)	(642, 47.0%)	(577, 42.3%)

I use my social media, like WhatsApp and others, to chat, blog and comment.	(34, 2.5%)	(76, 5.6%)	(93, 6.8%)	(702, 51.4%)	(460, 33.7%)
I use my social media, like WhatsApp and others, to send and receive images and videos.	(12, 0.9%)	(74, 5.4%)	(77, 5.6%)	(698, 51.1%)	(504, 36.9%)

According to table 5, 1 115 students (81.7%), 540 and 575, use their social media platforms, like WhatsApp and others for more than two hours every day, 172 students (12.6), 49 and 123, do not do so, while only 78 students (5.7%) are undecided. 1 177 students (86.2%), 579 and 598, believe that the social media platforms, like WhatsApp and others, have become part of their daily routine activity, only 111 students (8.1%), 25 and 86, do not believe that, while only 76 students (5.6%) are undecided.

Additionally, 1 037 students (76%), 566 and 471, feel that they need to check their social media platforms, like WhatsApp and others, every then and now, 192 students (14.1%), 42 and 150, do not feel that way, while 136 students (5.6%) are undecided. 805 students (59%), 517 and 288 would feel sorrows if they shut down the social media platforms, like WhatsApp and others, even for a short period of time, 421 students (30.8%), 145 and 276, wouldn't feel that way if it happens, while 139 students (10.2%) are undecided.

Moreover, 460 students (33.7%), 320 and 140, can neglect studying and doing their homework in favor of using their social media, like WhatsApp and others, 751 students (55%), 438 and 313, wouldn't do so, while 154 students (11.3%) are undecided. 1 219 students (89.3%), 642 and 577, always stay connected with their friends thanks to their social media platforms, like WhatsApp and others, only 76 students (5.5%) do not, while only 70 students (5.1%) are undecided.

1 162 students (85.1%), 702 and 460 use their social media, like WhatsApp and others, to chat, blog and comment, only 110 students (8.1%), 34 and 76, do not, while

only 93 students (6.8%) are undecided. Finally, 1 202 students (88%), 698 and 504, use their social media, like WhatsApp and others, to send and receive images and videos, only 86 students (6.3%), 12 and 74, do not, while 77 students (5.6%) are undecided.

These frequencies and percent have showed the strong bonding between the social media platforms, like WhatsApp and others, and the secondary students of the representative sample. Most students use their social media platforms that have become part of their daily routine activity, like WhatsApp and others, for more than two hours every day.

They always feel that they need to check their social media platforms every then and now. They'd feel sorrows if they were shut down, even for a short period of time. In an important note, thanks to these platforms, they always stay connected with their friends through which they chat, blog, comment, send and receive images and videos.

33.7%, just over a third of the participants in the representative sample, can neglect studying and doing their homework in favor of their social media, like WhatsApp and others. What is noticeable here is that this percent is associated with the social media platforms without counting the many other entertainment gadgets.

Table 6: Frequencies and Percent of Students' Math Timed Exams Anxiety

	Frequency and Percent				
Students' Math Timed Exams Anxiety	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
I cannot focus on anything before my math exam.	(184, 13.5%)	(323, 23.7%)	(212, 15.5%)	(416, 30.5%)	(230, 16.8%)
Usually, I'm not anxious when I start the math exam.	(341, 25.0%)	(410, 30.0%)	(246, 18.0%)	(247, 18.1%)	(121, 8.9%)
Usually, I'm not relaxed during math exams.	(153, 11.2%)	(307, 22.5%)	(251, 18.4%)	(447, 32.7%)	(206, 15.1%)

During math exams, I feel unable of thinking and recalling things, and I forget things I learned.	(203, 14.9%)	(361, 26.4%)	(216, 15.8%)	(411, 30.1%)	(173, 12.7%)
During a math exam, I panic if I wasn't capable of remembering the required equation(s), rule(s) or formula(s) to write.	(120, 8.8%)	(192, 14.1%)	(171, 12.5%)	(556, 40.7%)	(325, 23.8%)
During math exams, I find myself saying "can I succeed?".	(193, 14.1%)	(220, 16.1%)	(152, 11.1%)	(517, 37.9%)	(283, 20.7%)
After I submit the math exam paper to the teacher, I start paying attention to my mistakes and knowing answers to questions I left.	(67, 4.9%)	(102, 7.5%)	(102, 7.5%)	(604, 44.2%)	(489, 35.8%)

According to table 6, 646 students (47.3%), 416 and 230, cannot focus on anything before their math exam, 507 students (37.2%), 184 and 323, remain focused, while 212 students (15.5%) are undecided. 368 students (27%), 247 and 121 are not anxious at the start of their math exam, 751 students (50%), 341 and 410, are anxious at the start, while 246 students (10.0%) are undecided.

Additionally, 653 students (47.8%), 447 and 206, are not relaxed during math exams, 460 students (33.7%), 153 and 307 are relaxed, while 251 students (18.4%) are undecided. 584 students (42.7%), 411 and 173 feel that they are unable of thinking and recalling things, and forget things they have already learned, 564 students (51.3%) feel they are able of thinking clearly and recalling things, while 216 (15.8%) are undecided.

881 students (64.5%), 556 and 325, panic if they weren't capable of remembering the required equation(s), rule(s) or formula(s) to write during a math exam, 312 students (22.9%), 120 and 192, remain calm, while 171 students (12.5%) are undecided. 800 students (58.6%), 517 and 283, ask themselves if they can succeed during a math exam, 413 students (30.2%), 193 and 220, do not, while 152 students (11.1%) are undecided.

Finally, 1 093 students (80%), 604 and 489, pay attention to their mistakes and know answers to questions they left after they submit the math exam paper to the teacher, 169 students (12.4%), 67 and 102, don't, while 102 students (7.5%) are undecided.

These frequencies and percent showed that slightly less or more than fifty percent of the participants cannot focus on anything before their math exam. They are anxious at the start, remain so during the exam, unable of thinking and recalling things and forget things they have already learned.

Slightly less or more than sixty percent panic if they weren't capable of remembering the required equation(s), rule(s) or formula(s), and ask themselves if they can actually succeed. This percent increases dramatically as 80% of the participants realize their mistakes and know answers to questions they left after they submit their papers to the teacher.

Table 7: Frequencies and Percent of Students' Behavior in Class

	Frequency and Percent				
Students' Behavior in Class	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
Sometimes I talk to my classmates even if the teacher	(154, 11.3%)	(209, 15.3%)	(118, 8.6%)	(639, 46.8%)	(245, 17.9%)

was explaining the lesson.					
I avoid doing the tasks assigned during the class.	(273, 20.0%)	(426, 31.2%)	(153, 11.2%)	(407, 29.8%)	(106, 7.8%)
It is ok for me to copy my homework from my friend using my social media and present it to my teacher.	(285, 20.9%)	(308, 22.6%)	(141, 10.3%)	(435, 31.9%)	(196, 14.4%)
I might sleep during my learning sessions.	(365, 26.7%)	(270, 19.8%)	(92, 6.7%)	(433, 31.7%)	(205, 15.0%)
Sometimes I laugh in class even if the teacher is explaining our lesson.	(123, 9.0%)	(189, 13.8%)	(115, 8.4%)	(627, 45.9%)	(311, 22.8%)
I argue with my teachers even if I am mistaken.	(433, 31.7%)	(469, 34.4%)	(156, 11.4%)	(202, 14.8%)	(105, 7.7%)
Sometimes I don't concentrate in classes.	(101, 7.4%)	(146, 10.7%)	(129, 9.5%)	(721, 52.8%)	(268, 19.6%)
Sometimes I don't					

pay attention to the lessons displayed on the board in class.	(194, 14.2%)	(220, 16.1%)	(155, 11.4%)	(555, 40.7%)	(241, 17.7%)

According to table 7, 884 students (64.7%), 639 and 245, sometimes talk to their classmates even if the teacher was explaining the lesson, 363 students (26.6%), 154 and 209, don't, while 118 students (8.6%) are undecided. 513 students (37.6%), 407 and 106, avoid doing the tasks assigned during the class, 699 students (51.2%), 273 and 426, don't, while 153 students (11.2%) are undecided.

Additionally, it is ok for 631 students (46.3%), 435 and 196, to copy their homework from their friends through their social media to present it to their teachers, it is not ok for 593 students (43.5%), 285 and 308, while 141 students (10.3%) are undecided. 638 students (46.7%), 433 and 205, might sleep during their learning sessions, 635 students (46.5%), 365 and 270, don't, while only 92 students (6.7%) are undecided.

Moreover, 938 students (68.7%), 627 and 311, can laugh in class even if the teacher is explaining the lesson, 312 students (22.8%), 123 and 189, don't, while 115 students (8.4%) are undecided. 307 students (22.5%) can argue with their teachers even if they were mistaken, 902 students (66.1%), 433 and 469, don't, while 156 students (11.4%) are undecided.

Finally, 989 students (72.4%), 721 and 268, sometimes don't concentrate in classes, 247 (18.1%), 101 and 146, concentrate, while 129 students (9.5%) are undecided. 796 students (58.4%), 555 and 241, sometimes do not pay attention to the lessons displayed on the board in class, 414 students (30.3%), 194 and 220, do, while 155 students (11.4%) are undecided.

These frequencies and percent showed that many students behave in class in a way that does not help their learning. Despite willing to present their homework copied from their friends through their social media, the bulk of students prefer avoiding arguing with their teachers even if they were right.

Considerably, it is acceptable for some students to talk to their classmates and laugh even if the teacher was explaining the lesson. Some might even sleep during their learning sessions and avoid doing the tasks assigned.

Table 8: Frequencies and Percent of Students' Competencies in the Word Problem Solving Domain in Mathematics

	Frequency and Percent				
Students' Behavior in Class	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
I cannot plan and organize the given content of a math word problem like probability, numerical sequences, interest and economic functions	(170, 12.5%)	(290, 21.2%)	(167, 12.2%)	(561, 41.1%)	(175, 12.8%)
I fail to analyze a math word problem exercise.	(121, 8.9%)	(274, 20.1%)	(186, 13.6%)	(617, 45.2%)	(167, 12.2%)
I know how to translate the content of a word problem into math equations.	(150, 11.0%)	(368, 27.0%)	(264, 19.3%)	(461, 33.8%)	(122, 8.9%)
I fail at extracting relevant information from the content of a math word problem solving exercise.	(114, 8.4%)	(346, 25.3%)	(236, 17.3%)	(523, 38.3%)	(146, 10.7%)

I can explain in details the given of math word problems solving exercise.	(137, 10.0%)	(384, 28.1%)	(307, 22.5%)	(412, 30.2%)	(125, 9.2%)
I can shift from one mode of representation (register) to another in the same math word problem solving exercise.	(152, 11.1%)	(428, 31.4%)	(301, 22.1%)	(383, 28.1%)	(101, 7.4%)
I cannot choose the adequate model to solve a math word problem solving exercise.	(98, 7.2%)	(318, 23.3%)	(257, 18.8%)	(527, 38.6%)	(165, 12.1%)
I can validate the results of a math word problem solving exercise.	(167, 12.2%)	(434, 31.8%)	(242, 17.7%)	(410, 30.0%)	(112, 8.2%)
Usually, I fail in interpreting the results of a math word problem solving exercise.	(147, 10.8%)	(284, 20.8%)	(180, 13.2%)	(499, 36.6%)	(255, 18.7%)

I have a good mathematical reasoning in the math word problem solving exercise.	(143, 10.5%)	(285, 20.9%)	(333, 24.4%)	(449, 32.9%)	(155, 11.4%)

According to table 8, 736 students (53.9%), 561 and 175 cannot plan and organize the given content of a math word problem, 460 students (33.7%), 170 and 290, can do so, while 167 students (12.2%) are undecided. 784 students (57.4%), 617 and 167, fail to analyze a math word problem exercise, 395 students (29%), 121 and 274, don't, while 186 students (13.6%) are undecided.

583 students (42.7%), 461 and 122, know how to translate the content of a word problem into math equations, 518 students (38%), 150 and 368, don't, while 264 students (19.3%) are undecided. 669 students (49%), 523 and 146 fail at extracting relevant information from the content of a math word problem solving exercise, 460 students (33.7%), 114 and 346, don't, while 236 students (17.3%) are undecided.

Additionally, 537 students (39.4%), 412 and 125, can explain in details the given of math word problems solving exercise, 521 students (38.1%), 137 and 384, can't, while 307 students (22.5%) are undecided. 484 students (35.5%), 383 and 101, can shift from one mode of representation to another, 580 students (42.5%), 152 and 428, can't, while 301 students (22.1%) are undecided.

Moreover, 692 students (50.7%), 527 and 165, cannot choose the adequate model to solve a math word problem solving exercise, 416 students (30.5%), 98 and 318, can do so, while 257 students (18.8%) are undecided. 522 students (38.2%), 410 and 112, can validate the results of a math word problem solving exercise, 601 students (44%), 167 and 434, can't do so, while 242 students (17.7%) are undecided.

Finally, 754 students (55.3%), 499 and 255, usually fail in interpreting the results of a math word problem solving exercise, 431 students (31.6%), 147 and 284, don't, while 180 students (13.2%) are undecided. 604 students (44.3%), 449 and 155, believe that they have a good mathematical reasoning in the math word problem solving exercise, 428 students (31.4%), 143 and 285, don't believe that, 333 students (24.4%) are undecided.

These frequencies and percent have showed that more than half of the participants cannot plan and organize the given content of a math word problem, and fail in analyzing it. More than one third of them do not know how to translate the content of a word problem into math equations, cannot explain it in details and cannot shift from one mode of representation to another.

A little less or more than half of the participants fail at extracting relevant information from the content of a math word problem solving exercise, cannot choose the adequate model to solve it and fail in interpreting its results. 44% of the participants cannot validate the results of a math word problem solving exercise and near one third of them do not believe that they have a good mathematical reasoning in this domain.

In an important outcome, between 12.2% and 24.4% of the participants are undecided about planning, organizing, analyzing, translating and explaining the given content. They are undecided about extracting relevant information, shifting from one mode to another, choosing adequate model, validating and interpreting the results, and their mathematical reasoning abilities.

Table 9: The Mode of Each Item Related to the Smartphones with a Touch Screen
N.B- the mode is the most frequent answer among the 5 given choices.

Smartphones with a Touch Screen	**Mode**
I spend more than two hours using my smartphone every day.	5 = Strongly Agree
I use my smartphone to send and receive messages.	5 = Strongly Agree
I use my smartphone to surf the internet.	5 = Strongly Agree
I use my smartphone to access my social media platforms and applications.	5 = Strongly Agree
I use my smartphone to play games like Fortnite and PUBG.	1 = Strongly Disagree
I use my smartphone to watch all kinds of videos.	4 = Agree

I use my smartphone to call others.	5 = Strongly Agree
I check the readiness of my smartphone day and night even if there were no notifications/conversations.	4 = Agree

According to table 9, most students strongly agreed about spending more than two hours using their smartphones every day to send and receive messages, surf the internet, access their social media platforms and applications, and call others. They also agreed about using their smartphones to watch all kinds of videos.

Despite using their smartphones for all of the aforementioned, they strongly disagreed about using their smartphones to play games like Fortnite and PUBG.

Table 10: The Mode of Each Item for the Social Media Platforms, Like WhatsApp and Others

Social Media Platforms, like WhatsApp and Others	Mode
I use my social media platforms, like WhatsApp and others for more than two hours every day.	5 = Strongly Agree
Social media platforms, like WhatsApp and others, have become part of my daily routine activity.	5 = Strongly Agree
I always feel that I need to check my social media platforms, like WhatsApp and others, every then and now.	4 = Agree
I would feel sorrows if they shut down the social media platforms, like WhatsApp and others, even for a short period of time.	4 = Agree
I can neglect studying and doing my homework in favor of using my social media, like WhatsApp and others.	1 = Strongly Disagree
I always stay connected with my friends thanks to my social media platforms, like WhatsApp and others.	4 = Agree

I use my social media, like WhatsApp and others, to chat, blog and comment.	4 = Agree
I use my social media, like WhatsApp and others, to send and receive images and videos.	4 = Agree

According to table 10, most students strongly agreed about using their social media platforms, like WhatsApp and others, for more than two hours every day, which in turn have become a part of their daily routine activity. Most of them also agreed about feeling the need to check their social media platforms every then and now, in addition to feeling sorrows if they were shut down even for a short period of time.

Additionally, most of the participants agreed about staying connected with their friends all the time thanks to their social media platforms to chat, blog, comment, send and receive images and videos. Despite that, the majority strongly disagreed about willing to neglect doing their homework in favor of their social media platforms.

Table 11: The Mode of Each Item for Students' Math Timed Exams Anxiety

Students' Math Timed Exams Anxiety	**Mode**
I cannot focus on anything before my math exam.	4 = Agree
Usually, I'm not anxious when I start the math exam.	2 = Disagree
Usually, I'm not relaxed during math exams.	4 = Agree
During math exams, I feel unable of thinking and recalling things, and I forget things I learned.	4 = Agree
During a math exam, I panic if I wasn't capable of remembering the required equation(s), rule(s) or formula(s) to write.	4 = Agree
During math exams, I find myself saying "can I succeed?".	4 = Agree

After I submit the math exam paper to the teacher, I start paying attention to my mistakes and knowing answers to questions I left.	4 = Agree

According to table 11, most students agreed about being unable to focus on anything before their math exam, and despite that, most of them are not anxious when they start it.

They are not relaxed during math exams, feel unable of thinking and recalling things they learned, panic if they weren't capable of remembering the required equation(s), rule(s) or formula(s), pay attention to their mistakes and know answers to questions they left after submitting the math exam paper to the teacher.

Table 12: The Mode of Each Item for Students' Behavior in Class

Students' Behavior in Class	**Mode**
Sometimes I talk to my classmates even if the teacher was explaining the lesson.	4 = Agree
I avoid doing the tasks assigned during the class.	2 = Disagree
It is ok for me to copy my homework from my friend using my social media and present it to my teacher.	4 = Agree
I might sleep during my learning sessions.	4 = Agree
Sometimes I laugh in class even if the teacher is explaining our lesson.	4 = Agree
I argue with my teachers even if I am mistaken.	2 = Disagree
Sometimes I don't concentrate in classes.	4 = Agree
Sometimes I don't pay attention to the lessons displayed on the board in class.	4 = Agree

According to table 12, most participants disagreed about avoiding doing the tasks assigned during the class and arguing with their teachers even if they were mistaken.

Despite that, most students agreed about talking to their classmates and laughing even if the teacher was explaining the lesson, copying their homework from their friends through their social media and sleeping during the learning sessions.

More importantly, the majority agreed about not concentrating in class and not paying attention to the lessons displayed on the board in class in some times.

Table 13: The Mode of Each Item for Students' Competencies in the Word Problem Solving Domain in Mathematics

Students' Competencies in the Word Problem Solving Domain in Mathematics	**Mode**
I cannot plan and organize the given content of a math word problem like probability, numerical sequences, interest and economic functions.	4 = Agree
I fail to analyze a math word problem exercise.	4 = Agree
I know how to translate the content of a word problem into math equations.	4 = Agree
I fail at extracting relevant information from the content of a math word problem solving exercise.	4 = Agree
I can explain in details the given of math word problems solving exercise.	4 = Agree
I can shift from one mode of representation (register) to another in the same math word problem solving exercise.	2 = Disagree
I cannot choose the adequate model to solve a math word problem solving exercise.	4 = Agree

I can validate the results of a math word problem solving exercise.	4 = Agree
Usually, I fail in interpreting the results of a math word problem solving exercise.	2 = Disagree
I have a good mathematical reasoning in the math word problem solving exercise.	4 = Agree

According to table 13, most participants agreed about having the abilities to plan, organize, analyze and translate the given content of a math word problem, extract relevant information from the given and explain it in details. For that, they agreed about having a good mathematical reasoning in the math word problem solving exercise.

However, most participants fail at shifting from one mode of representation to another and interpreting the results of a math word problem solving exercise.

Pearson's Chi-Square Test

Table 14: Pearson's Chi Square Test Results for the Smartphones with a Touch Screen and Students' Math timed Exams Anxiety

The researcher has used the Pearson's chi square values to examine any possible association between each item of one of the independent variable (IV), the smartphones with a touch screen, and each item of the first dependent variables, students' math timed exams anxiety. In addition, the researcher has computed the Pearson value for all items of both variables.

Each item of the independent variable, the smartphones with a touch screen, was listed vertically, while each item of the first dependent variables, students' math timed exams anxiety, was listed horizontally. The p-values were presented to show if there was any statistically significant association between each two items.

Pearson Chi-Square Alfa Values for the Smartphones with a Touch screen and Students' Math timed Exams Anxiety

	I spend more than	I use my smart	I use my smar	I use my smartph	I use my smart phone to	I use my smart phone to	I use my smart	I check the readine

	two hours using my smart phone every day	phone to send and receive messages	t phone to surf the internet	one to access my social media platforms and applications	play games like Fortnite and PUBG	watch all kinds of videos	phone to call others	ss of my smart phone day and night even if there were no notifications/ conversations
I cannot focus on anything before my math exam	0.000011	0.000005	0.005	0.000011	0.0000	0.0000	0.000348	0.0000
Usually, I'm not anxious when I start the math exam	0.000006	0.02	0.456	0.072	0.000056	0.001	0.007	0.0000
Usually, I'm not relaxed during math	0.00001	0.002	0.013	0.00021	0.0000000221	0.002533	0.017	0.0000

exams								
During math exams, I feel unable of thinking and recalling things, and I forget things I learned	0.000001	0.089	0.101	0.003	0.0000001266	0.000049	0.014	0.0000
During a math exam, I panic if I wasn't capable of rememberi ng the required equation(s), rule(s) or formula(s) to write	0.046	0.001	0.044	0.003313	0.00303	0.073	0.001	0.000003
During math								

exams, I find myself saying "can I succeed?	0.000023	0.000161	0.006	0.004	0.000002	0.00000056	0.000151	0.000003
After I submit the math exam paper to the teacher, I start paying attention to my mistakes and knowing answers to questions I left	0.003	0.214	0.01	0.017	0.045	0.000075	0.0147	0.0000
Total factors								**0.000008**

A Chi-square test of independence was calculated to check possible association between each item of the smartphones with a touch screen and each item of students' math timed exams anxiety, and the possible association between them as a whole.

With the exception of no association between using the smartphone to surf the internet and not being anxious at the start of the exam, using the smartphones to send and receive messages and feeling unable to think and recall things, using the smartphones to send and receive messages and paying attention to mistakes/knowing answers to questions left, results showed a statistically significant association between the items at Fsédu-USJ the p-level less than 0.05. In addition there was a statistically significant association between the total factors of the smartphones with a touch screen and students' math timed exams anxiety also at the level of p = 0.000008 < 0.05.

Table 15: Pearson's Chi Square Test Results for the Smartphones with a Touch screen and Students' Behavior in Class

The researcher has used the Pearson's chi square values to examine any possible association between each item of one of the independent variable (IV), the smartphones with a touch screen, and each item of the second dependent variables, students' behavior in class. In addition, the researcher has computed the Pearson value for all items of both variables.

Each item of the independent variable, the smartphones with a touch screen, was listed vertically, while each item of the second dependent variables, students' behavior in class, was listed horizontally. The p-values were presented to show if there was any statistically significant association between each two items.

Pearson Chi-Square Alfa Values for the Smartphones with a Touch screen and Students' Behavior in Class

	I spend more than two hours using my smart phone every day	I use my smart phone to send and receive messages	I use my smart phone to surf the internet	I use my smartphone to access my social media platforms and applications	I use my smart phone to play games like Fortnite and PUBG	I use my smart phone to watch all kinds of videos	I use my smart phone to call others	I check the readiness of my smart phone day and night even if there were no notifications/ conversations
Sometimes I talk to								

my classmates even if the teacher was explaining the lesson	0.0000	0.000002	0.00003	0.00000585	0.0000	0.00000003	0.000012	0.00000075
I avoid doing the tasks assigned during the class	0.000001	0.000107	0.000406	0.00005	0.0000	0.00000917	0.005110	0.00000002
It is ok for me to copy my homework from my friend using my social media	0.00000	0.000074	0.000002	0.00000605	0.00000009	0.00000272	0.002596	0.000000016

and present it to my teacher								
I might sleep during my learning sessions	0.000005	0.000122	0.000204	0.000067	0.00000507	0.00000231	0.000009	0.000000007
Sometimes I laugh in class even if the teacher is explaining our lesson	0.000	0.000005	0.000024	0.00000408	0.00000004	0.00000303	0.001719	0.000000027
I argue with my teachers even if I am mistake	0.000003	0.009660	0.015517	0.000294	0.00000002	0.000002	0.000946	0.000000003

n								
Sometimes I don't concentrate in classes	0.000	0.000888	0.014614	0.000347	0.00001789	0.00000407	0.009214	0.000000307
Sometimes I don't pay attention to the lessons displayed on the board in class	0.0004	0.004122	0.011185	0.002842	0.00000069	0.00000054	0.027467	0.000000108
Total factors								**0.000002**

A Chi-square test of independence was calculated to check the possible association between each item of the smartphones with a touch screen and each item of students' behavior in class, in addition to examining the possible association between these two variables as a whole.

Results showed a statistically significant association between the items at the p-level less than 0.05. In addition there was a statistically significant association between the total factors of the smartphones with a touch screen and students' behavior in class also at the level of $p = 0.000002 < 0.05$.

Table 16: Pearson's Chi Square Test Results for the Smartphones with a Touch screen and Students' Competencies in the Word Problem Solving Domain

The researcher has used the Pearson's chi square values to examine any possible association between each item of one of the independent variable (IV), the smartphones with a touch screen, and each item of the third dependent variables, students' competencies in the word problem solving domain in mathematics. In addition, the researcher has computed the Pearson value for all items of both variables.

Each item of the independent variable, the smartphones with a touch screen, was listed vertically, while each item of the third dependent variables, students' competencies in the word problem solving domain in mathematics, was listed horizontally. The p-values were presented to show if there was any statistical significant association between each two items.

Pearson Chi-Square Alfa Values for the Smartphones with a Touch screen and Students' competencies in the word problem solving domain in mathematics

	I spend more than two hours using my smart phone every day	I use my smart phone to send and receive messages	I use my smart phone to surf the internet	I use my smartphone to access my social media platforms and applications	I use my smart phone to play games like Fortnite and PUBG	I use my smart phone to watch all kinds of videos	I use my smart phone to call others	I check the readiness of my smart phone day and night even if there were no notifications/ conversations
I cannot plan and organize the given content of a math								

word problem like probability, numerical sequences, interest and economic functions	0.035	0.207	0.026	0.003	0.000003	0.003	0.0139	0.000433
I fail to analyze a math word problem exercise	0.049	0.001	0.002	0.000327	0.000030	0.001	0.04	0.0000089
I know how to translate the content of a word problem into math equations	0.038	0.00025	0.001	0.002	0.00000005	0.001	0.000021	0.049
I fail at extracting relevant informati								

on from the content of a math word problem solving exercise	0.01	0.006	0.014	0.019	0.00000039	0.000207	0.0334	0.000000118
I can explain in details the given of math word problems solving exercise	0.011	0.000027	0.000013	0.005	0.00000748	0.001	0.000353	0.000325
I can shift from one mode of representation (register) to another in the same math word problem solving exercise	0.042	0.000008	0.000055	0.003	0.00000026	0.000056	0.000946	0.001

I cannot choose the adequate model to solve a math word problem solving exercise	0.000017	0.002	0.017	0.0361	0.0000	0.000295	0.0049	0.000037
I can validate the results of a math word problem solving exercise	0.061	0.014	0.001	0.0112	0.000002	0.001	0.045	0.000015
Usually, I fail in interpreting the results of a math word problem solving exercise	0.032	0.734	0.607	0.049	0.0000	0.003	0.0116	0.000008

I have a good mathematical reasoning in the math word problem solving exercise	0.002	0.000234	0.015	0.0348	0.0000	0.01	0.000002	0.000003
Total factors								**0.000018**

A Chi-square test of independence was calculated to check the possible association between each item of the smartphones with a touch screen and each item of students' competencies in the word problem solving domain in mathematics, in addition to examining the possible association between these two variables as a whole.

With the exception of no association between using the smartphone to send and receive messages and the inability to plan and organize the given content of a math word problem in addition to failing in interpreting its results, results showed a statistically significant association between the items at the p-level less than 0.05. In addition there was a statistically significant association between the total factors of the smartphones with a touch screen and students' competencies in the word problem solving domain in mathematics also at the level of $p = 0.000018 < 0.05$.

Table 17: Pearson's Chi Square Test Results for the Social Media Platforms, like WhatsApp and Others, and Students' Math timed Exams Anxiety

The researcher has used the Pearson's chi square values to examine any possible association between each item of one of the independent variable (IV), the social media platforms, like WhatsApp and others, and each item of the first dependent variables, students' math timed exams anxiety. In addition, the researcher has computed the Pearson value for all items of both variables.

Each item of the independent variable, the social media platforms, like WhatsApp and others, was listed vertically, while each item of the first dependent variables, students' math timed exams anxiety, was listed horizontally. The p-values were presented to show if there was any statistically significant association between each two items.

Pearson Chi-Square Alfa Values for the Social Media Platforms, like WhatsApp and Others, and Students' Math timed Exams Anxiety

	I use my social media platforms, like WhatsApp and others for more than two hours every day	Social media platforms, like WhatsApp and others, have become part of my daily routine activity	I always feel that I need to check my social media platforms, like WhatsApp and others, every then and now	I would feel sorrows if they shut down the social media platforms, like WhatsApp and others, even for a short period of time	I can neglect studying and doing my homework in favor of using my social media, like WhatsApp and others	I always stay connected with my friends thanks to my social media platforms, like WhatsApp and others	I use my social media, like WhatsApp and others, to chat, blog and comment	I use my social media, like WhatsApp and others, to send and receive images and videos
I cannot focus on anything before my math exam	0.000	0.0000004	0.000	0.000022	0.00012824	0.0000015	0.000025	0.0000042
Usually, I'm not anxious								

when I start the math exam	0.000003	0.0000002	0.0000015	0.0000198	0.00001038	0.000006	0.0000077	0.000241
Usually, I'm not relaxed during math exams	0.000	0.000	0.000	0.0000039	0.00000012	0.0000011	0.0000001	0.0000032
During math exams, I feel unable of thinking and recalling things, and I forget things I learned	0.000	0.000002	0.000	0.0000043	0.000	0.000004	0.0000038	0.0000084
During a math exam, I panic if I wasn't capable of								

remembering the required equation (s), rule(s) or formula(s) to write	0.000015	0.0000004	0.0000003	0.0000035	0.00000222	0.0000021	0.0000013	0.000340
During math exams, I find myself saying "can I succeed?	0.000	0.0000001	0.0000001	0.000	0.00000806	0.0000145	0.0000	0.0000074
After I submit the math exam paper to the teacher, I start paying attention to my mistakes and knowing	0.000012	0.001009	0.000013	0.0000245	0.00000002	0.005232	0.0000022	0.000191

answers to questions I left	
Total factors	**0.000003**

A Chi-square test of independence was calculated to check the possible association between each item of the social media platforms, like WhatsApp and others, and each item of students' math timed exams anxiety, in addition to examining the possible association between these two variables as a whole.

Results showed a statistically significant association between the items at the p-level less than 0.05. In addition there was a statistically significant association between the total factors of the social media platforms, like WhatsApp and others, and students' math timed exams anxiety also at the level of $p = 0.000002 < 0.05$.

Table 18: Pearson's Chi Square Test Results for the Social Media Platforms, like WhatsApp and Others, and Students' Behavior in Class

The researcher has used the Pearson's chi square values to examine any possible association between each item of one of the independent variable (IV), the social media platforms, like WhatsApp and others, and each item of the second dependent variables, students' behavior in class. In addition, the researcher has computed the Pearson value for all items of both variables.

Each item of the independent variable, the social media platforms, like WhatsApp and others, was listed vertically, while each item of the second dependent variables, students' behavior in class, was listed horizontally. The p-values were presented to show if there was any statistically significant association between each two items.

Pearson Chi-Square Alfa Values for the Social Media Platforms, like WhatsApp and Others, and Students' Behavior in Class

	I use my social media	Social media platforms, like	I always feel that I	I would feel sorrows if they	I can neglect studying and	I always stay connect	I use my social media,	I use my social media,

	platforms, like WhatsApp and others for more than two hours every day	WhatsApp and others, have become part of my daily routine activity	need to check my social media platforms, like WhatsApp and others, every then and now	shut down the social media platforms, like WhatsApp and others, even for a short period of time	doing my homework in favor of using my social media, like WhatsApp and others	ed with my friends thanks to my social media platforms, like WhatsApp and others	like WhatsApp and others, to chat, blog and comment	like WhatsApp and others, to send and receive images and videos
Sometimes I talk to my classmates even if the teacher was explaining the lesson	0.0000	0.0000018	0.0000	0.0000068	0.0000	0.0000002	0.000052	0.0000
I avoid doing the tasks								

assigned during the class	0.000017	0.0000013	0.0000	0.0000	0.0000	0.0000028	0.0000008	0.000000002
It is ok for me to copy my homework from my friend using my social media and present it to my teacher	0.0000003	0.0000	0.0000	0.0000079	0.0000	0.0000011	0.0000	0.0000
I might sleep during my learning sessions	0.0000024	0.0000016	0.0000018	0.0000	0.0000	0.0000018	0.0000008	0.000000019
Sometimes I laugh in class								

even if the teacher is explaining our lesson	0.0000145	0.000	0.0000074	0.0000031	0.0000093	0.0000057	0.0000019	0.000000558
I argue with my teachers even if I am mistaken	0.0000002	0.0000014	0.0000015	0.0000033	0.0000	0.0000004	0.0000008	0.000001554
Sometimes I don't concentrate in classes	0.0000	0.0000	0.0000022	0.0000019	0.0000	0.0000011	0.0000	0.000000556
Sometimes I don't pay attention to the lessons displayed on the board in	0.0000015	0.0000067	0.0000012	0.0000	0.0000	0.0000027	0.0000029	0.000000449

class	
Total factors	**0.0000019**

A Chi-square test of independence was calculated to check the possible association between each item of the social media platforms, like WhatsApp and others, and each item of students' behavior in class, in addition to examining the possible association between these two variables as a whole.

Results showed a statistically significant association between the items at the p-level less than 0.05. In addition there was a statistically significant association between the total factors of the social media platforms, like WhatsApp and others, and students' behavior in class also at the level of $p = 0.0000019 < 0.05$.

Table 19: Pearson's Chi Square Test Results for the Social Media Platforms, like WhatsApp and Others, and Students' Competencies in the Word Problem Solving Domain

The researcher has used the Pearson's chi square values to examine any possible association between each item of one of the independent variable (IV), the social media platforms, like WhatsApp and others, and each item of the third dependent variables, students' competencies in the word problem solving domain in mathematics. In addition, the researcher has computed the Pearson value for all items of both variables.

Each item of the independent variable, the social media platforms, like WhatsApp and others, was listed vertically, while each item of the third dependent variables, students' competencies in the word problem solving domain in mathematics, was listed horizontally. The p-values were presented to show if there was any statistically significant association between each two items.

Pearson Chi-Square Alfa Values for the Social Media Platforms, like WhatsApp and Others, and Students' Competencies in the Word Problem Solving Domain

	I use my social media platfor	Social media platfor ms, like Whats	I always feel that I need to	I would feel sorrows if they shut	I can neglect studying and doing my	I always stay connect ed with	I use my social media, like	I use my social media, like

	ms, like Whats App and others for more than two hours every day	App and others, have become part of my daily routine activity	check my social media platforms, like Whats App and others, every then and now	down the social media platforms, like Whats App and others, even for a short period of time	homework in favor of using my social media, like WhatsApp and others	my friends thanks to my social media platforms, like Whats App and others	Whats App and others, to chat, blog and comment	Whats App and others, to send and receive images and videos
I cannot plan and organize the given content of a math word problem like probability, numerical sequences, interest and economic functions	0.000002	0.000216	0.000001	0.0000023	0.000000018	0.0000051	0.0000057	0.000012
I fail to								

analyze a math word problem exercise	0.0000149	0.000008	0.0000035	0.0000019	0.0000	0.001	0.000005	0.000141
I know how to translate the content of a word problem into math equations	0.000005	0.000315	0.0000047	0.0000013	0.00000009	0.000020	0.000180	0.007
I fail at extracting relevant informati on from the content of a math word problem solving exercise	0.0000086	0.000011	0.0000012	0.0000	0.0000	0.015	0.0000095	0.000018
I can explain in details the given								

of math word problems solving exercise	0.000031	0.000443	0.0000072	0.0000001	0.00000045	0.002	0.0000149	0.000004
I can shift from one mode of represent ation (register) to another in the same math word problem solving exercise	0.000153	0.000093	0.000016	0.0000001	0.00000038	0.000172	0.0000059	0.000017
I cannot choose the adequate model to solve a math word problem solving exercise	0.0000024	0.0000043	0.0000076	0.0000	0.0000	0.0000004	0.0000001	0.000005

I can validate the results of a math word problem solving exercise	0.000002	0.000435	0.000001	0.0000035	0.00000018	0.001	0.000048	0.000135
Usually, I fail in interpreting the results of a math word problem solving exercise	0.0000027	0.000172	0.0000039	0.0000055	0.0000	0.000072	0.0000	0.000002
I have a good mathematical reasoning in the math word problem solving exercise	0.001034	0.000006	0.000009	0.0000002	0.0000	0.000101	0.0000017	0.000042
Total factors								**0.000004**

A Chi-square test of independence was calculated to check the possible association between each item of the social media platforms, like WhatsApp and others, and each item of students' competencies in the word problem solving domain in mathematics, in addition to examining the possible association between these two variables as a whole.

Results showed a statistically significant association between the items at the p-level less than 0.05. In addition there was a statistically significant association between the total factors of the social media platforms, like WhatsApp and others, and students' competencies in the word problem solving domain in mathematics also at the level of $p = 0.000004 < 0.05$.

Multiple Regression Analysis

The multiple regression analysis is a strong technique used to explain the relationship between one dependent variable and multiple independent variables, also called predictors (Lani & Moran, 2020a).

Table 20: Results for Students' Math Timed Exams Anxiety Predictors

A multi regression analysis was used to predict students' math timed exams anxiety, a dependent variable, by the smartphones with a touch screen and the social media platforms, like WhatsApp and others, the independent variables. Results of the multi regression analysis were displayed in table 20 as shown below.

Results of the Multi Regression Analysis		
Variables	**Coefficient**	**p-value**
Smartphones with a touch screen	0.375	0.0000
Social media platforms, like WhatsApp and others	0.395	0.0000
Students' Math Timed Exams Anxiety		$R^2 = 0.249$

Results of the multi regression analysis revealed a statistically significant association between students' math timed exams anxiety and each of the smartphones with a touch screen and the social media platforms, like WhatsApp and others, at the p-value less than 0.01.

Results also revealed a moderate degree of correlation (Lani & Moran, 2020b) between students' math timed exams anxiety and each of the smartphones with a touch screen and the social media platforms, like WhatsApp and others.

The R^2 value of the analysis above is 0.249. Meaning that, 24.9% of students' math timed exams anxiety could be explained by the smartphones with a touch screen and the social media platforms, like WhatsApp and others.

Table 21: Results for Students' Behavior in Class Predictors

A multi regression analysis was used to predict students' behavior in class, a dependent variable, by the smartphones with a touch screen and the social media platforms, like WhatsApp and others, the independent variables. Results of the multi regression analysis were displayed in table 21 as shown below.

Results of the Multi Regression Analysis		
Variables	**Coefficient**	**p-value**
Smartphones with a touch screen	0.589	0.0000
Social media platforms, like WhatsApp and others	0.607	0.0000
Students' Behavior in Class		$R^2 = 0.360$

Results revealed a statistically significant association between students' behavior in class and each of the smartphones with a touch screen and the social media platforms, like WhatsApp and others, at the p-value less than 0.01.

Results also revealed a high degree of correlation (Lani & Moran, 2020b) between students' behavior in class and each of the smartphones with a touch screen and the social media platforms, like WhatsApp and others.

The R^2 value of the analysis above is 0.360. Meaning that, 36% of students' behavior in class could be explained by the smartphones with a touch screen and the social media platforms, like WhatsApp and others.

Table 22: Results for Students' Competencies in the Word Problem Solving Domain Predictors

A multi regression analysis was used to predict students' competencies in the word problem solving domain in mathematics, a dependent variable, by the smartphones with a touch screen and the social media platforms, like WhatsApp and others, the independent variables. Results of the multi regression analysis were displayed in table 22 as shown below.

Results of the Multi Regression Analysis		
Variables	**Coefficient**	**p-value**
Smartphones with a touch screen	0.481	0.0000
Social media platforms, like WhatsApp and others	0.494	0.0000
Students' Competencies in the Word Problem Solving Domain in Mathematics		$R^2 = 0.256$

Results revealed a statistically significant association between students' competencies in the word problem solving domain in mathematics and each of the smartphones with a touch screen and the social media platforms, like WhatsApp and others, at the p-value less than 0.01.

Results also revealed a moderate degree of correlation (Lani & Moran, 2020b) between students' competencies in the word problem solving domain in mathematics and each of the smartphones with a touch screen and the social media platforms, like WhatsApp and others.

The R^2 value of the analysis above is 0.256. Meaning that, 25.6% of students' acquired competencies in the word problem solving domain in mathematics could be explained by the smartphones with a touch screen and the social media platforms, like WhatsApp and others.

Test of Normality

In statistics, for a sample size less than 50, the Shapiro-Wilk Test is used to test the normality of the data collected (Lund & Lund, 2018).

The normality test is regarded as the most significant one because it best fits many life phenomena, like scores (Frost, 2020) and a requirement for the t-test (Burhanna, 2020).

Table 23: Normality Test for the Grades of the Experimental Groups

The researcher has used the Shapiro-Wilk Test to test the normality of the collected data, the grades (scores) of the experimental groups in this case.

Grades (scores) of the experimental groups	**Level of significance at the significance level > 0.05**

The first experiment.	0.208
The second experiment.	0.929
The third experiment.	0.297
The fourth experiment.	0.553
The fifth experiment.	0.220
The sixth experiment.	0.344
The seventh experiment.	0.277
The eighth experiment.	0.341
The ninth experiment.	0.454
The tenth experiment.	0.120
The eleventh experiment.	0.240

For each of eleven experiments, results have showed that the data collected from each of the experimental groups is normal at the significance value p > 0.05.

Table 24: Normality Test for the Grades of the Control Groups

The researcher has used the Shapiro-Wilk Test to test the normality of the collected data, the grades (scores) of the control groups in this case.

Grades (scores) of the control groups	Level of significance at the significance level > 0.05
The first experiment.	0.537
The second experiment.	0.822
	0.526

	0.906
The third experiment.	0.240
	0.280
	0.113
The fourth experiment.	0.338
The fifth experiment.	0.427
The sixth experiment.	0.466
The seventh experiment.	0.237
	0.282
The eighth experiment.	0.252
The ninth experiment.	0.892
	0.989
	0.226
The tenth experiment.	0.893
	0.170
	0.971
The eleventh experiment.	0.371
	0.275
	0.598

For each of eleven experiments, results have showed that the data collected from each of the control groups is normal at the significance value $p > 0.05$. In conclusion, the grades of each of the experimental and control groups are normally distributed.

T-Tests

The paired t-test, also called the dependent t-test, is used to compare two means of the same person or group (Burhanna, 2020). The researcher has used the independent samples t-test to compare the grades of the students of the experimental group with their overall yearly grade average or their performance in other math topics.

The independent samples t-test, also called unpaired t-test, is used to compare the means of two independent given groups. The researcher has used the independent samples t-test to compare the grades of students of the experimental group with those of students in the control groups.

Table 25: Results of the First Experiment in an Independent Samples T-Test

An independent samples t-test was conducted to compare the grades averages of students in the third year secondary, section general sciences, in two public schools in Beirut in the lesson "conditional probability and random variables". Results of the independent samples t-test were displayed in table 25 as shown below.

Means (Averages) of the Groups Over 10	
Experimental Group	6.9028
Control Group	5.8611
Level of significance less than 0.05	0.049

Results have revealed a statistically significant difference in the experimental group grades (M = 6.9028, SD = 1.512543) and the control group grades (M = 5.8611, SD = 1.541634) conditions; $t(34) = 2.046$, $p = 0.049 <$ the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the control group in the lesson "conditional probability and random variables".

Table 26: Results of the Second Experiment in an Independent Samples T-Test

An independent samples t-test was conducted to compare the official exam grades averages of students in the third year secondary, section economics and sociology, in two classes in a public school in Beirut. Results of the independent samples t-test were displayed in table 26 as shown below.

Means (Averages) of the Groups Over 70	
Experimental Group	45.6154
Control Group	37.2963
Level of significance less than 0.05	0.008

Results have revealed a statistically significant difference in the experimental group grades (M = 45.6154, SD = 11.862805) and the control group grades (M = 37.2963, SD = 10.140607) conditions; $t(51) = -2.748$, $p = 0.008 <$ the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the control group in the official exam.

Table 27: Results of the Second Experiment in a Paired Samples T-Test

A paired samples t-test was conducted to compare students' yearly grade average with their third year secondary official exam grade average, section economics and sociology, in a public school in Beirut. Results of the paired samples t-test were displayed in table 27 as shown below.

Means (Averages) of the Groups Over 70	
Experimental Group Yearly Grade Average	36.1854
Experimental Group official Exam Grade Average	45.6154
Level of significance less than 0.05	0.000222

Results have revealed a statistically significant difference in the experimental group grade average (M = 36.1854, SD = 11.411118) and their official exam average (M = 45.6154, SD = 11.862805) conditions; $t(25) = -4.312$, $p = 0.000222 <$ the level of 0.05. These results have suggested that students' performance in the official exam ameliorated statistically and significantly compared to their performance in the school year.

Table 28: Results of the Third Experiment in an Independent Samples T-Test

An independent samples t-test was conducted to compare the grade average of students in the third year secondary, section economics and sociology, in one private school with the grades averages of students in three private schools in Beirut in the lesson "statistical distribution in two variables". Results of the independent samples t-test were displayed in table 28 as shown below.

Means (Averages) of the Groups Over 5	
Experimental Group	3.3438
First Control Group	2.4762
Second Control Group	2.6833
Third Control Group	2.4667
Level of significance less than 0.05	0.374
	0.006
	0.002

Results have revealed no statistical significant difference in the experimental group grades ($M = 3.3438$, $SD = 0.978413$) and the first control group grades ($M = 2.4762$, $SD = 0.935096$) conditions; $t(5) = 0.976$, $p = 0.374 >$ the level of 0.05.

These results have suggested that students in the experimental group performed better than those in the first control group despite no statistical significance.

Results have revealed a statistically significant difference in the experimental group grades ($M = 3.3438$, $SD = 0.978413$) and the second control group grades ($M = 2.6833$, $SD = 0.568321$) conditions; $t(44) = 2.905$, $p = 0.006 <$ the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the second control group.

Results have also revealed a statistically significant difference in the experimental group grades ($M = 3.3438$, $SD = 0.978413$) and the third control group grades ($M = 2.4667$, $SD = 0.827161$) conditions; $t(44) = 3.214$, $p = 0.002 <$ the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the third control group.

Table 29: Results of the Fourth Experiment in a Paired Samples T-Test

A paired samples t-test was conducted to compare students' grade average in the lesson "conditional probability and random variables" with their overall grade average in the third year secondary, section life sciences, in a private school in Beirut. Results of the paired samples t-test were displayed in table 29 as shown below.

Means (Averages) of the Groups Over 20	
Experimental Group Grade Average in the Lesson "Conditional Probability and Random Variables"	13.9130
Experimental Group Overall Grade Average	12.9565
Level of significance less than 0.05	0.043

Results have revealed a statistically significant difference in the experimental group grade average in the lesson "conditional probability and random variables" (M = 13.9130, SD = 2.810905) and their overall grade average (M = 12.9565, SD = 3.052246) conditions; $t(22) = 2.152$, $p = 0.043 <$ the level of 0.05.

These results have suggested that students' performance in the experimental group ameliorated statistically and significantly compared to their performance in the school year.

Table 30: Results of the Fifth Experiment in an Independent Samples T-Test

An independent samples t-test was conducted to compare the grade average of students in the third year secondary, section general sciences, in one public school with the grade average of students in a private school outside Beirut in the lesson "conditional probability and random variables". Results of the independent samples t-test were displayed in table 30 as shown below.

Means (Averages) of the Groups Over 10	
Experimental Group Grade Average	7.1522
Control Group Grade Average	5.0500
Level of significance less than 0.05	0.049

Results have revealed a statistically significant difference in the experimental group grades (M = 7.1522, SD = 1.536930) and the control group grades (M = 5.0500, SD = 1.765745) conditions; $t(36) = 2.038$, $p = 0.049 <$ the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the control group in the lesson "conditional probability and random variables".

Table 31: Results of the Sixth Experiment in an Independent Samples T-Test

An independent samples t-test was conducted to compare the grade average of students in the third year secondary, section economics and sociology, in a private school with the grade average of students in another private school in Beirut in the first part of the lesson "numerical sequences".

Results of the independent samples t-test were displayed in table 31 as shown below.

Means (Averages) of the Groups Over 5	
Experimental Group Grade Average	3.5313
Control Group Grade Average	2.9750
Level of significance less than 0.05	0.049

Results have revealed a statistically significant difference in the experimental group grades (M = 3.5313, SD = 0.956883) and the control group grades (M = 2.9750, SD = 0.673268) conditions; $t(34) = 2.046$, $p = 0.049 <$ the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the control group in the first part of the lesson "numerical sequences".

Table 32: Results of the Seventh Experiment in an Independent Samples T-Test

An independent samples t-test was conducted to compare the grade average of students in the third year secondary, section economics and sociology, in one private school with the grades averages of students in two private schools in Beirut in the second part of the lesson "numerical sequences".

Results of the independent samples t-test were displayed in table 32 as shown below.

Means (Averages) of the Groups Over 5	
Experimental Group	3.7031

First Control Group	3.1905
Second Control Group	3.2333
Level of significance less than 0.05	0.045 0.046

Results have revealed a statistically significant difference in the experimental group grades (M = 3.7031, SD = 0.791721) and the first control group grades (M = 3.1905, SD = 0.702250) conditions; t(35) = 2.082, p = 0.045 < the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the first control group in the second part of the lesson "numerical sequences".

Results have also revealed a statistically significant difference in the experimental group grades (M = 3.7031, SD = 0.791721) and the second control group grades (M = 3.2333, SD = 0.706904) conditions; t(44) = 2.059, p = 0.046 < the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the second control group in the second part of the "numerical sequences".

Table 33: Results of the Eighth Experiment in a Paired Samples T-Test

A paired samples t-test was conducted to compare students' grade average in the lesson "conditional probability and random variables" with their grade average in the other topics proposed in the midyear exam in the third year secondary, section life sciences, in a public school in Beirut.

Results of the paired samples t-test were displayed in table 33 as shown below.

Means (Averages) of the Groups Over 20	
Experimental Group Grade Average in the Lesson "Conditional Probability and Random Variables"	12.5952
Experimental Group Grade Average in the Other Topics in the Midyear Exam	11.1071
Level of significance less than 0.05	0.042

Results have revealed a statistically significant difference in the experimental group grade average in the lesson "conditional probability and random variables" (M = 12.5952, SD = 3.757057) and their grade average in the other topics in the midyear exam (M = 11.1071, SD = 3.453776) conditions; t(20) = 2.152, p = 2.168 < the level of 0.05.

These results have suggested that students' performance in the experimental group ameliorated statistically and significantly compared to their performance in the other topics proposed in the midyear exam.

Table 34: Results of the Ninth Experiment in an Independent Samples T-Test

An independent samples t-test was conducted to compare the grade average of students in the third year secondary, section economics and sociology, in one private school with the grades averages of students in one public school and two private schools in Beirut in the lesson "functions of economics and social sciences". Results of the independent samples t-test were displayed in table 34 as shown below.

Means (Averages) of the Groups Over 10	
Experimental Group	7.8281
First Control Group	5.6667
Second Control Group	6.5000
Third Control Group	7.840909
Level of significance less than 0.05	0.021
	0.046
	0.990

Results have revealed a statistically significant difference in the experimental group grades (M = 7.8281, SD = 1.752899) and the first control group grades (M = 5.6667, SD = 2.888719) conditions; t(26) = 2.458, p = 0.021 < 0.05. These results have suggested that students in the experimental group performed statistically better than those in the first control group in the lesson "functions of economics and social sciences".

Results revealed a statistically significant difference in the experimental group grades (M = 7.8281, SD = 1.752899) and the second control group grades (M = 6.5000, SD = 1.912132) conditions; t(31) = 2.076, p = 0.046 < 0.05. These results have suggested that students in the experimental group performed statistically better than those in the second control group in the lesson "functions of economics and social sciences".

Results also revealed no statistically significant difference in the experimental group grades (M = 7.8281, SD = 1.752899) and the third control group grades (M = 7.840909, SD = 3.244751) conditions; t(25) = -0.013, p = 0.990 > the level of 0.05.

These results have suggested that students' performance in the experimental group was near that of those in the third control group despite no significant association.

Table 35: Results of the Tenth Experiment in an Independent Samples T-Test

An independent samples t-test was conducted to compare the central exam grade average of students in the third year secondary, section economics and sociology, in one private school with the same central exam grades averages of students in three private schools in Beirut.

Results of the independent samples t-test were displayed in table 35as shown below.

Means (Averages) of the Groups Over 20	
Experimental Group	12.5469
First Control Group	12.6731
Second Control Group	12.0682
Third Control Group	10.5556
Level of significance less than 0.05	0.892
	0.691
	0.035

Results have revealed no statistically significant difference in the experimental group grades (M = 12.5469, SD = 2.516974) and the first control group grades (M = 12.6731, SD = 2.413902) conditions; t(27) = -0.137, p = 0.892 > the level of 0.05.

These results have suggested that students' performance in the experimental group was near that of those in the first control group but with no significant association.

Results have revealed no statistically significant difference in the experimental group grades (M = 12.5469, SD = 2.516974) and the second control group grades (M = 12.0682, SD = 3.696436) conditions; t(25) = 0.401, p = 0.691 > the level of 0.05.

These results have suggested that students' in the experimental group performed slightly better than those in the second control group but despite the lack of a statistically significant association.

Results have also revealed a statistically significant difference in the experimental group grades (M = 12.5469, SD = 2.516974) and the third control group grades (M = 10.5556, SD = 2.739358) conditions; t(32) = 2.197, p = 0.035 < the level of 0.05. These results have suggested that students in the experimental group performed statistically and significantly better than those in the third control group in the central exam.

Table 36: Results of the Eleventh Experiment in an Independent Samples T-Test

An independent samples t-test was conducted to compare the grade average of students in the third year secondary, section economics and sociology, in one private school with the grades averages of students in two public schools and one private school in Beirut in the lesson “simple interest, compound interest and annuities”. Results of the independent samples t-test were displayed in table 36 as shown below.

Means (Averages) of the Groups Over 10	
Experimental Group	7.4219
First Control Group	6.0900
Second Control Group	6.4250
Third Control Group	6.4318
Level of significance less than 0.05	0.012 0.062 0.030

Results have revealed a statistically significant difference in the experimental group grades (M = 7.4219, SD = 1.203186) and the first control group grades (M = 6.0900, SD = 1.763165) conditions; t(39) = 2.647, p = 0.012 < the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the first control group in the lesson "simple interest, compound interest and annuities".

Results have revealed no statistically significant difference in the experimental group grades (M = 7.4219, SD = 1.203186) and the second control group grades (M = 6.4250, SD = 1.758625) conditions; $t(34) = 1.932$, $p = 0.062 >$ the level of 0.05.

These results have suggested that students' in the experimental group performed better in the lesson "simple interest, compound interest and annuities" than those in the second control group despite no statistically significant association.

Results have also revealed a statistically significant difference in the experimental group grades (M = 7.4219, SD = 1.203186) and the third control group grades (M = 6.4318, SD = 1.416698) conditions; $t(36) = 2.262$, $p = 0.030 <$ the level of 0.05.

These results have suggested that students in the experimental group performed statistically and significantly better than those in the third control group in the lesson "simple interest, compound interest and annuities".

Chapter 5: Discussion, Conclusion, Future Directions and Recommendations

In this chapter, the research questions and the problematic situation were discussed and answered, results of this study were analyzed, conclusions were summed up, recommendations were provided and directions for future studies were set up

In the first phase of the study, the researcher examined the possibility of any statistically significant association between each of the independent variables (IV), the smartphones with a touch screen and the social media platforms, like WhatsApp and others, and each of the dependent variables (DP), students' math timed exams anxiety, behavior in class and competencies in the word problem solving domain in mathematics in the secondary public and private schools in Beirut.

In this phase, the data was collected through a modified and validated survey distributed to 1365 students in the secondary level who constituted a representative sample for the research population.

In the second phase of the study, regarding the problematic situation, the WhatsApp experiment was replicated by the researcher eleven times. The purpose of each experiment was examining the impact of employing WhatsApp on secondary students' mathematical performance in the problem solving and communication domain.

For a better analysis of all results, two math coordinators and three schools principals were interviewed. Each of these interviewees was asked to answer the questions according to his own perceptions and experience.

5.1. Answers of the First Interviewee

According to the first interviewee, feeling nervous before math exams is normal, but feeling anxious about it can detriment one's performance. Feeling anxious can affect any student in the middle school, the secondary level and higher education. It can even affect the performance of an employee who has to apply for an exam to ameliorate his post in work.

It is no strange to have a statistically significant association between the smartphones with a touch screen and the social media platforms, like WhatsApp and others, from one side and students' math timed exams from another side.

Many students are spending too much time using the smartphones with a touch screen and the social media platforms for meaningless activities after their day in school instead of employing them for learning or dedicating enough of that time for their studies, homework and exams.

After school, students should allocate enough time to study and be prepared for their exams. They have to solve old and new exercises so that their memory can keep on working adequately.

Instead of using Google, their smartphones or social media to find new exercises that may help them performing better in an upcoming exam, they are chatting, commenting, sending and receiving images and videos just because they adore doing so.

Additionally, instead of planning how to study for their math timed exams, many prefer to spend their time on social media on a daily basis. As a result, they find themselves out of time to prepare for the exam.

More importantly, many spend too much time on their social media and leave so little of it to study for their math timed exams. They just study during the day that precedes the exam without realizing that compressing all of these information does not help their working memory. Many of them forget too many formulas during the exam simply because the brain does not work this way to retain the information.

Regarding students' behavior in class, it has gradually changed since the introduction of the social media. Our students started seeing how others act in a diversified list of countries. In turn, standards, regulations, ethics, values and respect started to fall apart.

Nowadays students are not the same ones who used to sit in our classes. Many of them talk and laugh in class even if the teacher was explaining a new lesson, something that was not common among students in the past decades.

Even more, social media has become a blessing for many students because it enables them copying their homework from their colleagues to present it to the teacher in class.

During the learning sessions, many students find themselves thinking about what is going on with their social media instead of focusing on the material presented in class. They lose their concentration simply because this material is not interesting for them as much as the fun they usually have with their social media.

In here, lies a huge problematic situation. The learning sessions are not fun for many students because social media is the one that embodies what fun is. So, how can we insert fun into the teaching and learning process to gain our students' attention and ameliorate their performance in the exams?

Regarding students' competencies in the word problem solving, many students do not have enough time to sleep because they stay online till late times of the night. As a result, they cannot concentrate adequately in class and they might take a nap during the learning sessions because their brain is not well functioning properly.

They aren't capable of understanding what the teacher is saying in class and don't spare enough time after school to properly review what was presented in class. For that, many cannot understand the given content of a word problem exercise proposed in the exam, organize it, analyze it, interpret the outcomes or even be sure of the results.

When it came to replicating the WhatsApp experiment, the interviewee here implemented a similar one based on his experience in teaching and perceptions. The interviewee combined the YouTube with the interactive features of the WhatsApp platforms to teach the lesson "statistics" for students in grade 9.

The lesson was explained through tutorial videos uploaded on YouTube after which students asked their questions through a WhatsApp group at a synchronic time. During a week and after making sure that every student watched the videos and asked his questions, the interviewee started sending and correcting assignments through the WhatsApp group.

The experiment was culminated with an online exam at a predetermined time. Some students failed the test, many of them performed moderately but better than they usually do, while others scored high marks. All in all, 80% of the students successfully passed the online exam.

Despite not investigating why some students failed the exam, the interviewee was completely satisfied with replacing the traditional teaching with a one provided by the YouTube videos and the WhatsApp platform.

Regarding replicating the experiment by other teachers, it can be done under two conditions. The teacher and his students have to have the will to take the teaching and learning process one notch up, otherwise they are wasting their time.

We have to understand that technology is a wonderful creation. It wipes the old rotted routine implanted in the teaching and learning process, and breath a new life into it. The content presented differently because of the technology can intrigue the students and they may even be mesmerized by it.

The proper employment of the social media platform can spread the spirit of collaboration among the students. They can learn how to share useful information and be creative in finding new resources that benefit their learning. Thus, integrating social media in the curriculum should concentrate on developing students' creativity and research skills on a regular basis, otherwise it is doomed to failure from the start.

More importantly, if it happens and students started looking at their social media differently, the teacher cannot be replaced. His role will for sure change, and the responsibility of teaching won't lay on his shoulders anymore because his students will have to share it with him. He can still teach them as he used to inside the class and guide them in employing social media in researches outside it.

5.2. Answers of the Second Interviewee

The second interviewee was not surprised that there were statistically significant associations between the smartphones with a touch screen and the social media platforms, like WhatsApp and others, and students' math timed exams anxiety, behavior in class and competencies in the word problem solving.

According to him, students are wasting most of their time on social media and brands developed specifically for games. Despite social media being a major factor that can explain students' math timed exams anxiety, the way they behave in class and their inabilities in planning, organizing, interpreting, validating, shifting and analyzing, there are many others we can rely on to understand what is happening with our students after school.

Many students don't practice on their competencies at home. They are ignorants when it comes to employing social media for the benefit of their learning. The time they spend in school is more than enough for them, thus they can't imagine themselves studying through their social media.

These smartphones and social media platforms have taken control of everyone's life, including the students. For many of them, why should they waste time studying through their social media while they can use it to relax and have fun time after school? Why can't they copy others' behavior in the class and outside it?

Here we have to stop and ask ourselves how to convince this generation of students to employ social media for the benefit of their learning. Is it possible that all students can look at their social media differently?

Can they have the ability to use it for fun and employ it for learning when they should do so? Can they distinguish between inacceptable and acceptable behavior in class?

As long as our students are wasting their time after school on their social media, their math timed exams anxiety won't reduce, their behavior in class won't get better, and their inabilities in the word problem solving won't ameliorate.

Replicating the WhatsApp experiment can be done with many conditions. Beside the need of a good internet connection, students should participate completely and be fully committed. The teacher has to have the will to leave his old washed up teaching methods, integrate the interactive features of the social media platforms in his teaching, and collaborate online with his students.

So, integrating social media in the upcoming advanced curriculum is a must. Why? Because despite the massive development in technology, we are just at the beginning of a new era. Social media will be integrated in the curriculum whether the teachers like it or not and this can be done through different ways.

The flipped classroom is the first to come in mind when it comes to integrating social media in the curriculum. Assigning those who are aware of its benefit in teaching and those who had successfully experimented it in teaching is a must to come up with an advanced curriculum, otherwise we will remain stuck in the inertia of teaching.

5.3. Answers of the Third Interviewee

The third interviewee was surprised that the percent revealed by the multiple regression analysis weren't higher. According to her, students are addicted to their social media. In the school where she teaches, students are allowed to check their smartphones in between the sessions, and believe it or not most of them cannot wait for the session to end just to check the WhatsApp and other platforms.

These platforms have become part of their identities. Through them, they can connect with others and reflect on different topics according to their ways of thinking. More notably, they remain detached from reality for as long as they wish so.

What are the consequences of the aforesaid? Many students are neglecting their studies, don't dedicate enough time to study, cannot focus in class, and are unable to build their knowledge and become competent in mathematics as possible as they should be.

To make things worse, parents are not doing what they are supposed to do. They do not set up time limit or standards for using social media. They are not trying to enlighten their children about the negatives of social media and the attributes of its proper employment in learning. Why? Maybe they themselves do not know that.

Additionally, due to the inacceptable amount of time spent on social media outside the school, many students became hard to deal with inside the class. They don't concentrate with the teacher during the session simply because the smartphones locked in the locker interest them more than the material presented in class.

Beside the aforementioned negatives, social media is very beneficial for teaching and learning. As long as the teacher is willing to change and his students are ready to participate seriously, then the WhatsApp experiment can be replicated by anyone.

Add to that, social media should be integrated in the upcoming advanced curriculum. We cannot keep on teaching in the same way were are doing now forever. We cannot ignore the presence of social media, we have to embrace it and integrate it in the curriculum.

How is that possible? School time can be reduce. The teacher can teach regularly during that time and continue his sessions in the afternoon. Lesser time in school will be a relief for both students and teachers.

Students won't be sitting in class for too much time and they can continue their learning from their home for no more than two sessions. Many will embrace this way, especially the high achievers who are willing to experiment new teaching approaches to acquire more information and construct their knowledge.

5.4. Answers of the Fourth Interviewee

The fourth interviewee was not surprise about the statistically significant association between each of the independent variables and each of the dependent variables. According to her, times have changed. Smartphones and social media have imposed their presence among us whether we like it or not, and it is up to us to be aware of their negatives and invest their features for our benefits.

Many factors can contribute to students' math timed exams anxiety, behavior in class and their lack of competencies. Smartphones and social media might very well be one of these leading factors.

Students have been devoting too much time for their social media. The connection provided by their social media enables them to detach from their reality and present their personality to others in the way they see fit.

Of course this does not apply to all students. Some still prioritize their studies, while others do the opposite. This is why the percent revealed by this study are quite reasonable.

Now speaking of the positive attributes, the WhatsApp experiment can be replicated under many conditions. Teachers have to be aware of using the WhatsApp features in teaching, while students have to be as responsible as their teachers and ready to participate so that their performance becomes better in math exams.

Social media cannot replace the traditional teaching we have grown accustomed to. Despite that, it is excellent in transforming it. This is why it failed during the Corona virus crisis. We have to integrate it in the curriculum in a way that can help revolutionize our educational system.

We can either use social media or integrate it in the curriculum. Using social media could be like asking students to prepare a simple project on their own. On the other hand, integrating it could be the result of sending them instructions and sources they can rely on for interaction and cognitive collaboration, just like with the flipped classrooms.

5.5. Answers of the Fifth Interviewee

The final and fifth interviewee expected higher percent. Though, he admitted that other factors could play their role in explaining students' math timed exams anxiety, behavior in class and lack of competencies in not only the word problem solving domain but also in other math domains.

Factors like the games' brands, online games, teachers' practices, type of the school and students' social status. Despite these factors, we cannot neglect the fact that many students are building their own reality on their social media platforms and networking sites through which they can flee, leave their reality behind them and immerge themselves in a digital world that comforts them.

They are ok with doing so without realizing that the time they spend liking, chatting, commenting, sending and receiving can be associated with their anxiety. They are copying others' behavior just because they are cool. Too much time devoted for social media won't leave them what is enough to practice on their competencies.

Despite that, when students are motivated, they can change all of that negativity into a positivity. When they find themselves collaborating with a well-qualified teacher, they will realize their weaknesses and start working on improving their performance in math exams.

Teachers' methods, techniques and knowledge in their subject material are essential elements for any social media experiment to be successful. Their patience, knowledge of the weaknesses and strengths of their students, and abilities to propose multiple solutions that suit students with different needs are a must, otherwise the experiment is destined for failure.

For that, integrating social media in the curriculum requires many changes. Teachers have to teach less in class and complete the learning sessions at home. Those who are assigned for the construction of the newly advanced curriculum should prepare PowerPoint presentations and Tutorial videos for teachers to use inside the class and outside it. Through the social media platforms/networking sites, teachers can send these presentations and videos for students to prepare at home prior to the learning sessions.

This has the same concept of the flipped classroom. This way, the teacher is not pressured, and his students can read a content written in a professional way through which they can start analyzing and preparing their questions for the next day.

In a final step, from the answers of each interviewee, the researcher has extracted the sentences that enabled him a better analysis the results of both phases.

The first question in the interview was about students' math timed exams anxiety. The second question in the interview was about students' behavior in class. The third question in the interview was about students' competencies in the word problem solving domain.

The fourth question in the interview was about replicating employing the WhatsApp experiment by others, while the fifth and final question in the interview was about integrating social media in the upcoming advanced curriculum.

Table 37: Significant Sentences for the Analysis of the Results

Table 37: Significant Sentences for the Analysis of the Results

	Students' math timed exams anxiety	**Students' behavior in class**	**Students' competencies in the word problem solving domain**	**Replicating employing the WhatsApp experiment by others**	**Integrating social media in the upcoming advanced curriculum**
The first interviewee	Not enough time to properly study	Copying others' behavior	No focus in class and not enough time to sleep and review the content presented in class earlier	Depends on the will of the teachers and the students	Should concentrate on developing students' creativity and research skills

The second interviewee	Not enough time to properly study	Copying others' behavior	Not enough time to practice after school	Depends on the teachers' will to collaborate with his students online, their complete participation and full commitment.	Can be done through the flipped classrooms
The third interviewee	Inacceptable time spent on social media	Inacceptable time spent on social media	Inacceptable time spent on social media	Depend on teachers' will to change and students' serious participation	Can be done by reducing the time in school and continuing the learning sessions in the afternoon
The fourth interviewee	Too much time spent on smartphones and social media	Too much time spent on smartphones and social media	Too much time spent on smartphones and social media	Teachers awareness of using the social media interactive features in teaching, and students' readiness for a complete participation	Can be done through instructions and sources students can rely on for interaction and cognitive collaboration

The fifth interviewee	Not enough time to prepare for the exam because of the time spent on social media	Copying others' behavior	Not enough time to work on the competencies because of the time spent on social media	Depends on teachers' methods, techniques, patience, knowledge of their subject material, ability to propose multiple solutions that suit students with different needs, and their knowledge of students' weaknesses and strengths	Can be done through the flipped classroom concept with PowerPoint presentations and videos tutorials

The significant sentences extracted from the five interviewees were place in the table 37 as shown above.

5.6. Analysis of the Results

5.6.1. students' math timed exams anxiety. According to the results of this study, 85.9% of the students who constituted the sample of the study spend more than two hours using their smartphones every day.

95.5% use them to send and receive messages, 96.6% to surf the internet, 92.9% to access their social media platforms and applications, 34% to play games, 72.8% to watch all kinds of videos, 94.6% to call others, while 73.1% check their readiness day and night even if there were no notifications or conversations.

The 34% associated with using the smartphones to play games like Fortnite and PUBG is the lowest among others. These games require a high-tech smartphone, something not everyone has, especially middle class students in the society.

Even more, 81.7% use their social media platforms, like WhatsApp and others, for more than two hours every day. 86.2% believe that the social media platforms have become part of their daily routine activity, 76% feel that they need to check these platforms, every then and now, 59% would feel sorrows if they were shut down, 33.7% can neglect studying and doing their homework in favor of using their platforms, 89.3% always stay connected with their friends thanks to their platforms, 85.1% use them to chat, blog and comment, while 88% use them to send and receive images and videos.

These high percent have shown that the secondary students in Beirut who constituted the sample of this study spend too much time on their smartphones and social media platforms every day; and according to the literature in this dissertation, the lengthy and frequent usage of these smartphones and social media platforms is associated with humans' anxiety.

Being a type of anxiety, there was a possibility that students' math timed exams anxiety could be statistically and significantly associated with these smartphones and social media platforms.

According to the results of this study, 47.3% of these students cannot focus on anything before their math exam, 50% are anxious at its start, 47.8% are not relaxed during it, 42.7% feel that they are unable of thinking and recalling things.

64.5% panic if they weren't capable of remembering the required equation(s), rule(s) or formula(s), 58.6% ask themselves if they can succeed, and 80% pay attention to their mistakes and know answers to questions they left after they submit the math exam paper to the teacher.

The 80% associated with paying attention to mistakes and knowing answers to questions after submitting the math exam paper to the teacher is the highest among all others.

This is due to the fact that math anxiety forbids many of us from using many resources to complete a math exam by affecting our working memory ability (Passolunghi et al., 2016)

Results of this study has revealed a statistical significant association between each of the smartphones with a touch screen and social media platforms, like WhatsApp and others, and students' math timed exams anxiety.

With the exception of few cases, results have also revealed a statistically significant association between each item of these smartphones and social media platforms, and each item of students' math timed exams anxiety.

These percent and the statistically significant associations were not enough. Since the social media platforms are embedded in the smartphones with a touch screen, it was essential to determine the percent that could explain students' math timed exams anxiety due to these two independent variables.

Results have revealed that 24.9% of students' math timed exams anxiety could be explained due to these smartphones and social media platforms; and based on the interviewees' answers, the frequent and longitudinal usage of these smartphones and social media platforms was the main reason that explained such percent.

The interviewees were not astonished with such association, however they expected a higher percent due to the imposing presence of these smartphones and social media platforms on the society.

According to the literature, students' math anxiety could be explained due to other factors like teachers' practices, social status, type of school and parents' education level (Allen, 2001; Shehayeb & Anouti, 2018).

Therefore, despite the existence of other factors, this percent meant that about one quarter of students' math timed exams anxiety could be explained due to the sturdy presence of the smartphones and social media platforms, and the time wasted in commenting, calling, sending and receiving.

5.6.2. students' behavior in class. According to the results of this study, 64.7% of these students sometimes talk to their classmates even if the teacher was explaining the lesson, 37.6% avoid doing the tasks assigned during the class.

46.3% copy their homework from their friends through their social media to present it to their teachers, 46.7% might sleep during their learning sessions, and 68.7% can laugh in class even if the teacher is explaining the lesson.

22.5% can argue with their teachers even if they were mistaken, 72.4% sometimes don't concentrate in classes, and 58.4% sometimes do not pay attention to the lessons displayed on the board in class.

The 22.5% associated with students arguing with their teachers even if they were mistaken is the lowest among others. This could be explained due to students' belief that most teachers refuse to argue with any student even if the latter was right, as believed by 181 students among 214 respondents in the online survey below.

Do you think that most teachers refuse to argue with any student even if the latter was right?	
Yes	(181, 84.6%)
No	(33, 15.4%)
Total	(214, 100%)

Additionally, the 72.4% associated with students' inability to concentrate in class at some times is the highest among others. This is due to the fact that using these smartphones and social media platforms reduces our concentration ability because we are constantly distracted with what might be happening in the digital world (Budd, 2017).

According to the literature in this dissertation, the lengthy usage of these smartphones and the social media platforms negatively affects humans' behavior.

Results of this study have revealed a significant association between each of the smartphones with a touch screen and social media platforms, like WhatsApp and others, and students' behavior in class.

Results have also revealed a statistically significant association between each item of these smartphones and social media platforms, and each item of students' behavior in class.

These percent and the statistically significant associations were not enough. Since the social media platforms are embedded in the smartphones with a touch screen, it was essential to determine the percent that could explain students' behavior in class due to these independent variables.

Results have revealed that 36% of students' behavior in class could be explained due to these smartphones and social media platforms; and based on the interviewees' answers, copying others' behavior and using these smartphones and social media platforms for too much time were the main reasons that explained such percent.

According to the literature, students' behavior in class could be explained due to other factors like the status of the family, the desire to be in class, the social environment, teachers' practices and ways of communication (Şentürk, 2018).

Therefore, regarding students' behavior in class, this percent meant that more than one third of this behavior could be explained due to the imposing presence of the smartphones and social media platforms, and the time wasted in commenting, calling, sending and receiving.

5.6.3. students' competencies in the word problem solving domain in mathematics. According to the results of this study, 53.9% of these students cannot plan and organize the given content of a math word problem, 57.4% fail to analyze a math word problem exercise.

38% do not know how to translate the content, 49% fail at extracting relevant information from the content, 38.1% cannot explain in details the given, 42.5% cannot shift from one mode of representation to another. 50.7% cannot choose an adequate model, 44% cannot validate the results, and 55.3% usually fail in interpreting them.

Our learning can be affected by many factors like teachers' practices and absenteeism (Bauer, 2019). Add to them, according to the literature in this dissertation, it can also be negatively affected by the lengthy usage of the smartphones with a touch screen and the social media platforms.

Results of this study have revealed a significant association between each of the smartphones with a touch screen and social media platforms, like WhatsApp and others, and students' competencies in the word problem solving domain in mathematics.

With the exception of few cases, results have also revealed a statistically significant association between each item of these smartphones and social media platforms, and each item of students' competencies in the word problem solving domain.

These percent and the statistically significant associations were not enough. Since the social media platforms are embedded in the smartphones with a touch screen, it was essential to determine the percent that could explain students' inability in planning, organizing, analyzing, extracting, explaining, shifting, choosing, validating and interpreting due to these independent variables.

Results have revealed that 25.6% of students' unpossessed competencies in the word problem solving domain in mathematics could be explained due to these smartphones and social media platforms.

Based on the interviewees' answers, students are not focusing enough in class. They are not sleeping sufficiently. They are not reviewing adequately the content presented in class earlier nor practicing as they should be after schools simply because they are spending too much time on their smartphones and social media platforms after their day in school.

Students are delaying studying. Since many of them cannot resist their smartphones and social media platforms, then they will give up resisting and start texting, listening to music, calling and playing games (Jan Benitez, 2016).

Two reasons lay behind this. First because these features are more intriguing than studying, and second because short term rewards are more favorable for many people than the long term achievements (Jan Benitez, 2016).

Mostly, we reap the benefits of studying and accomplish our goals after graduation, while socializing with others in a digital environment takes minutes (Jan Benitez, 2016).

In all cases, students' lengthy usage of their social media seems to have a negative effect on their grades. Many admitted performing less in class and suffering a decline in their grades because they are devoting too much time to their social media (Rouis, Limayem & Salehi-Sangari 2011).

As a result, many of them became constantly distracted, which in turn lessened their concentration. Their time is consumed and they are unable to quit signing in even if there is no reason to log in. They love using it to stay in contact with everyone, share images, upload videos, comment on others' profiles, engage in lengthy discussions, and expand their bridge of friendships digitally (Rouis, Limayem & Salehi-Sangari 2011).

Of course this does not apply to all students. The "conscientious and open students" are those who are aware of how important it is to perform in class and exams at higher levels. They can organize their time after school on their own, control themselves, multitask when they need to do so and they are willing to try anything new to perform better (Rouis, Limayem & Salehi-Sangari 2011).

On the other hand, the "agreeable/extraverted students" are those who enjoy their time and need to be socially satisfied. Thus, they are more likely to log in to their social media constantly and spend too many hours on their leisure activities (Rouis, Limayem & Salehi-Sangari 2011).

They are entertained discussing, accepting invitations for more friendships, leading groups and sharing others with their interest and ideas even if they have never met them in real life. As a result, their learning is most likely to suffer and their grades are destined to decline (Rouis, Limayem & Salehi-Sangari 2011).

For the aforementioned reasons, one quarter of students' unpossessed competencies could be explained due to the imposing presence of these smartphones and platforms, and the time wasted in commenting, calling, sending and receiving.

5.6.4. students' performance at the end of the whatsapp experiment.

According to the results of this study, in most cases, there was a statistically significant difference between the means of the experimental and control groups.

The WhatsApp experiment has leaned on four of components of Bruner's scaffolding and the deliberate practice: students' active engagement through motivation, the repetition, the retention and the consolidation.

Engaging students in learning positively influences their thinking. They start to pay more attention, and their concentration increases as a result of that.

Through active learning, meaningful discussions between the students and their teachers can add to their curiosity and encourage them to participate and engage even more (Tuan, 2020).

Repetition is a self-technique and can also be taught by others. It is very important in learning because it reinforces students' performance (Gibson et al., 2020). It is the most familiar way used in learning by many. It creates a long term memory and enables us memorizing for longer periods by eliciting strong chemical interactions at the synapse of humans' neuron (Schmelzer, 2015).

Retention is about retrieving the information from the long term memory. The stored information are ready to use in response to solving given problems in different contexts (Bennett & Rebello, 2020).

Consolidation is similar to revision. It takes place at the end and serves as a reminder for the learners and a clearance for any doubts. Through consolidation, materials are reviewed and retained. Thus, through consolidation, learning is reinforced implicitly (Done et al., 2020).

Deeper learning has always been positioned as a priority in any curriculum. It is about motivating students and making sure they have fully understood to retain their knowledge and use it in new context whenever they need to do so (Saaris, 2017).

The brain's medial prefrontal cortex (MPC) is associated with the long term memory (Figure 26). Specific neuron groups in this region help collecting and storing multiple relevant information acquired from experiences (Packer, 2017), like the WhatsApp experience here.

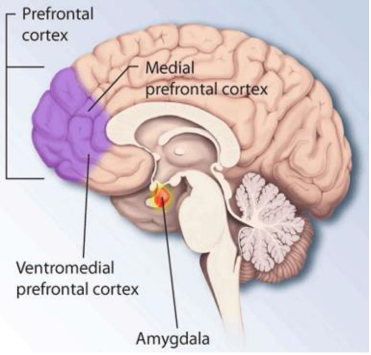


Figure 26 : The Medial Prefrontal Cortex (Packer, 2017).

Through the WhatsApp experiment, students were motivated and actively engaged with each other and the researcher. Similar exercises were repeatedly solved for the benefits of serving their long term memory.

New exercises were solved for students to retain their already acquired knowledge and use in new contexts. Finally, long term memory consolidation was used at the final stage of each experiment to erase students' doubts and cement their learning prior to each validated exam.

For the aforementioned reasons, in most cases, students of the experimental groups performed higher than those of the control groups.

5.7. Answering the First Research Question: Is there a statistically significant association between the smartphones with a touch screen and students' math timed exams anxiety in the secondary level in the private and public schools in Beirut?

The sample constituted for the first phase of the study represents the secondary students in eighteen secondary public and thirty one secondary private schools in Beirut.

According to the results of the first phase of the study in chapter 4, there is a statistically significant association between the smartphones with a touch screen and students' math timed exams anxiety in the sample of 1365 secondary students.

Since this sample represents the secondary students in these 18 secondary public schools and 31 secondary private schools, then the researcher can extend his research findings and conclude that it is statistically probable (Langstraat, 2020) that there is a statistically significant association between the smartphones with a touch screen and students' math timed exams anxiety in the secondary level in these schools.

Additionally, results of chapter 4 conform to those of the previously mentioned researchers outside Lebanon, the likes of Amelia Strickland (2014), Almu and Buhari (2014), Johnson (2015), Charles (2016), Maher (2017), Carr (2017), Vahedi and Saiphoo (2018), Carlson (2018) and Zipp (2018), who dedicated many of their studies to the smartphones with a touch screen and humans' anxiety.

5.8. Answering the Second Research Question: Is there a statistically significant association between the smartphones with a touch screen and students' behavior in class in the secondary level in the private and public schools in Beirut?

The sample constituted for the first phase of the study represents the secondary students in eighteen secondary public and thirty one secondary private schools in Beirut.

According to the results of the study in chapter 4, there is a statistically significant association between the smartphones with a touch screen and students' behavior in class in the sample of 1365 secondary students.

Since this sample represents the secondary students in these 18 secondary public schools and 31 secondary private schools, then the researcher can extend his research findings and conclude that it is statistically probable (Langstraat, 2020) that there is a statistically significant association between the smartphones with a touch screen and students' behavior in class in the secondary level in these schools.

Additionally, results of chapter 4 conform to those of the previously mentioned researchers outside Lebanon, the likes of Selvaraj (2013), Almu and Buhari (2014), Lee (2015), Grant, Tamim, Brown, Sweeney and Ferguson (2015), Fager (2017), Maher (2017), Vahedi and Saiphoo (2018) and Hossain (2019), who dedicated many of their studies to the smartphones with a touch screen and humans' behavior.

5.9. Answering the Third Research Question: Is there a statistically significant association between the smartphones with a touch screen and students' competencies in word problem solving in the secondary level in the private and public schools in Beirut?

The sample constituted for the first phase of the study represents the secondary students in eighteen secondary public and thirty one secondary private schools in Beirut.

According to the results of the study in chapter 4, there is a statistically significant association between the smartphones with a touch screen and students' competencies in word problem solving in the sample of 1365 students in the secondary level.

Since this sample represents the secondary students in these 18 secondary public schools and 31 secondary private schools, then the researcher can extend his research findings and conclude that it is statistically probable (Langstraat, 2020) that there is a statistically significant association between the smartphones with a touch screen and students' competencies in word problem solving in the secondary level in these schools.

Additionally, results of chapter 4 conform to those of the previously mentioned researchers outside Lebanon, the likes of Kuppuswamy and Narayan (2010), Kraushaar and Novak (2010), Dunn (2011), Wood, Zivcakova, Gentile, Archer, De Pasquale and Nosko (2012), Almu and Buhari (2014), Goundar (2014), Strickland (2014), Fager (2017), Bangera (2018), Carlson (2018), Zipps (2018) and Hossain (2019), who dedicated many of their studies to the smartphones with a touch screen and humans' learning.

5.10. Answering the Fourth Research Question: Is there a statistically significant association between the social media platforms, like WhatsApp and others, and students' math timed exams anxiety in the secondary level in the private and public schools in Beirut?

The sample constituted for the first phase of the study represents the secondary students in eighteen secondary public and thirty one secondary private schools in Beirut.

According to the results of the study in chapter 4, there is a statistically significant association between the social media platforms, like WhatsApp and others, and students' math timed exams anxiety in the sample of 1365 secondary students.

Since this sample represents the secondary students in these secondary 18 public schools and 31 private schools, then the researcher can extend his research findings and conclude that it is statistically probable (Langstraat, 2020) that there is a statistically significant association between the social media platforms, like WhatsApp and others, and students' math timed exams anxiety in the secondary level in these schools.

Additionally, results of chapter 4 conform to those of the previously mentioned researchers outside Lebanon, the likes of Rouis, Limayem, and Salehi-Sangari (2011), Almu and Buhari (2014), Johnson (2015), Maher (2017), Anwar and Shah (2018), Carlson (2018), Hughes (2018), Zipps (2018), and Bhoite, Patil and Patil (2019), who dedicated many of their studies to the social media platforms and humans' anxiety.

5.11. Answering the Fifth Research Question: Is there a statistically significant association between the social media platforms, like WhatsApp and others, and students' behavior in class in the secondary level in the private and public schools in Beirut?

The sample constituted for the first phase of the study represents the secondary students in eighteen secondary public and thirty one secondary private schools in Beirut.

According to the results of the study in chapter 4, there is a statistically significant association between the social media platforms, like WhatsApp and others, and students' behavior in class in the sample of 1365 secondary students.

Since this sample represents the secondary students in these 18 secondary public schools and 31 secondary private schools, then the researcher can extend his research findings and conclude that it is statistically probable (Langstraat, 2020) that there is a statistically significant association between the social media platforms, like WhatsApp and others, and students' behavior in class in the secondary level in these schools.

Additionally, results of chapter 4 conform to those of the previously mentioned researchers outside Lebanon, the likes of Rouis, Limayem, and Salehi-Sangari (2011), Almu and Buhari (2014), Jessica Schulz (2015), Lee (2015), Siddiqui and Singh (2016), Maher (2017), Anwar and Shah (2018), Hughes (2018), Bhoite, Patil and Patil (2019), Hossain (2019), who dedicated many of their studies to the social media platforms and humans' anxiety.

5.12. Answering the Sixth Research Question: Is there a statistically significant association between the social media platforms, like WhatsApp and others, and students' competencies in word problem solving in the secondary level in the private and public schools in Beirut?

The sample constituted for the first phase of the study represents the secondary students in eighteen secondary public and thirty one secondary private schools in Beirut.

According to the results of the study in chapter 4, there is a statistically significant association between the social media platforms, like WhatsApp and others, and students' competencies in word problem solving in the sample of 1365 secondary students.

Since this sample represents the secondary students in these 18 secondary public schools and thirty one secondary private schools, then the researcher can extend his research findings and conclude that it is statistically probable (Langstraat, 2020) that there is a statistically significant association between the social media platforms and students' competencies in word problem solving in the secondary level in these schools.

Additionally, results of chapter 4 conform to those of the previously mentioned researchers outside Lebanon, the likes of Kraushaar & Novak (2010), Kuppuswamy and Narayan (2010), Dunn (2011), Rouis, Limayem, and Salehi-Sangari (2011), Wood, Zivcakova, Gentile, Archer, De Pasquale and Nosko (2012), Almu and Buhari (2014), El-Badawy and Hashem (2015), Jessica Schulz (2015), Siddiqui and Singh (2016), Carlson (2018), Zipps (2018) and Hossain (2019), who dedicated many of their studies to the social media platforms and humans' learning.

5.13. Answering the Problematic Research Question: What is the impact of the proper employment of the WhatsApp platform, via its interaction features and collaborative learning, on students' mathematical performance, through their grades, in the problem solving and communication domain in the secondary level?

Based on the results of chapter 4, the researcher has concluded that students' mathematical performance was statistically and significantly reinforced in the problem solving and communication domain in the secondary level through collaborative learning and via the interaction features of the WhatsApp platform.

Additionally, results of chapter 4 conformed to those of the previously mentioned researchers outside Lebanon, the likes of Corbeil and Valdes-Corbeil (2007), Dunn (2011), Gikas (2011), Greenhow (2011), Ward (2013), Daraei (2015), Muller (2016), Albalawi (2017), Orlanda-Ventayen and Magno-Ventayen (2017), Balalle (2018), and Bhoite, Patil, and Patil (2019), who called for employing social media in education and experimented it according to how it was possible.

Despite that, the aforementioned results cannot be generalized because the WhatsApp experiment should be repeated multiple times on a larger scale number of students in different classes and levels.

More importantly, employing the WhatsApp platform through Engström's third generation system of activities that consists of rules, community, division of labor, subject, object, outcomes and tool turned out to be effective and not efficient because it requires students' full participation and complete commitment. It also requires from the teachers, skills, as in tagging, replying and sending voice notes as fast as they can to keep on going otherwise many students will lose interest, time, effort, patience, in-depth knowledge in this mathematical domain, character and promptitude.

Engström's third generation system of activities enabled the researcher identifying the WhatsApp platform as the tool, dividing the students into WhatsApp groups, setting the rules, assigning the summaries and tasks in the division of labor according to Bruner's scaffolding and the deliberate practice, and identifying the learner as the subject, the motive as the object and reinforcing students' mathematical performance in the problem solving and communication domain as the outcome of the learning experiment.

However, reinforcing students' mathematical performance in the aforesaid domain by reinventing the mathematical landscape of the aforementioned domain through the WhatsApp social media platform was not an easy task to accomplish and it is not "la vie en rose" when it comes to this point contrary to what was mentioned by previous researchers in the literature of this dissertation because of the lack of a well-designed curriculum, teachers' practices inside their classes, teachers' refusal to use or integrate social media in their teaching methods, teachers' loaded schedules, students' strong and inadequate bounding with their social media, students' inability to learn at the same pace, and students' lack of competencies in the problem solving and communication domain, factors that were not mentioned by many previous researchers but were determined by the research modified and validated survey, the exploratory work, the interviewees and the eleven non-randomized experiment.

Therefore, reinforcing students' mathematical performance through Engström's third generation system of activities and the WhatsApp social media platform is not doable by all teachers because of the aforementioned factors.

5.14. Accepting the Research Hypotheses

According to results of chapter 4, there is a statistically significant association between each of the independent variables, the smartphones with a touch screen and the social media platforms, like WhatsApp and others, and each of the dependent variables, students' math timed exams anxiety, behavior in class and competencies in the word problem solving in the secondary level.

In addition, in most cases, there was a statistically significant difference between the means of each of the experimental groups and each of the control groups.

For that, the researcher has accepted the seven hypotheses H1, H2, H3, H4, H5, H6, and H7 related to the first and second phases of the study.

5.15. Directions for Future Studies

Regarding Students' Math Timed Exams Anxiety, Behavior in Class and Competencies

Results of the study have revealed that the smartphones and the social media platforms, like WhatsApp and others, are statistically and significantly associated with students' math timed exams anxiety, behavior in class and competencies in the word problem solving in the secondary level.

Future studies should be dedicated to examining that association in other regions with different representative samples of secondary students. In this way, it is possible to construct a theory, or even more than one, regarding the effect of the smartphones and the social media platforms on students' math timed exams anxiety, behavior in class and competencies in the word problem solving in the secondary level.

Additionally, future studies should be dedicated to examining the possible statistically significant associations between each of the smartphones with a touch screen and the social media platforms, like WhatsApp and others, and students' math timed exams anxiety, behavior in class and competencies in the word problem solving in mathematics, or any other one, on the micro level.

Meaning that, studies should be dedicated to examining these associations according to the type of the school, private or public, the levels and the classes, which in turn may lead to examining other factors.

Regarding Taking Advantage of Students' Bounding with their Smartphones and Social Media Platforms in Learning Mathematics

Over the years, usage of the smartphones and the social media platforms became a dominant fact that imposed itself on many people. According to the results of this study, this usage is also dominant among students in the sample of 1365 secondary students.

Just over one third of the students in the sample of the study, 33.7% of them specifically, admitted that they can neglect studying and doing their homework in favor of using their social media, like WhatsApp and others.

85.9% admitted spending more than two hours using their smartphones every day, 81.7% admitted using their social media platforms, like WhatsApp and others, for more than two hours every day, while 86.2% believed that these platforms have become part of their daily routine activity.

In one hand, the first phase of the study revealed that many students in the secondary level consume too much time on their smartphones and social media platforms. On the other hand, in any curriculum, mathematics is an indispensable material, and despite that, many students despise it for multiple reasons (Gafoor & Kurukkan, 2015).

For that, future studies should focus on taking advantage of students' strong bounding with their smartphones and social media platforms in a way that benefits their learning in mathematics.

Just like with the flipped classrooms or the WhatsApp experiment in the second phase of the study, students may gradually accept studying mathematics through the smartphones/social media experiments designed specifically to serve their learning and performance in mathematics.

As a result, their learning skills may improve and they may be motivated to engage in fruitful discussions rather than meaningless ones. More importantly, collaborating online with their colleagues may facilitate their learning, ignite their creative thinking, increase their productivity and improve their academic performance, just like what happened with each of the eleven WhatsApp experiments of this study.

Therefore, students' neglect of their studies and homework in favor of these smartphones and platforms may no longer be a possibility after all.

5.16. Recommendations

Regarding the Teachers

Teaching is about promoting learning and giving the learners opportunities to learn (Lebrun, 2007).

For that, teachers are required to be creative in their activities to make sure that the learning outcomes are accomplished (B. Allen et al., 2012).

When it comes to social media, make no doubt about it that it is an important extension of the activities and the functionalities that occur inside the closed classrooms. Sadly, despite that fact, many teachers have yet to become familiar with taking advantages of social media to facilitate the content approaches of their subject materials and add to the learning of their students inside or outside the classrooms (B. Allen et al., 2012).

The orientation and the well organization of social media challenge the traditional teaching approach and dare to say that it can move the teaching and learning responsibilities off the teachers and place them in the hands of the students through motivation, commitment, social interaction and cognitive collaboration (B. Allen et al., 2012).

Unfortunately, despite the mediation of technology in different aspects of life and work, its authentic integration is slowly and poorly developing among the schools' administrations, especially in the case of creating a learning environment through the interaction features of social media (B. Allen et al., 2012).

When employing social media in the teaching and learning processes, teachers are recommended to use a pragmatic model of learning proposed by Marcel Lebrun, a professor in educational sciences (Figure 27).

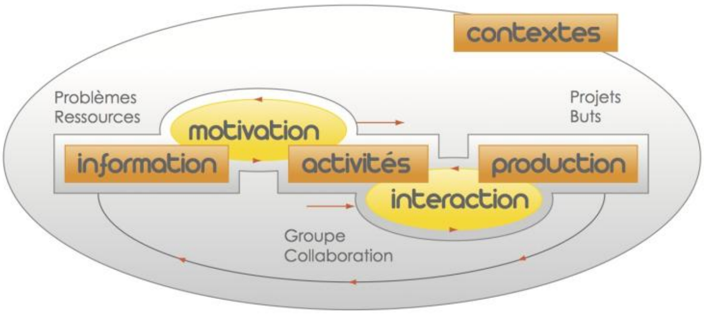


Figure 27 : A Pragmatic Model of Learning (Lebrun, 2007).

This model is composed of six components: the contexts, the information, the motivation, the activities, the interaction and the production (Lebrun, 2007).

The contexts are the spaces through which learning takes place. The information is about the resources and the knowledge. In here, the teacher selects the instrument to use and specifies the type of knowledge he intends to transfer (Lebrun, 2007).

The motivation is about the elements and ways used to encourage students' engagement and give them a meaning to the context of their learning (Lebrun, 2007).

The activities are about the procedures that enable the learners acquiring new skills and building new knowledge (Lebrun, 2007).

The interaction is about the well balanced moments and periods during which students and teachers work and interact (Lebrun, 2007).

The production is about students' learning outcomes and their personal or collective construction of knowledge (Lebrun, 2007).

In theory, teaching online is more flexible than teaching in class because it does not depend on time and space (Picciano, 2017). Additionally and theoretically speaking, social media is capable of reinventing education (Muller, 2016; Ward, 2013).

In practice, effective online teaching is a difficult task to accomplish at times and impossible at other times due to many uncontrollable factors (Picciano, 2017).

Practically speaking, many teachers are still rejecting employing social media in teaching because of its negatives on humans' behavior, anxiety and learning, just like many of those who teach mathematics in the middle schools and the secondary level in Lebanon (El Rouadi & Anouti, 2019)

Teachers have to realize that social media is suitable because it does not need the requirements of an effective online teaching. In this pragmatic model of learning, they can use the WhatsApp platform to enhance students' poor understanding, rectify their misconceptions, and reinforce their performance in timed exams whenever they need to do so.

Social media, like the WhatsApp platform, is a perfect technical instrument capable of representing Paivio's duel coding theory, which suggests that humans can expand their learning through visual aids, like images, verbal aids, like communication voices, or even both. As a result of that, information are stored and retrieved whenever they are needed (Paivio, 1986).

When employing social media in mathematics, just like with the WhatsApp platform, teachers have to motivate their students so that this kind of employment is meaningful for them. They have to remember that they are employing here a social media platform designed initially for entertainment purposes and not educational ones.

For that, their abilities in employing social media for educational purposes, patience, personality, knowledge and mastery of the content of their subject material are leading factors for a successful employment.

Employing WhatsApp to reinforce students' mathematical performance in the problem solving and communication domain was not an easy task to accomplish due to students' lack of competencies in this domain as revealed by the results of the survey. Despite that, the effort teachers will be putting during the well balanced periods visually and verbally may very well lead to reinforcing their performance in the aforesaid domain.

Regarding the Upcoming Advanced Math Curriculum

Through the years, the online learning invaded the traditional teaching landscape and became common for many schools and universities. For our good fortune, the advanced savvy technology stepped up and presented us with the mobile learning opportunity to take education into the next level (Korucu & Alkan, 2011).

While the mobile learning may seem to be a subdivision of the online learning or similar to it, they differ in some critical points. For the teachers, the online learning means that teaching is conducted through the internet, while for the students, it is about peers' participation in virtual classes, access of the content of their lectures and completion of the assigned quizzes online through laptops and desktop computers (Korucu & Alkan, 2011).

In addition, similar to tablets and computers, students can download podcasts and their assignments, and can still attend their online classes or download them to watch at a later time through their smartphones (Korucu & Alkan, 2011).

So what makes the differences between the mobile and online learning? Mobile learning supports the online learning by playing its role in providing the same content, assignments and virtual classes but independently from predetermined locations and times because of its ability to remove the boundaries of place and the restrictions of time (Korucu & Alkan, 2011).

Additionally, mobile learning is characterized by its technology that supports the constructivism learning theory through instant feedbacks, interaction and collaboration in non-formal situations, meaning that it is more flexible and does not need the requirements of the online learning (Korucu & Alkan, 2011).

It also supports and revamps the traditional teaching (Korucu & Alkan, 2011) by extending teaching and learning outside the confines of the classes at any time and from any place (West, 2013).

In the era we live in, learning should not be limited to the sessions provided by the schools. We need to look outside the walls of the classes and see learning as an individual or group activity that could take place on the outside (West, 2013).

Studies showed that students are becoming more open about using technology in learning, and therefore the contents of the materials must be well customized digitally and published everywhere to reach all students to enable them expanding their learning beyond their classrooms (West, 2013).

These contents could be tailored according to the most common needs among the students and provided by the mobile technology. As a result, a new role for technology will be created and its importance in education will be valued even more, a point that should not be overlooked because despite its premise, some studies showed that technology has yet to be sufficiently employed for the services of personalized learning (West, 2013).

Adding to West (2013), in 2017, Albalawi (2017), indicated that, in this age of technology, a new curriculum is considered to be effective only if the mobile learning is properly integrated in the teaching and learning contexts (Albalawi, 2017).

The flipped classroom, a blended learning model, comes to mind when thinking about the mobile learning. In the flipped classroom the content of a subject material is assigned and students are required to prepare it after their school day prior to the next learning session (Strayer, 2012).

In turn, class time is freed up to rectify students' misconceptions, answer their questions, enhance their collaboration and active engagement, and improve the quantity and the quality of their problem solving discussions (Strayer, 2012).

Even more, by flipping the classroom, teachers are presented with the opportunity to be actively engaged with their students in meaningful activities, scaffold these activities according to students' needs and skills, monitor their areas in which they need help, and assess them continuously for better feedbacks (Hung, 2015).

Students' parents, their older siblings and most of the people who are significant in their lives are mostly not familiar with the flipped classroom concept and have not even experienced it. So, it is not strange for us to say that we are all still in our infancy stage when it comes to the types of the blended learning (Miles & Foggett, 2016).

Notwithstanding that reality, El Rouadi and Anouti (2021) experimented the impact of the flipped classroom, through the WhatsApp interaction features and the well-constructed Microsoft PowerPoint presentations, on the learning and exam performance of twenty two Lebanese students in a math lesson in a concurrent triangulation mixed method study during the pandemic of the coronavirus (EL Rouadi & Anouti, 2021).

The study's quantitative data through two summative exams, one for each group, revealed that students mostly performed in a great way, while its qualitative data, through an open ended interview with seven participants, revealed that learning inside the class became easier, pressure was reduced during the session, and time was saved and invested in extra exercises (Appendices AAC, AAD and AAE).

In addition to that, students' understanding ameliorated, their self-confidence reinforced, and their behavior in class improved for the better (EL Rouadi & Anouti, 2021).

Despite the success of that experiment, one may ask why learning is still mostly locked inside the classes. Well, it is because the unreliable technological infrastructure challenges, the content-oriented practices, and the deep-seated rote learning explain teachers' rejection of teaching outside the walls of the classes and their views as of why teaching and learning should only take place inside the classes (Adam, 2016).

In addition, the context in which teaching takes place and its history associated with the obsolete learning experiences represent a challenge for changing the course of education because of their vital role in shaping teachers' practices and perceptions and determining the nature of the students, just like those who are accustomed to the traditional teaching (Adam, 2016).

Despite the above facts, the reality that many schools administrations and students fear change due to their human nature (Navindra, 2020), and the difficulty of changing our teaching methods (Silverthorn, Thorn, & Svinicki, 2006), Ward (2013) assured in his lecture that we are robbing our children from their success in the future by teaching them in the same ways we were taught (Ward, 2013).

Luckily, the visual, audible and dynamic effects afforded by the digital technology, and the interactive characteristics of a medium can fashion students' learning experience and reposition their engagement with mathematics (Murphy & Calder, 2016).

However, even with that luminous depict, technology, including social media, cannot go so far in impacting students' learning with their lack of motivation and full commitment (George, 2016).

Thus, it is fundamental for us to ask how students' learning could be supported, in what ways can they function as a group(s) and what kind of software or digital tech should be used for these purposes (Edwards, 2016).

The accurate answers of these questions along with students' full commitment can create a sense of responsibility in them and allow them to organize themselves and balance between their passion for nowadays modern technology and its usage in learning (Edwards, 2016).

Add to the preceding, staying focused for too many sessions in class is a challenge that cannot be conquered by many students (Dempsey, 2017). Blended learning, a style in which students learn in class and via an electronic instrument (Heick, 2020), could be a solution for that fact.

Blended learning creates a contemporary learning environment in which students learn at a distance and in class; and despite the fact that the face-to face interaction inside the class cannot be replaced by any digital technology, social media can be employed as collaborative platforms in semi structured tasks if the appropriate opportunity arises (Edwards, 2016).

Those who are going to be assigned for the development of the newly advanced math curriculum should be aware of that, especially with the presence of diversified factors that consume a significant portion of students' concentration during most times at day and night.

They can leverage the results of the previously mentioned study to invest students' strong bounding with their smartphones and social media, such as the WhatsApp platform, in a way that benefits their mathematical learning, by using or integrating them into teaching and learning mathematics.

Using technology in education targets the lower level of Anderson's Taxonomy that consists of remembering, understanding and applying, while employing it passes through that lower level and targets the upper level formed of analyzing, evaluating and creating (Heick, 2016).

On one hand, the smartphones with a touch screen and the WhatsApp platform could be used to assign projects for students through-which they remember what they were taught, show their understanding and apply what they learned.

On the other hand, there are seven types of intelligence (Figure 28) with the logical-mathematical intelligence, the ability to solve matters logically and understand relationships between numbers, being one of them (Kim, 2017).

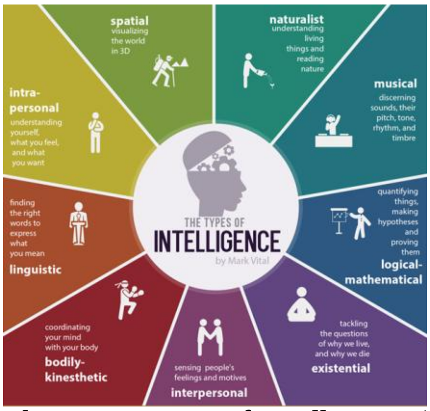


Figure 28 : The Seven Types of Intelligence (Kim, 2017)

Integrating the WhatsApp platform and the well-tailored PowerPoint presentations in teaching and learning mathematics, through the flipped classroom blended learning concept, through-which students are capable of understanding, remembering, applying, analyzing, evaluating and maybe creating, could very well reinforce their logical-mathematical intelligence.

Therefore, those who are going to be assigned for the construction of the upcoming advanced math curriculum are recommended to prepare its content through well-tailored presentations that add to students' learning, serve their personalized learning and properly approach the above six levels of Anderson's taxonomy or most of them.

Presentations they can prepare individually or through the WhatsApp interaction features prior to their learning session. As a result, students who cannot remain focused during the learning sessions will add to their learning and rectify their misconceptions and poor understanding individually or in groups formed of heterogeneous learners with different skills and needs.

In addition, in spite of the unreliable telecommunication infrastructure technology in Lebanon and one of the world slowest internet connection (Gizis, 2019), our rote-seated teaching will be supported within the classrooms, which in turn ease students' learning, make the session more intriguing and provide more time for class interaction between the teacher and his students as explained above.

Having said that, everyone associated with school education has to believe that blended mobile learning model, through the flipped classroom and the interactive social media features, contributes in change and is here to stay.

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Appendices

Appendix A

Social Media Preliminary Survey

I am a student in:

Grade Ten _____________

Grade Eleven __________

Grade twelve __________

Nb	Question	Answers				
		Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	I have a smartphone with social media applications.					
2	I use social media to spend time chatting with my friends.					
3	I want to stay connected all the time to see what others post and comment, and send images and videos.					
4	I spend too much time on social media chatting, commenting, sending and receiving even in the night.					
5	I use social media like WhatsApp to enforce my mathematical learning and critical thinking.					

Check mark the social media tool that you use the most during the day				
WhatsApp	Instagram	Twitter	Facebook	Snapshot

You use social media to solve mathematics exercises:

Yes __________ No __________

If yes, then you solve exercises in:

Algebra ______ Geometry ______ Problem solving ______

Appendix B

Survey Questionnaire

Saint-Joseph University

Faculty of Education

Doctorate Dissertation Title

Impact Of Employing The WhatsApp Platform, Via Its Interaction Features, On Secondary Students' Mathematical Performance

Prepared by: Mohammad Anouti Supervised by: Pr. Naim El Rouadi

Part One: Students' Consent

Dear Secondary Students:

I am a PhD student at the Saint-Joseph University and I am completing this dissertation in partial fulfillment of the requirements for the degree of Doctor of Science Education. I extend my gratitude to each one of you for his contributions to this questionnaire.

For that, you are hereby invited to participate in a survey questionnaire for a doctorate dissertation regarding examining the statistically significant association, if any, between each of the smartphones with a touch screen and the social media platforms, like WhatsApp and others, and each of students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in the secondary level in public and private schools in Beirut.

The purpose of this questionnaire is not only to examine the aforesaid associations between the mentioned variables but also to constitute a background for the experiment prepared for this dissertation regarding employing the WhatsApp platform for the benefit of secondary students' mathematical performance in the previously mentioned math domain.

Be aware that this survey questionnaire will remain anonymous as it will be used for the purpose of this dissertation research only, and there will be no venture, damage, worries, concerns or discomfort whatsoever associated with this research study beyond what you normally encounter and deal with during your normal daily life routine.

The information you provide will be used to enlighten on the association between the smartphones and the social media platforms, and todays' generation of secondary students.

You might not benefit directly from this study as it will take time to be completely implemented but be sure that you will be helping those who will be in your place in the coming

1

years. Note that this survey needs a maximum of fifteen minutes of your time to be adequately filled with complete freedom and proper answers. This will definitely help the research study accuracy.

Continuing and answering the research study questions indicates that you agree with the statements listed below:

1. I was given proper and enough information about this dissertation research study.
2. I am confident that my answers won't be given or released to anyone whoever it is and my identity will remain unknown and off the record to anyone who is not responsible about this dissertation study.
3. My name will not be mentioned, I won't be identified and I won't be associated to any information in any case when the study results are reported. The researcher will be the only one with the ability to access the data collected from my answers however I cannot be linked or associated with it.
4. I know that I have the will to withdraw from the research and not complete the survey questionnaire any time I want for whatever reason I see fit, and I have the liberty to skip any question that I prefer not answering.
5. I completely understand that I will not be penalized if I refuse participating in the study as it won't causes me any loss of benefits I was entitled to for collaboration.
6. I am aware that this study is committed to all common and acknowledge worldwide ethical codes and that this survey questionnaire was first reviewed and then approved by the Institutional Review Board (IRB) at the Saint-Joseph University.
7. I understand that I have the right to ask the researcher responsible of this study any additional question as I see fit.
8. I have completely read and I am aware of the statements related to this form.
9. I, on my own will, volunteer to participate in this dissertation study by properly completing its survey questionnaire.

For any questions whatsoever, you may please contact

Name	Phone number	Email address
Mohammad Anouti	03067273	mohammad.anouty@net.usj.edu.lb

This survey is comprised of seven sections. The first section above contains students consent to participate in the study, the second concerns students general information, the third is formed of 8 items, the fourth section contains 8 items, the fifth section holds 7 items, the sixth section contains 8 items and the seventh section encompasses 10 items divided into five areas respectively on 5-point likert scale with numerical values given for each response as 1 = Strongly disagree, 2 = Disagree, 3 = Undecided, 4 = Agree and 5 = Strongly agree.

Part Two: General Information

Please check mark your suitable answer in each question below

Type of the school: Private ( ) Public ( )

Class: First Year Secondary ( )

Baccalaureate Second Year Secondary Scientific ( )

Baccalaureate Second Year Secondary Humanities/Economics ( )

Third Year Secondary Economic and Sociology ( )

Third Year Secondary Life Sciences ( )

Third Year Secondary General Sciences ( )

Third Year Secondary Humanities ( )

Part Three: Smartphones with a Touch Screen Questionnaire

The purpose of this section of the survey is to determine the spatial point of the smartphones with a touch screen during your daily life routine.

- **Please answer:**
  - Strongly agree if you completely agree with the given;
  - Agree if you the given convinces you to a certain extent or you somewhat agree;
  - Disagree if the given does not convince you, or you somewhat disagree;
  - Strongly disagree if you are sure the given is totally false or does not apply to you at all;
  - Undecided if you cannot give a decisionؤ
- **Make sure you answer all questions and check mark only one answer per question.**

		Answers				
Nb	Question	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	I spend more than two hours using my smartphone every day.					
2	I use my smartphone to send and receive messages.					
3	I use my smartphone to surf the internet.					
4	I use my smartphone to access my social media platforms and applications.					
5	I use my smartphone to play games like Fortnite and PUBG.					
6	I use my smartphone to watch all kinds of videos.					
7	I use my smartphone to call others.					
8	I check the readiness of my smartphone day and night even if there were no notifications/ conversations.					

Part Four: Social Media Platforms, like WhatsApp and Others, Questionnaire

The purpose of this section of the survey is to determine the spatial point of the social media platforms, like WhatsApp and others, during your daily life routine.

		Answers				
Nb	Question	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	I use my social media platforms, like WhatsApp and others for more than two hours every day.					
2	Social media platforms, like WhatsApp and others, have become part of my daily routine activity.					
3	I always feel that I need to check my social media platforms, like WhatsApp and others, every then and now.					

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4	I would feel sorrows if they shut down the social media platforms, like WhatsApp and others, even for a short period of time.					
5	I can neglect studying and doing my homework in favor of using my social media, like WhatsApp and others.					
6	I always stay connected with my friends thanks to my social media platforms, like WhatsApp and others.					
7	I use my social media, like WhatsApp and others, to chat, blog and comment.					
8	I use my social media, like WhatsApp and others, to send and receive images and videos.					

Part Five: Students' Math Timed Exams Anxiety Questionnaire

The purpose of this section of the survey is to determine the spatial point of students' anxiety towards mathematics timed exams.

		Answers				
Nb	Question	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	I cannot focus on anything before my math exam.					
2	Usually, I'm not anxious when I start the math exam.					
3	Usually, I'm not relaxed during math exams.					
4	During math exams, I feel unable of thinking and recalling things, and I forget things I learned.					
5	During a math exam, I panic if I wasn't capable of remembering the required equation(s), rule(s) or formula(s) to write					

5

6	During math exams, I find myself saying "can I succeed?".					
7	After I submit the math exam paper to the teacher, I start paying attention to my mistakes and knowing answers to questions I left.					

Part Six: Students' Behavior in Class Questionnaire

The purpose of this section of the survey is to determine students' behavior, the way they act in class.

		Answers				
Nb	Question	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	Sometimes I talk to my classmates even if the teacher was explaining the lesson.					
2	I avoid doing the tasks assigned during the class.					
3	It is ok for me to copy my homework from my friend using my social media and present it to my teacher.					
4	I might sleep during my learning sessions.					
5	Sometimes I laugh in class even if the teacher is explaining our lesson.					
6	I argue with my teachers even if I am mistaken.					
7	Sometimes I don't concentrate in classes.					
8	Sometimes I don't pay attention to the lessons displayed on the board in class.					

Part Seven: Students' Competencies in the Word Problem Solving Domain in Mathematics

The purpose of this section of the survey is to determine the spatial point of students' competencies in the word problem solving domain in mathematics.

		Answers				
Nb	Question	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
1	I cannot plan and organize the given content of a math word problem like probability, numerical sequences, interest and economic functions					
2	I fail to analyze a math word problem exercise.					
3	I know how to translate the content of a word problem into math equations.					
4	I fail at extracting relevant information from the content of a math word problem solving exercise.					
5	I can explain in details the given of math word problems solving exercise.					
6	I can shift from one mode of representation (register) to another in the same math word problem solving exercise.					
7	I cannot choose the adequate model to solve a math word problem solving exercise.					
8	I can validate the results of a math word problem solving exercise.					
9	Usually, I fail in interpreting the results of a math word problem solving exercise.					
10	I have a good mathematical reasoning in the math word problem solving exercise.					

7

Appendix C

جامعة القدّيس يوسف

كليّة التربية

استبيان خاص بالأطروحة

عنوان الأطروحة

تأثير استخدام منصّة الواتساب، عبر ميّزات التفاعل، على تعلّم طلاب المرحلة الثانويّة في مادّة الرياضيات

إعدّاد: محمد فيصل عانوتي إشراف: برفسور نعيم الروادي

الجزء الأوّل: موافقة الطلاب

أعزائي طلاب المرحلة الثانويّة:

أنا طالب دكتوراه في جامعة القدّيس يوسف وأكمل هذه الرسالة في الوفاء الجزئي لمتطلبات درجة الدكتوراه في العلوم التربوية. أتقدم من كل طالب منكم بالشكر و العرفان لمساهمته بهذا الأستبيان.

لذلك، أنتم مدعوون هنا للمشاركة في استبيان لرسالة دكتوراه متعلقة بدراسة بفحص الارتباط ذي الدلالة الإحصائية ، إن وجد ، بين كل من الهواتف الذكية ذات الشاشة التي تعمل باللمس ومنصات التواصل الاجتماعي، مثل الواتساب وغيرها، وكل من قلق الطلاب أثناء امتحانات الرياضيات ذات الوقت المحدد، السلوك في الحصص الدراسية والكفاءات في حلّ المسائل الرياضية في المرحلة الثانوية في المدارس الحكومية والخاصة في بيروت.

الغرض من هذا الاستبيان ليس فقط فحص الارتباطات المذكورة أعلاه بين المتغيرات المذكورة ولكن أيضًا تشكيل خلفية للتجربة المعدة لهذه الرسالة فيما يتعلق باستخدام منصة الواتساب لصالح الأداء الرياضي لطلاب المرحلة الثانوية في مجال الرياضيات المذكور سابقًا .

كن أكيداً أنّ الأجوبة على هذا الاستبيان ستظل مجهولة المصدر لأنها ستُستخدم فقط لغرض البحث العلمي ولن يسبّب لك هذا العمل الرصين أيّ ضرر أو مخاوف أو إزعاج.

سيتم استخدام المعلومات التي تقدمها للتنوير على العلاقة بين الهواتف الذكية ومنصات التواصل الاجتماعي، وجيل اليوم من طلاب المرحلة الثانوية.

قد لا تستفيد مباشرة من هذه الدراسة لأنّ الأمر سيستغرق بعض الوقت لتنفيذها بالكامل ولكن تأكّد من أنّك ستساعد أولئك الذين سيكونون مكانك في السنوات المقبلة. هذا الاستبيان يحتاج إلى خمس عشرة دقيقة كحدٍّ أقصى من وقتك ليتم ملؤه بشكل كافٍ وصحيح بكامل حرّيتك، مما سيساعد للتوصل لدقّة البحث العلمي.

متابعتك القراءة والإجابة على أسئلة البحث تدلّ على موافقتك على العبارات الواردة أدناه:

1. لقد تلقّيت معلومات صحيحة وكافية حول هذه الدراسة البحثية.
2. أنا واثق من أنّ إجاباتي لن تُمنح لأي شخص أو تُنشر، وستظل هويتي مجهولة وغير قابلة للعرض لأيّ شخص خارج أهداف هذه الدراسة.
3. لن يتمّ ذكر إسمي ، ولن يتمّ تحديد هويّتي ولن أكونَ مرتبطًا بأيّ معلومات في أيّ حال عند الإعلان عن نتائج الدراسة. سيكون الباحث هو الوحيد الذي لديه القدرة للوصول إلى البيانات التي تم جمعها من إجاباتي ولكن لا يمكن ربطي بها.

4. أعلم أن لديّ الإمكانيّة للإنسحاب من البحث وعدم إكمال الاستبيان في أيّ وقت أريد لأيّ سبب أراه مناسباً ، ولديّ الحُريّة في تخطي أيّ سؤال لا أريد الإجابة عليه.
5. أدرك تمامًا أنني لن أعاقب إذا رفضت المشاركة في الدراسة وأنّ ذلك لن يسبّب لي أيّ خسارة في الفوائد التي كنت سأجنيها عند التعاون.
6. أدرك أنّ هذه الدراسة ملتزمة بجميع القواعد الأخلاقية الشائعة في جميع أنحاء العالم، وأنّ هذا الاستبيان قد تمّت مراجعته أولاً ثم وافق عليه مجلس المراجعة المؤسسيّة (IRB) في جامعة القدّيس يوسف.
7. أفهم أنه يحق لي أن أسأل الباحث المسؤول عن هذه الدراسة أيّ سؤال إضافي حسب ما أراه مناسباً.
8. لقد قرأتُ بشكلٍ كافٍ وأنا على درايةٍ بالبيانات المتعلّقة بهذا النموذج.
9. أنا، بناءً على إرادتي الشخصيّة، أتطوّع للمشاركة في هذه الدراسة من خلال استكمال الاستبيان الخاص بها بشكل صحيح.

لمُطلقِ سؤالٍ يمكنك الاتصال ب:

الاسم	رقم الخليوي	عنوان البريد الإلكتروني
محمد فيصل عانوتي	03067273	mohammad.anouty@net.usj.edu.lb

يتكوّن هذاالاستبيان من سبعة أقسام. يحتوي القسم الأول أعلاه على موافقة الطلاب للمشاركة في الدراسة، القسم الثاني يتعلّق بالمعلومات العامّة للطلاب، القسم الثالث يتكوّن من 8 عناصر، القسم الرابع يحتوي على 8 عناصر، القسم الخامس يحمل 7 عناصر، القسم السادس يحتوي على 8 عناصر ويشمل القسم السابع 10 عناصرمقسمّة إلى خمسة مناطق متتالية على مقياس likert من 5 نقاط متتالية مع القيم العدديّة لكل استجابة: 1 = لا أوافق بشدّة ، 2 = لا أوافق ، 3 = غير محدّد ، 4 = أوافق و 5 = أوافق بشدّة.

الجزء الثاني: معلومات عامة

يرجى تحديد إجابتك المناسبة عن كل سؤال أدناه

نوع المدرسة: خاص ( ) رسمي ( )

الصّف: الأوّل ثانوي ( )

الثاني ثانوي علمي ( )

الثاني ثانوي إنسانيات\اقتصاد ( )

الثالث ثانوي اقتصاد واجتماع ( )

الثالث ثانوي علوم الحياة ( )

الثالث ثانوي العلوم العامّة ( )

الثالث ثانوي انسانيات ( )

الجزء الثالث: استبيان الهواتف الذكيّة ذات شاشة تعمل باللمس

الغرض من هذا القسم من الاستبيان هو تحديد النقطة المكانيّة للهواتف الذكيّة ذات الشاشة التي تعمل باللمس خلال روتين حياتك اليوميّة.

•الرجاء الإجابة:

أوافق بشدة إذا كنت توافق تمامًا على المعطى؛

أوافق إذا كنت مقتنعاً إلى حدٍّ ما؛

غير موافق إذا كان المعطى لا يقنعك ، أو لا توافق إلى حدٍّ ما؛

لا أوافق بشدّة إذا كنت متأكّداً من أنّ المعطى خاطئ تمامًا أو لا ينطبق عليك مطلقًا؛

غير محدد إذا لم تتمكن من اتخاذ قرار.

• تأكّد من الإجابة على جميع الأسئلة و وضع علامة واحدة فقط لكل سؤال.

الرقم	السؤال	الأجوبة				
		لا أوافق بشدّة	لا أوافق	متردّد	أوافق	أوافق بشدّة
1	أقضي أكثر من ساعتين في استخدام هاتفي الذكي كلّ يوم.					
2	أستخدم هاتفي الذكي لإرسال واستقبال الرسائل.					
3	أستخدم هاتفي الذكي لتصفّح الانترنت.					
4	أستخدم هاتفي الذكي للوصول إلى التطبيقات ومنصّات التواصل الاجتماعي الخاصة بي.					
5	أستخدم هاتفي الذكي لممارسة ألعاب مثل Fortnite و PUBG.					
6	أستخدم هاتفي الذكي لمشاهدة جميع أنواع مقاطع الفيديو.					
7	أستخدم هاتفي الذكي للاتصال بالآخرين.					
8	أتحقق من جهوزية هاتفي الذكي ليلًا ونهارًا حتى لو لم تكن هنالك إخطارات / محادثات.					

الجزء الرابع: استبيان منصّات التواصل الاجتماعي، مثل الواتساب وغيرها

الغرض من هذا القسم من الاستبيان هو تحديد النقطة المكانيّة لمنصّات التواصل الاجتماعي خلال روتين حياتك اليوميّة.

		الأجوبة				
الرقم	السؤال	لا أوافق بشدّة	لا أوافق	متردّد	أوافق	أوافق بشدّة
1	أستخدم منصّات التواصل الاجتماعي الخاصة بي، مثل الواتساب وغيرها، لأكثر من ساعتين يوميًّا.					
2	أصبحت منصّات التواصل الاجتماعي، مثل الواتساب وغيرها، جزءًا من نشاطي اليومي الروتيني.					
3	أشعر دائمًا أنني أحتاج إلى التحقق من منصّات التواصل الاجتماعي الخاصّة بي، مثل الواتساب وغيرها، كل حين.					
4	سأشعر بالحزن إذا أغلقت منصّات التواصل الاجتماعي، مثل الواتساب وغيرها، ولو لفترةٍ قصيرةٍ من الزمن.					
5	يمكنني إهمال دراستي وواجباتي لصالح استخدام منصّات التواصل الاجتماعي الخاصّة بي، مثل الواتساب وغيرها.					
6	أبقى دائمًا على اتصال مع أصدقائي بفضل منصّات التواصل الاجتماعي الخاصّة بي، مثل الواتساب وغيرها.					
7	أستخدم منصّات التواصل الاجتماعي الخاصّة بي، مثل الواتساب وغيرها، للدردشة والتدوين والتعليق.					
8	أستخدم منصّات التواصل الاجتماعي ، مثل الواتساب وغيرها، لإرسال واستقبال الصور ومقاطع الفيديو.					

الجزء الخامس: استبيان قلق الطلاب من امتحان الرياضيات ذات الوقت المحدّد

الغرض من هذا القسم من الاستبيان هو تحديد النقطة المكانية لقلق الطلاب تجاه امتحانات الرياضيات ذات الوقت المحدّد.

		الأجوبة				
الرقم	السؤال	لا أوافق بشدّة	لا أوافق	متردّد	أوافق	أوافق بشدّة
1	لا يمكنني التركيز على أي شيء قبل امتحان الرياضيات.					
2	عادة، لا أشعر بالقلق عندما أبدأ امتحان الرياضيات.					

3	عادة ، أنا لست مرتاحًا أثناء امتحانات الرياضيات.					
4	خلال امتحانات الرياضيات ، أشعر بعدم القدرة على التفكير وتذكّر الأشياء ، وأنسى أموراً تعلمتها.					
5	أثناء امتحان الرياضيات ، أشعر بالذعر إذا لم أتمكن من تذكّر المعادلة (المعادلات) المطلوبة أو القاعدة (القواعد) أو الصيغة الواجب كتابتها.					
6	خلال امتحانات الرياضيات ، أجد نفسي أقول "هل يمكنني النجاح؟".					
7	بعد أن أقدّم ورقة امتحان الرياضيات إلى الأستاذ ، أبدأ في الانتباه إلى أخطائي ومعرفة إجابات الأسئلة التي تركتها.					

الجزء السادس: استبيان سلوك الطلاب في الصّف

الغرض من هذا القسم من الاستبيان هو تحديد سلوك الطلاب في الصّف.

		الأجوبة				
الرقم	السؤال	لا أوافق بشدّة	لا أوافق	متردّد	أوافق	أوافق بشدّة
1	أتحدث أحيانًا إلى زملائي في الفصل حتى لو كان المعلم يشرح الدرس.					
2	أتجنب القيام بالمهام المسندة إلي خلال الحصّة الدراسيّة.					
3	لا بأس بالنسبة لي نسخ واجبي من صديقي باستخدام وسائط التواصل الاجتماعي الخاصّة بي وتقديمها إلى أستاذي.					
4	قد أنام أثناء الحصّة الدراسيّة.					
5	أحيانًا أضحك في الحصّة الدراسيّة حتى أثناء شرح المعلم للدّرس.					
6	أتجادل مع أساتذتي حتى لو كنت مخطئًا.					
7	في بعض الأحيان لا أركّز في الحصص الدراسيّة.					
8	في بعض الأحيان لا أنتبه للدروس المعروضة على اللوح في الصف.					

الجزء السابع: استبيان كفاءات الطلاب في مجال حلّ المسائل الرياضية

الغرض من هذا القسم من الاستبيان هو تحديد النقطة المكانيّة لكفاءات الطلاب في مجال حلّ المسائل الرياضية.

		الأجوبة				
الرقم	السؤال	لا أوافق بشدّة	لا أوافق	متردّد	أوافق	أوافق بشدّة
1	لا يمكنني تخطيط وتنظيم المحتوى المعطى في مجال حلّ المسائل الرياضية مثل probabilité, suites numériques, intérêt et fonction de l'économie.					
2	أخفق في تحليل تمرين في مجال حلّ المسائل الرياضية.					
3	أعرف كيف أترجم محتوى تمرين في مجال حلّ المسائل الرياضية إلى معادلات رياضيّة.					
4	أخفق في استخراج معلومات ذات صلة من تمرين في مجال حلّ المسائل الرياضية.					
5	أستطيع أن أشرح بالتفصيل المعطى لتمرين في مجال حلّ المسائل الرياضية.					
6	يمكنني الإنتقال من **سجل** إلى آخر في نفس التمرين في مجال حلّ المسائل الرياضية.					
7	لا يمكنني اختيار النموذج المناسب لحل تمرين في مجال حلّ المسائل الرياضية.					
8	يمكنني التحقق من صحّة نتائج تمرين في مجال حلّ المسائل الرياضية.					
9	عادةً، أفشل في تفسير نتائج تمرين في مجال حلّ المسائل الرياضية.					
10	لديّ تفكير رياضيّ جيّد لحل تمرين في مجال حلّ المسائل الرياضية.					

Appendix D

USJ
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Faculté des sciences de l'éducation

كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3157

جانب وزارة التربية و التعليم العالي

حضرة المدير العام الأستاذ فادي يرق المحترم

بيروت في ٢٠١٩/١٠/١٦

<u>المستدعي:</u> محمد عانوتي (طالب دكتوراة في جامعة القديس يوسف)

<u>الموضوع:</u> الموافقة على تطبيق دراسة دكتوراة في العلوم التربوية

تحية طيبة وبعد،

إن الطالب محمد عانوتي المسجل في جامعة القديس يوسف في بيروت يقوم بإعداد بحث من أجل نيل شهادة دكتوراة فى العلوم التربوية عنوانه:

" تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"

إن تطبيق هذا البحث يتطلب من الباحث توزيع استبيان على الطلاب في المدارس الثانوية الرسمية في بيروت.

هذا الاستطلاع، الذي تم تقييمه بـ ٥ نقاط على مقياس Likert وهو يهدف لدراسة مدى تأثير الهواتف الذكية مع شاشة تعمل باللمس ومنصّات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد.

وبناءً على ما تقدم أعلاه، نرجو من جانبكم الكريم الموافقة على طلبنا هذا لما فيه أهمية في تطور الابحاث التربوية في لبنان.

ولكم جزيل الشكر.

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

Campus des sciences humaines, rue de Damas
B.P. 17-5208 Mar Mikhaël Beyrouth, 1104 2020 - Liban

حَرَم العلوم الإنسانيّة، طريق الشام

Appendix E

Université Saint-Joseph de Beyrouth
القدّيس يوسف في بيروت

Faculté des sciences de l'éducation
كلية العلوم التربويّة

Référence : 19/USJ/FSEDU/3157

وزارة التربية والتعليم العالي
ديوان التربية
رقم التسجيل:

جانب وزارة التربية و التعليم العالي
حضرة المدير العام الأستاذ فادي يرق المحترم

بيروت في ٢٠١٩/١٠/١٦

المستدعي: محمد عانوتي (طالب دكتوراة في جامعة القديس يوسف)

الموضوع: الموافقة على تطبيق دراسة دكتوراة في العلوم التربوية

تحية طيبة وبعد،

إن الطالب محمد عانوتي المسجل في جامعة القديس يوسف في بيروت يقوم بإعداد بحث من أجل نيل شهادة دكتوراة في العلوم التربوية عنوانه:

" تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"

إن تطبيق هذا البحث يتطلب من الباحث توزيع استبيان على الطلاب في المدارس الثانوية الرسمية في بيروت.

هذا الاستطلاع، الذي تم تقييمه بـ ٥ نقاط على مقياس Likert وهو يهدف لدراسة مدى تأثير الهواتف الذكية مع شاشة تعمل باللمس ومنصات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد.

وبناءً على ما تقدم أعلاه، نرجو من جانبكم الكريم الموافقة على طلبنا هذا لما فيه أهمية في تطور الابحاث التربوية في لبنان.

ولكم جزيل الشكر.

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

جانب مديرية التعليم الثانوي
للتفضل بالاطلاع وبيان الرأي

COMPUTER صادر

Campus des sciences humaines, rue de Damas

Appendix F

الجمهوريـــة اللبنانيـــة
وزارة التربية والتعليم العالي
المديرية العامة للتربية

رقم الصادر: ٣/٢٥٠١٩
بيروت في ١٦/١٢

جـانب جامعـة القـديس يـوسف
كلية العلوم التربوية

الموضوع: تطبيق دراسة دكتوراه في العلوم التربوية.
المرجــــع: كتابكم تاريخ ٢٠١٩/١٠/١٦.

إشارة إلى الموضوع والمرجع المبينين أعلاه،

نحيطكم علماً بموافقة المديرية العامة للتربية على السماح للطالب **محمد عانوتي** بدخول الثانويات الرسمية في بيروت خلال العام الدراسي ٢٠٢٠/٢٠١٩ لإعداد بحث بعنوان" تأثير استخدام منصة الواتس آب على تعلّم الطلاب في مادة الرياضيات في المرحلة الثانوية"، من أجل نيل شهادة دكتوراه في العلوم التربوية، يشمل توزيع استبيان على التلاميذ، على أن تكون مشاركة التلاميذ اختيارية لمن يرغب منهم، وأن يصار إلى التنسيق مع إدارات الثانويات المعنية بغية تحديد الفترة المناسبة لتنفيذ المطلوب وتأمين حسن سير العمل فيها، وأن يتمّ تزويد المديرية العامة للتربية بنتائج هذا البحث بعد الانتهاء من تنفيذه،

للتفضل بالاطلاع وأخذ العلم ./.

المدير العـام للتربيــة

فـادي يــرق

Appendix G

طلب رسمي لتوزيع استمارة البحث

نطلب اذن حضرتكم لتوزيع استبيان على طلابكم في المرحلة الثانوية.
هذا الاستطلاع، الذي تم تقييمه بـ 5 نقاط على مقياس Likert، لا يؤثر على الطلاب. هو مصمم فقط لفحص مدى تاثير الهواتف الذكية مع شاشة تعمل باللمس ومنصات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد. السلوك في الصف والكفاءات في مجال حل المسائل الرياضية في المرحلة الثانوية .

ستمكن موافقتكم الباحث من الحصول على خلفية كافية في المرحلة الاولى من الدراسة للاعداد بشكل صحيح للجزء التجريبي في المرحلة الثانية التي تبحث في توظيف الـ WhatsApp، منصة التواصل الاجتماعي، من خلال الهواتف الذكية، على اداء الطلاب، من خلال درجاتهم، في المرحلة الثانوية.

يحظى تقديركم وموافقتكم على تنفيذ دراستنا بتقدير كبير حيث انها توفر العينات اللازمة للكشف عن التاثيرات والجوانب المتنوعة لمنصات التواصل الاجتماعي والهواتف الذكية من خلال شاشة تعمل باللمس على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال في مادة الرياضيات في المرحلة الثانوية.

بكل اخلاص:
المشرف على الاطروحة: البرفسور نعيم الرويدي
الباحث: محمد فيصل عنوتي

تمت مراجعة هذا الطلب وتوقيعه من قبل:

Beirut Annunciation Orthodox College
مدرسة البشارة الارثوذكسية
HUMAN RESOURCES DEPARTMENT

التوقيع

نبال البستاني
الاسم

Appendix H

A Formal Request to Distribute the Survey of the Research Study

We are requesting your permission to distribute the survey questionnaire among your students in the secondary level.

This 5-points Likert scale survey has no impact on students. It only examines the extent of the effect of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in mathematics in the secondary level.

Your acceptance would enable the researcher to have enough background in the first phase of the study to properly prepare for the experimental part in the second phase that investigates employing WhatsApp, a social media platform, through smartphones on students' performance, through their grades, in the secondary level.

Your consideration and approval for us to implement our study is greatly appreciated as it affords needed samples to uncover the diverse influences and aspects of the social media platforms and smartphones with a touch screen on our students' math timed exams anxiety, behavior in class and competencies in a mathematical domain in the secondary level.
Sincerely.

The dissertation director: Pr. Naim El Rouadi
The researcher: Mohammad Anouti.

This request was reviewed and signed by:

Dr. Randa Zein
Name

Signature

ND
الإدارة

Appendix I

الأستاذ محمد عانوتي
للإتصال به بعد الساعة 3,00
03-067273

طلب رسمي لتوزيع استمارة البحث

نطلب إذن حضرتكم لتوزيع استبيان على طلابكم في المرحلة الثانوية.
هذا الاستطلاع، الذي تم تقييمه بـ 5 نقاط على مقياس Likert، لا يؤثر على الطلاب. هو مصمم فقط لفحص مدى تأثير الهواتف الذكية مع شاشة تعمل باللمس ومنصّات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال حل المسائل الرياضيّة في المرحلة الثانوية .

ستمكّن موافقتكم الباحث من الحصول على خلفية كافية في المرحلة الاولى من الدراسة للاعداد بشكل صحيح للجزء التجريبي في المرحلة الثانية التي تبحث في توظيف ال WhatsApp، منصة التواصل الاجتماعي، من خلال الهواتف الذكية، على أداء الطلاب، من خلال درجاتهم، في المرحلة الثانويّة.

يحظى تقديركم وموافقتكم على تنفيذ دراستنا بتقدير كبير حيث إنها توفر العيّنات اللازمة للكشف عن التأثيرات والجوانب المتنوعَة لمنصات التواصل الاجتماعي والهواتف الذكية من خلال شاشة تعمل باللمس على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال في مادّة الرياضيات في المرحلة الثانويّة.

بكلّ إخلاص:
المشرف على الأطروحة: البرفسور نعيم الرويدي
الباحث: محمّد فيصل عانوتي

تمت مراجعة هذا الطلب وتوقيعه من قبل:

محمد فرحات
الإسم

التوقيع

المعهد العربي التربوي
المدير العام
Educational Arab Institute Est.

Appendix J

USJ 1875
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Faculté des sciences de l'éducation

كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3158

إفـادة

لمن يهمّه الأمر.

إنَّ **الطالب محمد عانوتي**، المولود في بيروت (لبنان)، سنة ١٩٧٨، مسجّل في الكلية في الفصل الجامعي الأول من العام الدراسي ٢٠١٩ – ٢٠٢٠، لإعداد رسالة الدكتوراه في العلوم التربوية.

وهو يُعِدّ اطروحته بعنوان : " تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"، وذلك بإشراف الدكتور نعيم الرويدي.

فنرجو من أصحاب العلاقة التفضّل بتسهيل أمره، ليتمكّن من القيام بما تقتضيه اطروحته ، ولهم منّا جزيل الشكر، وفائق الاحترام.

وبناءً على طلب صاحب العلاقة، مُنحت هذه الإفادة.

بيروت، ٢٠١٩/١٠/١٦

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

الموافقة

المدير د. الياس شوفاني

7/11/2019

ثانوية الأدفنتست - المصيطبة
MUSEITBEH ADVENTIST SECONDARY SCHOOL BEIRUT
بيروت

Campus des sciences humaines, rue de Damas

حرم العلوم الإنسانية، طريق الشام

Appendix K

A Formal Request to Distribute the Survey of the Research Study

We are requesting your permission to distribute the survey questionnaire among your students in the secondary level.

This 5-points Likert scale survey has no impact on students. It only examines the extent of the effect of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in mathematics in the secondary level.

Your acceptance would enable the researcher to have enough background in the first phase of the study to properly prepare for the experimental part in the second phase that investigates employing WhatsApp, a social media platform, through smartphones on students' performance, through their grades, in the secondary level.

Your consideration and approval for us to implement our study is greatly appreciated as it affords needed samples to uncover the diverse influences and aspects of the social media platforms and smartphones with a touch screen on our students' math timed exams anxiety, behavior in class and competencies in a mathematical domain in the secondary level.

Sincerely.

The dissertation director: Pr. Naim El Rouadi

The researcher: Mohammad Anouti.

This request was reviewed and signed by:

Mona Shbaklo Dayya

Name

Signature

Appendix L

A Formal Request to Distribute the Survey of the Research Study

We are requesting your permission to distribute the survey questionnaire among your students in the secondary level.

This 5-points Likert scale survey has no impact on students. It only examines the extent of the effect of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in mathematics in the secondary level.

Your acceptance would enable the researcher to have enough background in the first phase of the study to properly prepare for the experimental part in the second phase that investigates employing WhatsApp, a social media platform, through smartphones on students' performance, through their grades, in the secondary level.

Your consideration and approval for us to implement our study is greatly appreciated as it affords needed samples to uncover the diverse influences and aspects of the social media platforms and smartphones with a touch screen on our students' math timed exams anxiety, behavior in class and competencies in a mathematical domain in the secondary level.
Sincerely,

The dissertation director: Pr. Naim El Rouadi
The researcher: Mohammad Anouti.

This request was reviewed and signed by:

Name **Signature**

01/305941

Appendix M

جمعية المقاصد الخيرية الإسلامية في بيروت

تأسست ١٢٩٥هـ - ١٨٧٨م

إدارة الشؤون التربوية

بيروت في **2019/10/11**

رقم التسجيل: [illegible] / تربية/2019

حضرة مديرة كلية خديجة الكبرى

السيدة ليلى ترك المحترمة

الموضوع: توزيع استمارة على تلامذة الصفوف الثانوي

تحية وبعد،

مع الموافقة على طلب توزيع الاستمارة المرفقة من قبل الاستاذ محمد عانوتي على تلامذة الصفوف الثانوي في مدارس المقاصد .

مديرة إدارة الشؤون التربوية

د. غنى البدوي

نسخة الى :

- كلية خالد بن الوليد
- كلية علي بن ابي طالب
- كلية عمر بن الخطاب

Appendix N

جمعية المقاصد الخيرية الإسلامية في بيروت

تأسست ١٢٩٥هـ - ١٨٧٨م

إدارة الشؤون التربوية

بيروت في 2019/10/11

رقم التسجيل: [illegible]/ تربية/2019

حضرة مدير كلّية خالد بن الوليد

السيّد أمين الطويل المحترم

الموضوع: توزيع استمارة على تلامذة الصفوف الثانوي

تحية وبعد،

مع الموافقة على طلب توزيع الاستمارة المرفقة من قبل الاستاذ محمد عانوتي على تلامذة الصفوف الثانوي في مدارس المقاصد .

مديرة إدارة الشؤون التربوية

د. غنى البدوي

Appendix O

جمعية المقاصد الخيرية الإسلامية في بيروت

تأسست ١٢٩٥هـ - ١٨٧٨م

إدارة الشؤون التربوية

بيروت في 2019/10/11

رقم التسجيل: [illegible]/ تربية/2019

حضرة مدير كلّية عمر بن الخطّاب

السيّد أحمد غلاييني المحترم

الموضوع: توزيع استمارة على تلامذة الصفوف الثانوي

تحية وبعد،

مع الموافقة على طلب توزيع الاستمارة المرفقة من قبل الاستاذ محمد عانوتي على تلامذة الصفوف الثانوي في مدارس المقاصد .

مديرة إدارة الشؤون التربوية

د. غنى البدوي

Appendix P

جمعية المقاصد الخيرية الإسلامية في بيروت

تأسست ١٢٩٥هـ - ١٨٧٨م

إدارة الشؤون التربوية

بيروت في **2019/10/11**

رقم التسجيل: ... / تربية/2019

حضرة مديرة كلّية علي بن أبي طالب

السيّدة رنا صبّيدين المحترمة

الموضوع: توزيع استمارة على تلامذة الصفوف الثانوي

تحية وبعد،

مع الموافقة على طلب توزيع الاستمارة المرفقة من قبل الاستاذ محمد عانوتي على تلامذة الصفوف الثانوي في مدارس المقاصد .

مديرة إدارة الشؤون التربوية

د. غنى البدوي

Appendix Q

طلب رسمي لتوزيع استمارة البحث

نطلب إذن حضرتكم لتوزيع استبيان على طلابكم في المرحلة الثانوية.
هذا الاستطلاع، الذي تم تقييمه بـ 5 نقاط على مقياس Likert، لا يؤثر على الطلاب. هو مصمم فقط لفحص مدى تأثير الهواتف الذكية مع شاشة تعمل باللمس ومنصّات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال حل المسائل الرياضيّة في المرحلة الثانوية .

ستمكّن موافقتكم الباحث من الحصول على خلفية كافية في المرحلة الاولى من الدراسة للإعداد بشكل صحيح للجزء التجريبي في المرحلة الثانية التي تبحث في توظيف ال WhatsApp ، منصة التواصل الاجتماعي، من خلال الهواتف الذكية، على أداء الطلاب، من خلال درجاتهم، في المرحلة الثانويّة.

يحظى تقديركم وموافقتكم على تنفيذ دراستنا بتقدير كبير حيث إنها توفر العيّنات اللازمة للكشف عن التأثيرات والجوانب المتنوعَة لمنصات التواصل الاجتماعي والهواتف الذكية من خلال شاشة تعمل باللمس على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال في مادّة الرياضيات في المرحلة الثانويّة.

بكلّ إخلاص:
المشرف على الأطروحة: البرفسور نعيم الرويدي
الباحث: محمّد فيصل عانوتي

تمت مراجعة هذا الطلب وتوقيعه من قبل:

شيرين حلواني

الإسم

مدرسة البيادر
بيروت – لبنان

التوقيع

Appendix R

Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Faculté des sciences de l'éducation
كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3158

إفـادة

لمن يهمّه الأمر.

إنّ **الطالب محمد عانوتي**، المولود في بيروت (لبنان)، سنة ١٩٧٨، مسجّل في الكلية في الفصل الجامعي الأول من العام الدراسي ٢٠١٩ – ٢٠٢٠، لإعداد رسالة الدكتوراه في العلوم التربوية.

وهو يُعِدّ اطروحته بعنوان : " تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"، وذلك بإشراف الدكتور نعيم الرويدي.

فنرجو من أصحاب العلاقة التفضّل بتسهيل أمره، ليتمكّن من القيام بما تقتضيه اطروحته ، ولهم منّا جزيل الشكر، وفائق الاحترام.

وبناءً على طلب صاحب العلاقة، مُنحت هذه الإفادة.

بيروت، ٢٠١٩/١٠/١٦

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

مدير الدروس
أ. محمود جعفر
ثانوية ابن رشد

Campus des sciences humaines, rue de Damas
B.P. 17-5208 Mar Mikhaël Beyrouth 1104 2020 - Liban
حرم العلوم الإنسانيّة، طريق الشام

Appendix S

A Formal Request to Distribute the Survey of the Research Study

We are requesting your permission to distribute the survey questionnaire among your students in the secondary level.

This 5-points Likert scale survey has no impact on students. It only examines the extent of the effect of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in mathematics in the secondary level.

Your acceptance would enable the researcher to have enough background in the first phase of the study to properly prepare for the experimental part in the second phase that investigates employing WhatsApp, a social media platform, through smartphones on students' performance, through their grades, in the secondary level.

Your consideration and approval for us to implement our study is greatly appreciated as it affords needed samples to uncover the diverse influences and aspects of the social media platforms and smartphones with a touch screen on our students' math timed exams anxiety, behavior in class and competencies in a mathematical domain in the secondary level.
Sincerely.

The dissertation director: Pr. Naim El Rouadi
The researcher: Mohammad Anouti.

This request was reviewed and signed by:

Bissan Issa
Name

Bissan
Signature

Appendix T

USJ 1875
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Faculté des sciences de l'éducation

كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3158

إفادة

لمن يهمّه الأمر.

إنَ **الطالب محمد عانوتي**، المولود في بيروت (لبنان)، سنة ١٩٧٨، مسجّل في الكلية في الفصل الجامعي الأول من العام الدراسي ٢٠١٩ — ٢٠٢٠، لإعداد رسالة الدكتوراه في العلوم التربوية.

وهو يُعِدّ اطروحته بعنوان : " تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"، وذلك بإشراف الدكتور نعيم الرويدي.

فنرجو من أصحاب العلاقة التفضّل بتسهيل أمره، ليتمكّن من القيام بما تقتضيه اطروحته ، ولهم منّا جزيل الشكر، وفائق الاحترام.

وبناءً على طلب صاحب العلاقة، مُنحت هذه الإفادة.

بيروت، ١٦/١٠/ ٢٠١٩

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

لا مانع

مدير ثانوية الحريري الثالثة

اسامه محمد شعيب

Hariri High School III
الادارة
ثانوية الحريري الثالثة

5/11/2019

Campus des sciences humaines, rue de Damas
B.P. 17-5208 Mar Mikhaël Beyrouth 1104 2020 - Liban

حرم العلوم الإنسانيّة، طريق الشام

Appendix U

A Formal Request to Distribute the Survey of the Research Study

We are requesting your permission to distribute the survey questionnaire among your students in the secondary level.

This 5-points Likert scale survey has no impact on students. It only examines the extent of the effect of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in mathematics in the secondary level.

Your acceptance would enable the researcher to have enough background in the first phase of the study to properly prepare for the experimental part in the second phase that investigates employing WhatsApp, a social media platform, through smartphones on students' performance, through their grades, in the secondary level.

Your consideration and approval for us to implement our study is greatly appreciated as it affords needed samples to uncover the diverse influences and aspects of the social media platforms and smartphones with a touch screen on our students' math timed exams anxiety, behavior in class and competencies in a mathematical domain in the secondary level.

Sincerely,

The dissertation director: Pr. Naim El Rouadi

The researcher: Mohammad Anouti.

This request was reviewed and signed by:

NABIL Zouheiry

Name

Signature

INSTITUT SECONDAIRE MAANIEH Karakol El Druze Beyrouth

Appendix V

A Formal Request to Distribute the Survey of the Research Study

We are requesting your permission to distribute the survey questionnaire among students in secondary schools in Beirut.

This 5-points Likert scale survey has no impact on students. It only examines the extent of the effect of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in mathematics in the secondary level.

Your acceptance would enable the researcher to have enough background in the first phase of the study to properly prepare for the experimental part in the second phase that investigates employing WhatsApp, a social media platform, through smartphones on students' performance, through their grades, in the secondary level.

Your consideration and approval for us to implement our study is greatly appreciated as it affords needed samples to uncover the diverse influences and aspects of the social media platforms and smartphones with a touch screen on our students' math timed exams anxiety, behavior in class and competencies in a mathematical domain in the secondary level.

Sincerely.

The dissertation director: Pr. Naim El Rouadi

The researcher: Mohammad Anouti.

This request was reviewed and signed by:

Mostafa Kheir

Name

AL IMAM PILOT SECONDARY SCHOOL THE ADMINISTRATION — BEIRUT

Signature

Appendix W

طلب رسمي لتوزيع استمارة البحث

نطلب إذن حضرتكم لتوزيع استبيان على طلابكم في المرحلة الثانوية.
هذا الاستطلاع، الذي تم تقييمه بـ 5 نقاط على مقياس Likert، لا يؤثر على الطلاب. هو مصمم فقط لفحص مدى تأثير الهواتف الذكية مع شاشة تعمل باللمس ومنصّات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال حل المسائل الرياضية في المرحلة الثانوية .

ستمكّن موافقتكم الباحث من الحصول على خلفية كافية في المرحلة الاولى من الدراسة للإعداد بشكل صحيح للجزء التجريبي في المرحلة الثانية التي تبحث في توظيف ال WhatsApp، منصة التواصل الاجتماعي، من خلال الهواتف الذكية، على اداء الطلاب، من خلال درجاتهم، في المرحلة الثانوية.

يحظى تقديركم وموافقتكم على تنفيذ دراستنا بتقدير كبير حيث إنها توفر العينات اللازمة للكشف عن التأثيرات والجوانب المتنوعة لمنصات التواصل الاجتماعي والهواتف الذكية من خلال شاشة تعمل باللمس على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال في مادّة الرياضيات في المرحلة الثانوية.

بكل اخلاص:
المشرف على الأطروحة: البرفسور نعيم الرويدي
الباحث: محمّد فيصل عانوتي

تمت مراجعة هذا الطلب وتوقيعه من قبل:

مدير ليسيه المتحف

LYCÉE DU MUSÉE
Bureau Pédagogique

التوقيع

٢٦/١١/٢٠١٩

LYCÉE DU MUSÉE
Bureau Pédagogique

Appendix X

Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت
Faculté des sciences de l'éducation
كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3158

إفادة

لمن يهمّه الأمر.

إنَّ **الطالب محمد عانوتي**، المولود في بيروت (لبنان)، سنة ١٩٧٨، مسجّل في الكلية في الفصل الجامعي الأول من العام الدراسي ٢٠١٩ – ٢٠٢٠، لإعداد رسالة الدكتوراه في العلوم التربوية.

وهو يُعِدّ اطروحته بعنوان : " تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"، وذلك بإشراف الدكتور نعيم الرويدي.

فنرجو من أصحاب العلاقة التفضّل بتسهيل أمره، ليتمكّن من القيام بما تقتضيه اطروحته ، ولهم منّا جزيل الشكر، وفائق الاحترام.

وبناءً على طلب صاحب العلاقة، مُنحت هذه الإفادة.

بيروت، ٢٠١٩/١٠/١٦

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

Maral Degirmenjian

CENTRAL HIGH SCHOOL BEIRUT

بيروت - لبنان

Campus des sciences humaines, rue de Damas | حرم العلوم الإنسانيّة، طريق الشام

Appendix Y

Collège du Sacré-Cœur
Gemmayzé - Beyrouth
Le Chef d'Établissement

مَدرَسَــة القَـلب الأقـْدَس
الجميزة - بيروت
الـمدير

Je, soussigné, M. Salim Gereige, directeur du Collège du Sacré Cœur, accepte que M. Amouti Mohammade fasse une étude pour sa thèse en doctorat auprès des élèves du cycle secondaire.

15/11/2019

Appendix Z

USJ 1875
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Faculté des sciences de l'éducation

كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3158

إفادة

لمن يهمّه الأمر.

إنَ **الطالب محمد عانوتي**، المولود في بيروت (لبنان)، سنة ١٩٧٨، مسجّل في الكلية في الفصل الجامعي الأول من العام الدراسي ٢٠١٩ — ٢٠٢٠، لإعداد رسالة الدكتوراه في العلوم التربوية.

وهو يُعِدّ اطروحته بعنوان : " تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"، وذلك بإشراف الدكتور نعيم الرويدي.

فنرجو من أصحاب العلاقة التفضّل بتسهيل أمره، ليتمكّن من القيام بما تقتضيه اطروحته ، ولهم منّا جزيل الشكر، وفائق الاحترام.

وبناءً على طلب صاحب العلاقة، مُنحت هذه الإفادة.

بيروت، ١٦/١٠/ ٢٠١٩

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

Campus des sciences humaines, rue de Damas

حرم العلوم الانسانية، طريق الشام

Appendix AA

طلب رسمي لتوزيع استمارة البحث

نطلب إذن حضرتكم لتوزيع استبيان على طلابكم في المرحلة الثانوية.
هذا الاستطلاع، الذي تم تقييمه بـ 5 نقاط على مقياس•Likert، لا يؤثر على الطلاب. هو مصمم فقط لفحص مدى تأثير الهواتف الذكية مع شاشة تعمل باللمس ومنصات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال حل المسائل الرياضية في المرحلة الثانوية .

ستمكن موافقتكم الباحث من الحصول على خلفية كافية في المرحلة الأولى من الدراسة للإعداد بشكل صحيح للجزء التجريبي في المرحلة الثانية التي تبحث في توظيف ال WhatsApp، منصة التواصل الاجتماعي، من خلال الهواتف الذكية، على أداء الطلاب، من خلال درجاتهم، في المرحلة الثانوية.

يحظى تقديركم وموافقتكم على تنفيذ دراستنا بتقدير كبير حيث إنها توفر العيّنات اللازمة للكشف عن التأثيرات والجوانب المتنوعة لمنصات التواصل الاجتماعي والهواتف الذكية من خلال شاشة تعمل باللمس على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال في مادّة الرياضيات في المرحلة الثانوية.

بكلّ إخلاص:
المشرف على الأطروحة: البرفسور نعيم الرويدي
الباحث: محمّد فيصل عانوتي

تمت مراجعة هذا الطلب وتوقيعه من قبل:

الأخت نوري أبو ناضل
الإسم

التوقيع

المدرسة الثانوية لراهبات المحبة
الهاتف : ٣٣٩٩٣٨ / ١٦٦٤٠٧
الأشرفية – السيوفي – بيروت

Appendix AB

طلب رسمي لتوزيع استمارة البحث

نطلب إذن حضرتكم لتوزيع استبيان على طلابكم في المرحلة الثانوية.
هذا الاستطلاع، الذي تم تقييمه بـ 5 نقاط على مقياس Likert، لا يؤثر على الطلاب. هو مصمّم فقط لفحص مدى تأثير الهواتف الذكية مع شاشة تعمل باللمس ومنصّات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال حل المسائل الرياضيّة في المرحلة الثانوية .

ستمكّن موافقتكم الباحث من الحصول على خلفية كافية في المرحلة الأولى من الدراسة للإعداد بشكل صحيح للجزء التجريبي في المرحلة الثانية التي تبحث في توظيف ال WhatsApp، منصة التواصل الاجتماعي، من خلال الهواتف الذكية، على أداء الطلاب، من خلال درجاتهم، في المرحلة الثانويّة.

يحظى تقديركم وموافقتكم على تنفيذ دراستنا بتقدير كبير حيث إنها توفر العيّنات اللازمة للكشف عن التأثيرات والجوانب المتنوعّة لمنصات التواصل الاجتماعي والهواتف الذكية من خلال شاشة تعمل باللمس على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال في مادّة الرياضيات في المرحلة الثانويّة.

بكلّ إخلاص:
المشرف على الأطروحة: البرفسور نعيم الرويدي
الباحث: محمّد فيصل عانوتي

تمت مراجعة هذا الطلب وتوقيعه من قبل:

الإسم

Appendix AC

A Formal Request to Distribute the Survey of the Research Study

We are requesting your permission to distribute the survey questionnaire among your students in the secondary level.

This 5-points Likert scale survey has no impact on students. It only examines the extent of the effect of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in mathematics in the secondary level.

Your acceptance would enable the researcher to have enough background in the first phase of the study to properly prepare for the experimental part in the second phase that investigates employing WhatsApp, a social media platform, through smartphones on students' performance, through their grades, in the secondary level.

Your consideration and approval for us to implement our study is greatly appreciated as it affords needed samples to uncover the diverse influences and aspects of the social media platforms and smartphones with a touch screen on our students' math timed exams anxiety, behavior in class and competencies in a mathematical domain in the secondary level.
Sincerely.

The dissertation director: Pr. Naim El Rouadi
The researcher: Mohammad Anouti.

مدرسة مار الياس بطينا الثانوية
الادارة
Collège Saint Elie Btina

This request was reviewed and signed by:

______________________ ______________________

Name **Signature**

Appendix AD

A Formal Request to Distribute the Survey of the Research Study

We are requesting your permission to distribute the survey questionnaire among your students in the secondary level.

This 5-points Likert scale survey has no impact on students. It only examines the extent of the effect of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in mathematics in the secondary level.

Your acceptance would enable the researcher to have enough background in the first phase of the study to properly prepare for the experimental part in the second phase that investigates employing WhatsApp, a social media platform, through smartphones on students' performance, through their grades, in the secondary level.

Your consideration and approval for us to implement our study is greatly appreciated as it affords needed samples to uncover the diverse influences and aspects of the social media platforms and smartphones with a touch screen on our students' math timed exams anxiety, behavior in class and competencies in a mathematical domain in the secondary level.
Sincerely,

The dissertation director: Pr. Naim El Rouadi
The researcher: Mohammad Anouti.

This request was reviewed and signed by:

Alice Azar Wazir
Name

لبنان
Lebanon
THE BEIRUT BAPTIST SCHOOL
Signature

Appendix AE

USJ 1875
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Faculté des sciences de l'éducation

كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3158

إفادة

لمن يهمّه الأمر.

إنّ **الطالب محمد عانوتي**، المولود في بيروت (لبنان)، سنة ١٩٧٨، مسجّل في الكلية في الفصل الجامعي الأول من العام الدراسي ٢٠١٩ – ٢٠٢٠، لإعداد رسالة الدكتوراه في العلوم التربوية.

وهو يُعِدّ اطروحته بعنوان : " تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"، وذلك بإشراف الدكتور نعيم الرويدي.

فنرجو من أصحاب العلاقة التفضّل بتسهيل أمره، ليتمكّن من القيام بما تقتضيه اطروحته ، ولهم منّا جزيل الشكر، وفائق الاحترام.

وبناءً على طلب صاحب العلاقة، مُنحت هذه الإفادة.

بيروت، ١٦/١٠/ ٢٠١٩

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

Ecole des Frères Saint Joseph - Achrafieh
FSJ
مدرسة أبناء مار يوسف
الادارة التربوية

Campus des sciences humaines, rue de Damas

حرم العلوم الانسانية، طريق الشام

Appendix AF

03.067273

Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Faculté des sciences de l'éducation

كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3158

إفادة

لمن يهمّه الأمر.

إنَ **الطالب محمد عانوتي**، المولود في بيروت (لبنان)، سنة ١٩٧٨، مسجّل في الكلية في الفصل الجامعي الأول من العام الدراسي ٢٠١٩ — ٢٠٢٠، لإعداد رسالة الدكتوراه في العلوم التربوية.

وهو يُعِدّ اطروحته بعنوان : " تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"، وذلك بإشراف الدكتور نعيم الرويدي.

فنرجو من أصحاب العلاقة التفضّل بتسهيل أمره، ليتمكّن من القيام بما تقتضيه اطروحته ، ولهم منّا جزيل الشكر، وفائق الاحترام.

وبناءً على طلب صاحب العلاقة، مُنحت هذه الإفادة.

بيروت، ٢٠١٩/١٠/١٦

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

Campus des sciences humaines, rue de Damas

حرم العلوم الإنسانية، طريق الشام

Appendix AG

طلب رسمي لتوزيع استمارة البحث

نطلب إذن حضرتكم لتوزيع استبيان على طلابكم في المرحلة الثانوية.

هذا الاستطلاع، الذي تم تقييمه بـ 5 نقاط على مقياس Likert، لا يؤثر على الطلاب. هو مصمّم فقط لفحص مدى تأثير الهواتف الذكية مع شاشة تعمل باللمس ومنصّات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال حل المسائل الرياضيّة في المرحلة الثانوية .

ستمكّن موافقتكم الباحث من الحصول على خلفية كافية في المرحلة الأولى من الدراسة للإعداد بشكل صحيح للجزء التجريبي في المرحلة الثانية التي تبحث في توظيف ال WhatsApp، منصة التواصل الاجتماعي، من خلال الهواتف الذكية، على أداء الطلاب، من خلال درجاتهم، في المرحلة الثانويّة.

يحظى تقديركم وموافقتكم على تنفيذ دراستنا بتقدير كبير حيث إنها توفر العيّنات اللازمة للكشف عن التأثيرات والجوانب المتنوعّة لمنصات التواصل الاجتماعي والهواتف الذكية من خلال شاشة تعمل باللمس على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال في مادّة الرياضيات في المرحلة الثانويّة.

بكلّ إخلاص:

المشرف على الأطروحة: البرفسور نعيم الرويدي

الباحث: محمّد فيصل عانوتي

تمت مراجعة هذا الطلب وتوقيعه من قبل:

Le 11-12-19

Randa Sakhel Kaih

الإسم

Ecole Notre Dame des Anges des Pères Capucins Beyrouth Badaro

التوقيع

Appendix AH

طلب رسمي لتوزيع استمارة البحث

نطلب إذن حضرتك لتوزيع استبيان على الطلاب في المدارس الثانوية العامة في بيروت.
هذا الاستطلاع، الذي تم تقييمه بـ 5 نقاط على مقياس Likert، لا يؤثر على الطلاب. هو مصمّم فقط لفحص مدى تأثير الهواتف الذكية مع شاشة تعمل باللمس ومنصّات التواصل الاجتماعي ، مثل WhatsApp وغيرها، على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوكٌ في الصف والكفاءات في مجال حل المسائل الرياضيّة في المرحلة الثانوية .

ستمكّن موافقتك الباحث من الحصول على خلفية كافية في المرحلة الأولى من الدراسة للإعداد بشكل صحيح للجزء التجريبي في المرحلة الثانية التي تبحث في توظيف ال WhatsApp، منصة التواصل الاجتماعي، من خلال الهواتف الذكية، على أداء الطلاب، من خلال درجاتهم، في المرحلة الثانويّة.

يحظى تقديرك وموافقتك على تنفيذ دراستنا بتقدير كبير حيث إنها توفر العيّنات اللازمة للكشف عن التأثيرات والجوانب المتنوعّة لمنصات التواصل الاجتماعي والهواتف الذكية من خلال شاشة تعمل باللمس على قلق الطلاب في امتحانات الرياضيات ذات الوقت المحدد، السلوك في الصف والكفاءات في مجال في مادّة الرياضيات في المرحلة الثانويّة.

بكلّ إخلاص:
المشرف على الأطروحة: البرفسور نعيم الرويدي
الباحث: محمّد فيصل عانوتي

تمت مراجعة هذا الطلب وتوقيعه من قبل:

سلوى عمر مراد
الإسم

التوقيع

ثانوية بيروت
مرسوم رقم
٢٧٥٩
Beirut High School

Appendix AI

USJ 1875
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Faculté des sciences de l'éducation

كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3158

إفـادة

لمن يهمّه الأمر.

إنّ **الطالب محمد عانوتي**، المولود في بيروت (لبنان)، سنة ١٩٧٨، مسجّل في الكلية في الفصل الجامعي الأول من العام الدراسي ٢٠١٩ — ٢٠٢٠، لإعداد رسالة الدكتوراه في العلوم التربوية.

وهو يُعِدّ اطروحته بعنوان : " تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"، وذلك بإشراف الدكتور نعيم الرويدي.

فنرجو من أصحاب العلاقة التفضّل بتسهيل أمره، ليتمكّن من القيام بما تقتضيه اطروحته ، ولهم منّا جزيل الشكر، وفائق الاحترام.

وبناءً على طلب صاحب العلاقة، مُنحت هذه الإفادة.

بيروت، ١٦/١٠/٢٠١٩

مديرة مختبر الأبحاث التربوية
الدكتورة ايفيت الغريب

la direction accepte la demande de M. Mohamad Anouty / USJ / fsedu.

INSTITUTION Ste. ANNE
S.A.
...ncon, Beyrouth

Campus des sciences humaines, rue de Damas

حرم العلوم الإنسانيّة، طريق الشام

Appendix AJ

USJ 1875
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Faculté des sciences de l'éducation

كليّة العلوم التربويّة

Référence : 19/USJ/FSEDU/3158

إفادة

لمن يهمّه الأمر.

إنَ **الطالب محمد عانوتي**، المولود في بيروت (لبنان)، سنة ١٩٧٨، مسجّل في الكلية في الفصل الجامعي الأول من العام الدراسي ٢٠١٩ — ٢٠٢٠، لإعداد رسالة الدكتوراه في العلوم التربوية.

وهو يُعِدّ اطروحته بعنوان : " تأثير استخدام منصة الواتس اب على تعلم الطلاب في مادة الرياضيات في المرحلة الثانوية"، وذلك بإشراف الدكتور نعيم الرويدي.

فنرجو من أصحاب العلاقة التفضّل بتسهيل أمره، ليتمكّن من القيام بما تقتضيه اطروحته ، ولهم منّا جزيل الشكر، وفائق الاحترام.

وبناءً على طلب صاحب العلاقة، مُنحت هذه الإفادة.

بيروت، ٢٠١٩/١٠/١٦

مديرة مختبر الأبحاث التربوية

الدكتورة ايفيت الغريب

Approved by Director
Mohamad Halawani

Makhaa National School
Beirut 1966

Campus des sciences humaines, rue de Damas | حرم العلوم الإنسانيّة، طريق الشام

Appendix AK

USJ
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Comité d'éthique

لجنة الأخلاقيّات

Beyrouth, le 16 janvier 2020

Monsieur le Professeur Nadim EL ROUADI
Faculté des sciences de l'éducation

Nos réf. : USJ -2020-22 (numéro à rappeler dans toute correspondance)

Titre : Impact of employing the WhatsApp platform, via its interaction features, on secondary students' mathematical learning.

Cher Collègue,

Lors de sa réunion du 14 janvier, le Comité a étudié ce dossier introduit dans le cadre de la thèse de doctorat de Mohammad ANOUTI. Le Comité a pris acte de votre courriel daté du 08/01 ; ce courriel était accompagné du protocole de l'étude en version anglaise, de la lettre du promoteur, d'un formulaire d'information introductif au questionnaire en versions anglaise et arabe, de l'accord du ministère de l'éducation nationale et de l'accord de 27 écoles privées.

Après en avoir délibéré, le Comité estime à l'unanimité que ce projet ne soulève aucune objection d'ordre éthique ; il vous notifie donc bien volontiers son accord et vous autorise à utiliser le questionnaire proposé. Par ailleurs, je vous invite à me faire parvenir un courriel introduisant le doctorant.

Avec tous mes vœux pour le succès de cette recherche, je vous prie de croire, Cher collègue, en l'assurance de mes sentiments dévoués.

Professeur Michel SCHEUER
Président

N.B. Merci d'aviser le CÉR de toute modification au protocole de recherche pouvant avoir une incidence sur le plan éthique et de l'informer des conclusions générales et des résultats de l'étude.

Centre universitaire d'éthique, Campus des sciences médicales, rue de Damas
B.P. 11-5076 Riad el Solh, Beyrouth 1107 2180 - Liban
Tél. 961-1-421229 Email cue@usj.edu.lb

المركز الجامعي للأخلاقيّات، حرم العلوم الطبيّة، طريق الشام
ص.ب.: ١١-٥٠٧٦، رياض الصلح - بيروت
هاتف ٩٦١-١-٤٢١٢٢٩

المدرسة البطريركية
تأسست سنة ١٨٦٤

Appendix AL

APPLICATION FOR ETHICS CLEARANCE FOR RESEARCH INVOLVING HUMAN PARTICIPANTS

SAIT-JOSEPH UNIVERSITY
FACULTY OF SCIENCES OF EDUCATIO

Name and student number:
Mohammad Faysal Anouty.

Matricule 193882

Title of the Dissertation:
Impact of Employing the WhatsApp Platform, Via Its Interaction Features, On Secondary Students' Mathematical Learning.

Supervisor:
Prof. Naim El Rouadi.

Purpose of the Study:

Through a modified survey validated by two assistant professors in math education, the first phase of the study examines the impact of smartphones and social media platforms, like WhatsApp, on students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in the secondary level in private and public schools in Beirut.

The preliminary survey of the study has revealed that WhatsApp, a social media platform, is the most common used platform among students in the secondary level. Thus, in its second phase and through a sample of students in the secondary level, the study investigates the impact of employing WhatsApp, via its interaction features and collaborative learning, on reinforcing their mathematical learning in the previously mentioned domain.

More specifically, this study enlightens on the advantages of a social media platform, WhatsApp, when it is properly employed to serve students' learning in a mathematical domain, and the disadvantages of social media and smartphones on important aspects of students' math learning in the secondary level in Beirut according to the way they are currently used.

Thus, identifying the impact of smartphones and social media platforms (independent variables) on students' math timed exams anxiety, behavior in class and competencies the problem solving and communication domain in mathematics in the secondary level (dependent variables) is a purpose for this research. However, the study's also aims at presenting the WhatsApp platform, via its interaction features and collaborative learning, as a possible learning instrument for secondary students math learning, which in turn might positively reflect on students' in the middle schools and the elementary level if proven useful.

By identifying the possible disadvantages of social media and smartphones, the relationship(s), if any, between or among the previously mentioned independent and dependent variables, parents, teachers and educators might be able to identify some of the reasons negatively influencing students' math timed exams anxiety, behavior in class and competencies in the problem solving and communication domain in mathematics in the secondary level.

In addition, by identifying the possible advantages of social media and smartphones, educators will also be presented with a new aspect concerning proper employment of WhatsApp as a possible contemporary platform that can reinforce students' learning in the same math domain in the secondary level through online interaction and collaboration, which they could adopt for the benefit of learning of their students.

Finally, according to the head of the mathematics Department at the Center for Educational Researches and Development and the rapporteur of the official exams committee in the secondary level, the Lebanese curriculum has remained subject-centered for many decades. For that, this dissertation also aims at help further improving the construction of the upcoming advanced Lebanese curriculum in mathematics. Educators assigned to its construction may prefer adopting the students-centered approach. In this case, they may consider taking advantage of the social media popularity among students and label the WhatsApp platform, with proper employment, as an instrument that solidifies students' math learning if proven useful according to the results of this dissertation.

It is hoped that results of the study will expand upon a wide number of researchers interested in aspects near or similar to this research due to the importance of the targeted factors.

Duration:
Spreading the survey among 10% of students in the secondary level in private and public schools in Beirut needs two months. In addition, collecting the distributed surveys needs almost the same duration.

SUPERVISOR'S APPROVAL

Comments of the Director of the Dissertation:

In my point of view, I consider this dissertation to be a pioneering work on the national and regional levels.

In Lebanon, students' mathematical learning is essential in determining their future academic pathway. Many majors in universities, such as engineering and computer sciences, require high mathematical skills from students. Thus it very important from us to determine factors that negatively contribute to their mathematical learning in order to find solutions and properly employ them.

Students' math anxiety in timed exams, their behavior in class and their competencies determine their performance in math and craft their image in front of their teachers. Thus, it is important for us to determine what could possibly be negatively influencing them.

Social media platforms and smartphones are ubiquitously popular among people, including students. Many are calling for more studies to uncover their effect on students' learning specifically because they are the future of any country. Thus, it also important for us to determine the relationships that exist, if any, between students' usage of smartphones and social media platforms, and their math timed exams anxiety, behaviour in class and competencies, Lebrun (2012), in one mathematical domain since it is not possible to examine all math domains in one dissertation.

In addition to all of the aforementioned, the ultimate goal of this dissertation is to properly employ the WhatsApp platform for the benefit of students' mathematical learning in the same domain through an experiment based on online interaction and collaboration between the students themselves and the researcher, Engstrom's third generation system of activities, the scaffolding of Bruner and the deliberate practice through-which students' learning will be supported by extra sheets that were not be solved during the learning sessions to reach better grades in math exams.

It is important for us to indicate that the researcher has already experimented the impact of WhatsApp as a learning instrument on students in the third year secondary, section economics and sociology, according to what was mentioned in the previous paragraph and under my supervision. Though results were satisfying, our goal is to replicate the experiment and examine the results of students in other sections like life sciences, general sciences and second year secondary scientific in the same problem solving and communication math domain.

With all due respect, Pr. Naim El Rouadi

USJ 1875
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

Comité d'éthique

لجنة الأخلاقيّات

Beyrouth, le 16 janvier 2020

Monsieur le Professeur Nadim EL ROUADI
Faculté des sciences de l'éducation

Nos réf. : USJ -2020-22 (numéro à rappeler dans toute correspondance)

Titre : Impact of employing the WhatsApp platform, via its interaction features, on secondary students' mathematical learning.

Cher Collègue,

Lors de sa réunion du 14 janvier, le Comité a étudié ce dossier introduit dans le cadre de la thèse de doctorat de Mohammad ANOUTI. Le Comité a pris acte de votre courriel daté du 08/01 ; ce courriel était accompagné du protocole de l'étude en version anglaise, de la lettre du promoteur, d'un formulaire d'information introductif au questionnaire en versions anglaise et arabe, de l'accord du ministère de l'éducation nationale et de l'accord de 27 écoles privées.

Après en avoir délibéré, le Comité estime à l'unanimité que ce projet ne soulève aucune objection d'ordre éthique ; il vous notifie donc bien volontiers son accord et vous autorise à utiliser le questionnaire proposé. Par ailleurs, je vous invite à me faire parvenir un courriel introduisant le doctorant.

Avec tous mes vœux pour le succès de cette recherche, je vous prie de croire, Cher collègue, en l'assurance de mes sentiments dévoués.

UNIVERSITÉ SAINT-JOSEPH USJ Comité d'éthique

Professeur Michel SCHEUER
Président

N.B. Merci d'aviser le CÉR de toute modification au protocole de recherche pouvant avoir une incidence sur le plan éthique et de l'informer des conclusions générales et des résultats de l'étude.

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هاتف ٩٦١-١-٤٢١٢٢٩

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Appendix AM

Saint-Joseph University

Faculty of Education

Experimenting the Impact of Employing the WhatsApp platform on Students' Performance in the Problem Solving and Communication Domain in the Secondary Level

Participation Consent Form

On behalf of my classmates, I, the delegate, approve our participation in experimenting the impact of employing the WhatsApp platform on our mathematical performance in the problem solving and communication domain.

The researcher is hereby authorized to collect our mobiles numbers and create a WhatsApp group to interact and collaborate online at a daily predetermined synchronic time.

We understand that this experiment might benefit our math performance in exams/official exams. Therefore, we are seriously committed to accomplish its objectives as much as possible.

We also understand that we are here volunteering to participate. Meaning that, any of us is free to withdraw at any time he wants without any repercussion or penalty.

Finally, through the WhatsApp, we realize that we have the ability to ask a question in private if we need to do so outside the predetermined meeting time at an asynchronous time.

By signing this consent form, I confirm reading and understanding all of the mentioned above

____________________ ____________________

Name **Signature**

Appendix AN

Probabilité conditionnelle et variables aléatoire posttest- Classe : Science General
Année scolaire 2018-2019- Durée : 50 minutes

Exercice 1 - [4 points]

Répondre par vrai ou faux en justifiant votre réponse.

1) A et B sont deux événements tels que $P(A \cup B) = 0{,}7$ et $P(A/\overline{B}) = 0{,}3$ alors $P(B) = \frac{2}{7}$.
2) Une urne contient des boules numérotées de 1 à 100. Si on tire une boule de l'urne alors la probabilité que le nombre porté par cette boule soit un multiple de 3 sachant qu'il est un nombre premier est $\frac{17}{50}$.
3) Dans une école, $\frac{1}{4}$ des étudiants pratiquent le basketball, $\frac{2}{3}$ des étudiants pratiquent le tennis et $\frac{1}{4}$ des étudiants ne pratiquent ni le tennis ni le basketball. On interroge un étudiant au hasard. La probabilité qu'il pratique le tennis sachant qu'il pratique le basketball est $\frac{2}{3}$.
4) Trois dés bien équilibrés sont lancés. On considère les événements suivants:
   E : Le produit des nombres obtenus est 18.
   F : Au moins l'un des nombres obtenus est pair.
   Alors $P(E/F) = \frac{1}{21}$.

Exercice 3 - [6 points]

Un joueur achète par 10 dollars un billet permettant de participer à un jeu constitué d'un grattage suivi d'une loterie.
Il gratte une case sur le billet.
Il peut alors gagner 100 dollars avec une probabilité de $\frac{1}{50}$ ou bien ne rien gagner.
G désigne l'évènement : « Le joueur gagne au grattage ».
Il participe ensuite à une loterie avec le même billet.
À cette loterie, il peut gagner 100 dollars, ou 200 dollars, ou bien ne rien gagner.
L_1 désigne l'évènement « Le joueur gagne 100 dollars à la loterie ».
L_2 désigne l'évènement « Le joueur gagne 200 dollars à la loterie ».
P désigne l'événement : « Le joueur ne gagne rien à la loterie ».

Si le joueur gagne 100 dollars au grattage, la probabilité qu'il ne gagne rien à la loterie est $\frac{1}{10}$.
Si le joueur n'a rien gagné au grattage, la probabilité qu'il gagne 100 dollars à la loterie est $\frac{1}{70}$, et la probabilité qu'il gagne 200 dollars à la loterie est $\frac{1}{490}$.

1) Calculer la probabilité que le joueur ne gagne rien à la loterie, sachant qu'il n'a rien gagné au grattage.
2) On note X la variable aléatoire qui représente le gain algébrique total du joueur, après grattage et loterie, déduction faite du prix du billet.
   a) Montrer que -10, 90, 190 et 290 sont les quartes valeurs possibles de X.
   b) Sachant que $p(X=190)=\frac{1}{250}$, montrer que la probabilité que le joueur gagne 100 dollars à la loterie, sachant qu'il a gagné 100 dollars au grattage, est égale à $\frac{1}{10}$.
   c) Montrer que $p(X=90)=\frac{2}{125}$.
   d) Déterminer la loi de probabilité de X.
   e) Calculer l'espérance de X et interpréter sa valeur.

Appendix AO

وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات	امتحانات الشهادة الثانوية العامة الفرع : اجتماع و اقتصاد	دورة سنة 2019 العادية
عدد المسائل أربع	مسابقة في مادة الرياضيات المدة: ساعتان	الاسم: الرقم:

I- (4 points)
The table below represents the number of passengers (in millions) in an airport, for each year from 2014 to 2018.

Year	2014	2015	2016	2017	2018
Rank of the year: x_i	4	5	6	7	8
Number of passengers in millions): y_i	15	18	22	24	25

1) Represent the scatter plot of points $(x_i\ ,\ y_i)$ in a rectangular system.
2) Calculate the coordinates of the center of gravity $G(\bar{x}\ ;\ \bar{y})$ and plot G in the preceding system.
3) Calculate the correlation coefficient r and give an interpretation of the value thus obtained.
4) Determine an equation of the regression line $(D_{y/x})$, of y in terms x, and draw $(D_{y/x})$ in the preceding system.
5) Assume that the above model remains valid till the year 2023.
   a- Estimate the number of passengers in 2021.
   b- Suppose that the percentage increase in the number of passengers from the year 2018 to a year to be determined is 45.6 %. Determine this year.

II- (4 points)
A cafeteria sells dessert and coffee only.
A customer can buy one dessert, one cup of coffee, both or none.
In this cafeteria:

- 70 % of the customers buy dessert, among which 40 % buy coffee,
- among the customers who do not buy dessert, 35 % do not buy coffee.

One customer of this cafeteria is randomly selected and interviewed.
Consider the following events:
D : « The interviewed customer buys a dessert»,
C : « The interviewed customer buys a cup of coffee ».

1) a- Calculate the probabilities $P(C \cap D)$ and $P(C \cap \overline{D})$.
   b- Deduce that $P(C) = 0.475$.
2) A customer does not buy a cup of coffee. Calculate the probability that this customer does not buy a dessert.
3) In this cafeteria, the price of a dessert is 7 000 LL and the price of a cup of coffee is 3 000 LL. Denote by X the random variable equal to the sum paid by a customer.

a- Justify that $P(X = 0) = 0{,}105$.
b- Determine the probability distribution of X.
c- During a certain day, 500 customers entered the cafeteria.
Estimate the total revenue during that day.

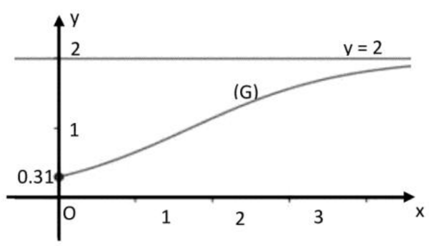
III- (4 points)
A company produces a certain type of objects.
At the end of January 2018, the monthly total cost was 9 million LL.
At the end of each month, the monthly total cost increases by 21 % with additional expenses of 840 000 LL, and so on for the following months.
For all natural numbers $n > 0$, denote by C_1 the monthly total cost, in millions LL, at the end of January 2018 and by C_n the monthly total cost, in millions LL, at the end of the n^{th} month.
Thus $C_1 = 9$ et $C_{n+1} = 1.21C_n + 0.84$.

1) Calculate C_3. Interpret the result obtained.
2) Consider the sequence (V_n) defined by $V_n = C_n + 4$.
   a- Show that (V_n) is a geometric sequence whose common ratio r and first term V_1 are to be determined.
   b- Show that $C_n = 13\times(1.21)^{n-1} - 4$.
   c- Show that the sequence (C_n) is strictly increasing.
   d- After how many months will the monthly total cost exceed 300 million LL for the first time? Justify.
3) The monthly revenue in millions LL, at the end of the nth month, for this company is modeled as $R_n = 100\times(1.07)^{n-1}$ for all natural numbers $n > 0$.
   Does the company achieve profit at the end of June 2019? Justify.

IV - (8 points)
Consider the function f defined over $[0\,;+\infty[$ as $f(x)=\dfrac{2}{2+e^{x-1}}$ and denote by (C) its representative curve in an orthonormal system $(O\,;\vec{i}\,;\vec{j})$.

Part A

1) a- Calculate f(0) and f(2) to the nearest 10^{-3}.
   b- Determine $\lim\limits_{x\to+\infty} f(x)$. Deduce an asymptote to (C).
2) a- Show that f is strictly decreasing.
   b- Set up the table of variations of f.
3) Consider the function g defined over $[0\,;+\infty[$ as $g(x)=\dfrac{2e^{x-1}}{2+e^{x-1}}$.
   The representative curve (G) of the function g and its asymptote are



given in the adjacent figure.

a- Solve the equation f(x) = g(x).

b- Copy (G) and draw (C) in the same system.

Part B

A factory produces a certain type of objects.

The demand function and the supply function are respectively modeled as $f(x)=\frac{2}{2+e^{x-1}}$ and $g(x)=\frac{2e^{x-1}}{2+e^{x-1}}$; where x is the unit price expressed in millions LL..

f(x) et g(x) are expressed in thousands of objects with $x \in]0 ; 5]$.

1) Calculate the demanded number of objects for a unit price of 2 million LL.
2) Calculate the unit price for a supply of 1000 objects.
3) Determine the equilibrium price.
4) Denote by E(x) the elasticity of the demand with respect to the unit price x.

a- Show that E(x) = $\frac{xe^{x-1}}{2+e^{x-1}}$ and calculate E(2).

b- If the unit price of 2 million LL increases by 1 %, then calculate the number of demanded objects.

Appendix AP

Distribution in two variables pre-test- Class: Economics and Sociology
Academic year: 2019-2020- Duration: 30 minutes

I- (10 points)
Complete the given sentences:

1- The set of points $M(x_i ; y_i)$ is called …………

2- If Y increases as X increases, then we say that there is …………….

3- If Y decreases as X increases, then we say that there is …………….

4- The point $G(\bar{x} ; \bar{y})$ is called ……………. or ………………….

5- The formula of the variance of X is ……………..

6- The formula of the variance of Y is ……………..

7- The formula of the standard deviation of X is ……………..

8- The formula of the standard deviation of Y is ……………..

9- The formula of the covariance of the variables X and Y is ………………..

10- The equation of the regression line $(D_{y/x})$, of y in x is …………… where ………. and ………..

11- The equation of the other regression line $(D'_{x/y})$, x in y, of equation ………….. where …………… and …………..

12- The regression line, $(D_{y/x})$ or $(D'_{x/y})$, has to pass through ………………..

13- To draw a line we have to ………………………………….

14- The coefficient of correlation of the series (X ;Y) is given by …………………

15- There is a weak correlation when ……………… or …………………….

16- There is a moderate correlation when ……………… or …………………

17- There is a strong correlation when ……………… or …………………

18- The percentage of increase of a variable is defined by ………………..

19- The percentage of decrease of a variable is defined by ………………..

20- The percentage of error in the estimation of a variable is defined by ………………..

Appendix AQ

Distribution in two variables post-test- Class: Economics and Sociology
Academic year: 2019-2020- Duration: 40 minutes

I- (5 points)
The table below represents the evolution of the Indian population, in millions, between the years the years 1995 and 2015:

Year	1995	2000	2005	2010	2015
Rank of the year : x_i	1	6	11	16	21
Number of inhabitants, in millions : y_i	963	1056	1147	1234	1310

Source : worldometers.info (2019)

1) Draw the scatter plot associated to the points $(x_i ; y_i)$.
2) Write an equation of the regression line $(D_{y/x})$, of y in terms of x, and draw it in the preceding system.
3) Calculate the coefficient of correlation r and interpret its value.
4) The Indian population increased in the year 2017 by 38.94% with respect to that in the year 1995. What was the Indian population in 2017?
5) Suppose that the above pattern remains valid till the year 2030.
   a- Estimate the number of Indian inhabitants in 2018.
   b- In reality, the number of Indian inhabitants in 2018 was 1 352 642 280.
   Calculate the percentage of error committed by the preceding estimation.
   c- Starting from which year would the Indian population la population exceed 1.5 billion inhabitants for the first time? Justify.
6) The scatter plot (N) is divided into two parts: (N_1) is the scatter plot associated to the three values 1, 2 and 3, and (N_2) is associated to the values 4 and 5.
   Denote by G_1 and G_2 the respective mean points of the scatter plots (N_1) and (N_2).
   a) We admit that an equation of the line (G_1G_2) is $y = 17.3336x + 951.3284$.
   Verify that G belongs to (G_1G_2).
   b) Between the two preceding lines $(D_{y/x})$ and (G_1G_2), which one gives a better estimation of the number of Indian inhabitants in 2018? Justify your answer.

Appendix AR

Probabilité conditionnelle et variable aléatoire posttest. Classe : Sciences de la Vie
Année scolaire : 2019-2020- Durée: 40 minutes

I- (10 points)

Le tableau suivant représente la distribution des élèves d'une école secondaire :

	Filles	Garçons
Première année	7	13
Deuxième année	10	12
Troisième année	13	15

Un groupe de trois élèves est choisi **simultanément** pour représenter l'école dans une compétition.

1) On considère les événements suivants:
   A: « Les trois élèves choisis sont deux filles et un garçon »
   B: « Les trois élèves choisis sont en deuxième année secondaire »
   a) Vérifier que la probabilité P(A) est égale à $\frac{870}{2737}$ et calculer P(B).
   b) Montrer que $P(A \cap B) = \frac{27}{2737}$. En déduire $P(A \cap \overline{B})$ et $P(A/\overline{B})$.
   c) Calculer $P(A \cup B)$. Déduire $P(\overline{A} \cap \overline{B})$.
   d) Les trois élevés choisis sont des garçons. Calculer la probabilité qu'ils soient de la troisième année secondaire.
   e) Deux garçons et une fille sont choisis. Calculer la probabilité qu'ils sont de la même année secondaire.
2) On désigne par X la variable aléatoire égal au nombre des garçons de la troisième année secondaire choisis parmi ces trois élevés.
   a) Calculer la loi de probabilité de X.
   b) Calculer $P(X < 2)$.
3) Dans cette partie on choisit au hasard et **successivement sans remise** trois élèves.
   a) Quelle est la probabilité que le premier élevé choisi est un garçon en 1ère année, la deuxième est une fille est en 2ème année et la troisième est une fille est en 3ème année ?
   b) Quelle est la probabilité qu'un garçon est en 1ère année, une fille est en 2ème année et une autre fille est en 3ème année ?
   c) Quelle est la probabilité de choisir au moins un garçon ?
   d) Quelle est la probabilité de choisir au plus deux filles ?
   e) Quelle est la probabilité que les trois élèves sont deux filles et un garçon sachant qu'ils sont en 2ème année secondaire ?
   f) Quelle est la probabilité qu'au moins un élève choisi soit de la 1ère année, au moins un élève choisi soit de la 2ère année et aucun élève choisi soit de la 3ère année?

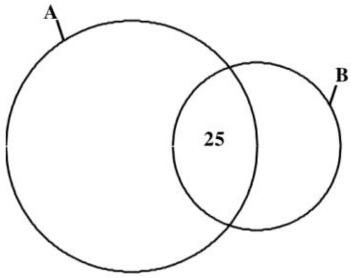
Appendix AS

Conditional probability and random variables pre-test- Class: General Sciences

Academic year: 2019-2020- Duration: 40 minutes

I- (10 points)

We asked 100 persons about their interest in tennis, if they do practice the sport or they just watch it on television. The results as follows: 75 are tennis spectators on the television, 40 practice this sport, 25 do both.



1. Let A be the set of spectators and B the set of tennis players among the persons who were asked in the first place.
   Complete the given diagram above by indicating the number of persons who have no interest in tennis at all.
2. Determine $P(A)$, $P(B)$ and $P(A \cap B)$. (Respective probabilities that a chosen individual is a spectator, player or at the same time a spectator and a player).
3. We are interested in the proportion of the players among the spectators which is.
   What is its value ?
   Compare it with $\frac{P(A \cap B)}{P(A)}$. What can you deduce?
   (We call this quotient: probability that an individual is a player knowing that he is a spectator, or conditional probability of the event B knowing A). We denote it by: $P(B/A)$.
4. Determine as well the probability that an individual is a spectator knowing that he is a player, noted $P(A/B)$.
5. As well calculate, by giving the signification, the following probabilities : $P(A/\overline{B})$, $P(\overline{A}/B)$, $P(\overline{A}/\overline{B})$, $P(B/\overline{A})$, $P(\overline{B}/A)$.
6. Calculate $P(A \cap B) + P(A \cap \overline{B})$ then compare it to P(A).
7. Calculate $P(A \cap B) + P(\overline{A} \cap B)$ then compare it to P(B).
   The obtained equality is called : formula of total probability.
8. Now we chose 2 persons randomly, and we are interested in the number of tennis players between the two chosen persons.
   a. Complete the following sentences :

0 = between the 2 chosen persons no one plays tennis.
1 = ……………………………………………………….
2 = ……………………………………………………….
The set of values obtained is noted by the random variable X which represents the number of tennis players obtained between the 2 chosen persons.

b. Calculate: $P(X=1)$, $P(X=2)$ and complete the following table:

$X = x_i$	0	1	2	Total
$P(X = x_i)$				

Deduce that : $P(X=0)+P(X=1)+P(X=2)=1$

c. Calculate the value of: $0\times P(X=0)+1\times P(X=1)+2\times P(X=2)$.
Deduce the expected value EX.

.

Appendix AT

Probabilité conditionnelle et variables aléatoire posttest- Classes : Science General
Année scolaire : 2019-2020- Durée : 50 minutes

I- [10 points]
On considère deux urnes U et V tels que :
L'urne U contient 7 boules blanches et 3 boules vertes.
L'urne V contient 3 boules blanches et 6 boules vertes.

Partie A
On tire 4 boules simultanément et au hasard de l'urne U.
Calculer la probabilité de chacun des événements suivants :
A : « exactement deux boules parmi les 4 boules tirées sont blanches » ;
B : « au moins une boule parmi les 4 boules tirées est verte ».

1) Montrer que $P(A) = \frac{3}{10}$ et calculer P(B).
2) Calculer $P(A \cap B)$. En déduire que $P(A/B) = \frac{9}{25}$.
3) Calculer $P(\overline{A} \cap \overline{B})$.
4) Calculer la probabilité de tirer au moins une boule blanche et au moins deux boules vertes dans le même tirage de l'urne U.

Partie B
On tire deux boules simultanément de l'urne U, et deux boules successivement et sans remise de l'urne V.

1) Calculer la probabilité d'obtenir 2 boules blanches d'une urne et deux boules vertes de l'autre urne.
2) Montrer que la probabilité d'obtenir exactement une boule verte est $\frac{49}{180}$.
3) Les deux boules tirées de l'urne U sont blanches, calculer la probabilité que les deux boules tirées de l'urne V sont vertes.

Partie C
On tire une boule de l'urne U et on la place dans V puis on tire simultanément 2 boules de l'urne V.
On désigne par X la variable aléatoire égale au nombre des boules vertes **restantes** dans l'urne V à la fin des deux tirages.

1) Montrer que $P(X = 5) = \frac{77}{150}$.
2) Déterminer la loi de probabilité de X.
3) Calculer $P(X = 4 / X \leq 5)$.
4) Calculer l'espérance mathématique EX et interpréter sa valeur.

Partie D

On choisit l'une des deux urnes U et V puis on tire successivement et avec remise trois boules de l'urne choisie.
L'urne U a deux fois de chances d'être choisie que l'urne V.
On considère les événements suivants :
U : « l'urne choisie est U » ;
W : « obtenir au plus une boule blanche parmi les trois boules tirées »

1) Montrer que $P(U) = \frac{2}{3}$.
2) Montrer que $P(W/U) = \frac{27}{125}$. Déduire $P(W \cap U)$.
3) Calculer $P(W)$.
4) Sachant que, parmi les trois boules tirées, exactement deux boules sont vertes, calculer la probabilité que l'urne choisie est U.

Appendix AU

Suites numériques posttest- classe : Economie et Sociologie
Année scolaire : 2019-2020- Durée : 40 minutes

I- (5 points)
Ahmad veut louer un appartement pour sept ans. Pour cela, le propriétaire lui propose deux contrats :

Contrat № 1 :
Ahmad paye 8 000$ au début de la première année puis il y aura une augmentation de 400$ par an.
On désigne par A_n, en $, la somme payée au début de la $n^{ième}$ année. Ainsi $A_1 = 8\ 000$.

1) Calculer la somme payée, par Ahmad, au début de la troisième année.
2) Vérifier que (A_n) est une suite arithmétique croissante puis exprimer A_n en fonction de n.
3) Calculer la somme payée, par Ahmad, au début de la 7^{ieme} année.
4) Calculer la somme total payée par Ahmad durant les sept ans.

Contrat № 2 :
Ahmad paye 8 000$ au début de la première année puis il y aura une augmentation de 5% par an.
On désigne par B_n, en $, la somme payée au début de la $n^{ième}$ année. Ainsi $B_1 = 8\ 000$.

1) Calculer la somme payée, par Ahmad, au début de la troisième année.
2) Exprimer B_n en fonction de n.
3) Montrer que (B_n) est une suite strictement croissante.
4) Calculer la somme payée, par Ahmad, au début de la 7^{ieme} année.
5) Parmi les deux contrats proposés à Ahmad, lequel est le plus avantageux pour lui durant les sept ans? Justifier.

Appendix AV

Numerical sequences post-test- class: Sociology and Economics
Scholar year: 2019-2020- Duration: 40 minutes

I- (6 points)
A statistical study concerning the number of inhabitants of a village showed that:

- The number of inhabitants was 6 000 at the beginning of the year 2010.
- The annual increase in the number of inhabitants is 2%.
- The annual decrease in the number of inhabitants is 200 (new arrivals coming for a permanent living, emigrations, etc….).

Denote by U_n the number of inhabitants of this village in the year (2010 + n).
Thus, $U_0 = 6\ 000$.

1) Show that $U_1 = 5920$.
2) Verify that $U_{n+1} = 1{,}02U_n - 200$.
3) Consider the sequence (V_n) defined by $V_n = U_n - 10\ 000$; $(n \geq 0)$.
   a) Show that (V_n) is a geometric sequence of common ratio 1.02 and calculate its first term.
   b) Calculate V_n in terms of n and deduce U_n in terms of n.
4) Calculate U_6. Interpret the value thus obtained.
5) Prove that the sequence (U_n) is strictly decreasing.
6) In which year would the number of inhabitants of this village become less than 3 000 for the first time?
7) In which year would the population of this village extinct?
8) Starting from the year 2010, the municipality demanded that each inhabitant pays 50$ at the beginning of each year for municipal work related to municipal infrastructure and equipment

   We admit that each inhabitant pays each year without hesitation.

   Calculate the sum of money collected by the municipality from the year 2010 till the year 2020.

Appendix AW

Midyear exam post-test- class: Life Sciences
Scholar year: 2019-2020- Duration: 120 minutes

I- (10 points)

In the complex plane referred to a direct orthonormal system $(O;\vec{u};\vec{v})$, consider the points A, B, M and M' of respective affixes i, $-i$, z and z' such that $z' = \frac{1-iz}{z-i}$ where $z \neq i$.

1) Show that if z is pure imaginary, then z' is also.
2) Show that if M' belongs to the circle (ω) of center O and radius 1, then M belongs to the axis of abscissas.
3) a. Show that, for every $z \neq i$, we have $z' + i = \frac{2}{z-i}$.
   b. Deduce that AM × BM' = 2 and $(\vec{u};\overrightarrow{BM'}) = -(\vec{u};\overrightarrow{AM})\ [2\pi]$.
   c. Show that if M belongs to the circle (C) of center A and radius 4, then M' belongs to the circle (C') of center and radius to be determined.
   d. Show that if M belongs to the line (D) of equation $y = x + 1$, then M' belongs to a line (D') whose equation is to be determined.
4) Suppose that $z = x + iy$ et $z' = x' + iy'$ where $x, y, x', y' \in$ IR.
   a. Prove that $x' = \frac{2x}{x^2+(y-1)^2}$ and $y' = \frac{-x^2-y^2+1}{x^2+(y-1)^2}$.
   b. Determine the set of points M if z' is real.
   c. i- Determine the set of points (E) of M for which $z - i$ is a non-zero real.
   ii- Prove that if M belongs to (E), then M' describes a line (Δ) whose equation is to be determined.
   iii- Determine, in this case, the coordinates of M and those of M' so that AMM'B is a rectangle.

II- (10 points)

The 50 students of the third year secondary, of a school, are divided into 4 classes as shown in the table below.

	LS	ES	GS	LH
Number of boys	9	9	7	1
Number of girls	6	11	3	4

Part A

Four students are selected simultaneously and randomly.

1) Calculate the probability of selecting students of 4 different classes knowing that they are boys.
2) Calculate the probability of selecting at least two students of the LS class and at least one girl of the LH class.
3) Two girls and two boys are selected. Calculate the probability that they are of the same class.

Part B

Randomly, we select a student from the LS class then two students simultaneously from the ES class, two students successively without replacement from the GS class and one student from the LH class.

1) Calculate the probability of selecting exactly five girls
2) Calculate the probability of selecting at least one girl.
3) A girl is selected from the LS class and a girl is selected from the LH class. Calculate the probability of selecting two boys of the ES class then a girl and a boy from the GS class.

Part C

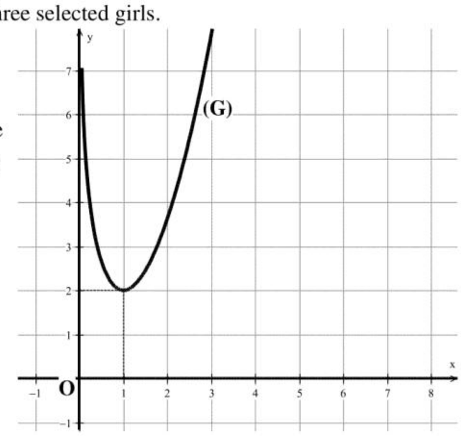
A software selected successively without replacement three names among those of the 50 students. Designate by X the random variable equal to the number of girls selected from the LS class.

1) Show that $P(X = 2) = \frac{33}{980}$.
2) Determine the probability distribution of X.
3) Estimate the number of girls of the LS class among the three selected girls.

III- (20 points)

Part A.

In the figure given here, (G) is the representative curve of the function g, defined over $]0\,;+\infty[$ as $g(x) = x^2 + a + b\ln x$ where $a, b \in$ IR.



1) Prove that $a = 1$ and $b = -2$.
2) Determine the sign of $g(x)$ for every $x > 0$.

Part B.

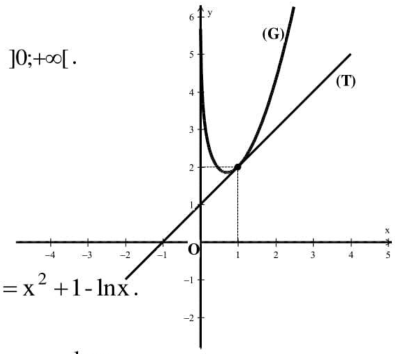
Consider the function f defined over $]0;+\infty[$ as $f(x) = x + \frac{1+2\ln x}{x}$ and (C) its representative curve in an orthonormal system $(O;\vec{\imath};\vec{\jmath})$.

1) Determine the limits of f at 0 and at $+\infty$. Deduce an asymptote to (C).
2) a. Show that the line (d) of equation $y = x$ is an asymptote to (C) at $+\infty$.
   b. Find the coordinates of the point of intersection of (C) and (d), then study their relative positions.
3) Show that $f'(x) = \frac{g(x)}{x^2}$ then set up the table of variations of f.
4) Determine a point E of (C) where the tangent is parallel to (d).
5) Show that the equation $f(x) = 0$ admits a unique solution α such that $0.5 < \alpha < 0.6$.
6) Draw (d) and (C).
7) a. Show that f admits over $]0;+\infty[$ an inverse function h whose domain of definition is to be determined.
   b. Set up the table of variations of h.
   c. Show that the point A(2 ;1) belongs to the curve (H) of h, and calculate $h'(2)$.
   d. Draw (H) in the same figure as (C).
8) Let l be a function defined as $]-\infty;2]$ such that $l'(2) = \frac{1}{2}$.
   a. Determine the domain of definition of the function lof.
   b. Calculate $(lof)'(1)$.

Appendix AX

Fonction logarithme et économie posttest- classe : Economie et Sociologie
Année scolaire : 2019-2020- Durée : 50 minutes

I- (12 points)
Partie A



La courbe (G) ci-contre représente la fonction g sur $]0;+\infty[$.

Par lecture graphique :

1) Déterminer $\lim\limits_{x \to +\infty} g(x)$ et $\lim\limits_{x \to 0} g(x)$.
2) Etudier, sur $]0;+\infty[$, le signe de g(x).
3) La fonction g est définie sur $]0;+\infty[$ par :
   $g(x) = x^2 + a - b(\ln x)$.
   Utiliser la figure donnée pour montrer que $g(x) = x^2 + 1 - \ln x$.

Partie B

On considère la fonction f définie sur $]0;+\infty[$ par $f(x) = x + \dfrac{\ln x}{x}$ où (C) est sa courbe représentative dans un repère orthonormé $(O; \vec{i}, \vec{j})$.

1) Déterminer $\lim\limits_{x \to 0} f(x)$. En déduire une asymptote à (C).
2) Soit (d) la droite d'équation $y = x$.
   a) Déterminer $\lim\limits_{x \to +\infty} f(x)$.
   b) Montrer que la droite (d) est une asymptote à (C).
   c) Etudier, suivant les valeurs de x, la position relative de (C) et (d).
3) Montrer que $f'(x) = \dfrac{g(x)}{x^2}$ et dresser le tableau de variations de f.
4) Montrer que l'équation f(x) = 0 admet une solution unique α et que $0{,}65 < \alpha < 0{,}67$.
5) Tracer (C) et (d).

Partie C (dans ce qui suit prends α = 0,66)

Une entreprise qui produit et vend un certain type d'objets électriques a réalisé que sa fonction du profit P, en millions de LL, est modélisée pour tout x dans [0,1 ; 5] par $P(x) = x + \dfrac{\ln x}{x}$ où x est le nombre des objets électriques produits en centaines.

1) Déterminer le seuil de rentabilité de cette entreprise. En déduire le nombre minimal des objets électriques à vendre pour que l'entreprise commence à réaliser un gain.
2) Etudier si l'entreprise peut réaliser un gain supérieur à 6 millions LL.
3) Le tableau ci-contre est le tableau de variations de la fonction linéaire de revenu R de cette entreprise, en millions LL.

   On désigne par *p* le prix de vente d'un objet électrique, en LL, pour la vente de 300 objets.

x	0,1		3	5
$R'(x)$		+		
$R(x)$		↗	5,4	

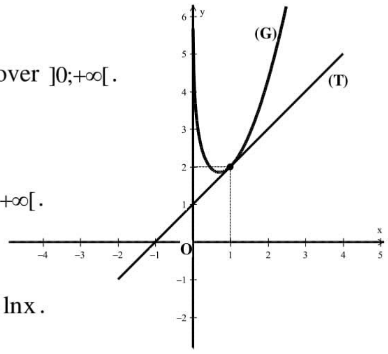
a) Vérifier que p = 18 000 LL.
b) Compléter le tableau de variation de la fonction de revenu.
c) Calculer, en LL, le coût réalisé par la vente de premiers 300 objets électriques. En déduire, dans ce cas, le coût moyen de production d'un objet.

Economic Function and Logarithm post-test- class: Sociology and Economics
Scholar year: 2019-2020- Duration: 50 minutes

I- (12 points)

Part A

The curve (G) given here represents the function g over $]0;+\infty[$.



By graph reading:

1) Determine $\lim_{x\to+\infty} g(x)$ and $\lim_{x\to 0} g(x)$.
2) Give, with justification, the sign of g(x) over $]0;+\infty[$.
3) The function g is defined over $]0;+\infty[$ as :
   $g(x) = x^2 + a - b(\ln x)$.
   Use the given figure to show that $g(x) = x^2 + 1 - \ln x$.

Part B

Consider the function f defined over $]0;+\infty[$ as $f(x) = x + \frac{\ln x}{x}$ where (C) is its representative curve in an orthonormal system $(O; \vec{i}, \vec{j})$.

1) Determine $\lim_{x\to 0} f(x)$. Deduce an asymptote to (C).
2) Let (d) be the line of equation y = x.
   a) Determine $\lim_{x\to+\infty} f(x)$.
   b) Show that the line (d) is an asymptote to (C).
   c) Study, according to the values of x, the relative positions of (C) and (d).
3) Show that $f'(x) = \frac{g(x)}{x^2}$ and set up the table of variations of f.
4) Prove that the equation f(x) = 0 admits a unique solution α and that 0.65 < α < 0.67.
5) Draw (C) and (d).

Part C (in what follows take α = 0.66)

An enterprise that produces and sells a certain type of electronic objects has realized that it profit function P is modeled for every x in [0.1 ; 5] as $P(x) = x + \frac{\ln x}{x}$ in millions LL where x is the number of electronic objects produced in hundreds.

1) Determine the break-even level of this enterprise. Deduce the minimum number of objects to be sold for the enterprise to start achieving a gain.
2) Study if the enterprise can achieve a gain greater than 6 millions LL.
3) The table given here is the table of variations Of the linear revenue function R of this enterprise, in millions LL.

x	0,1	3	5
$R'(x)$		+	
$R(x)$	↗	5,4	↗

   Denote by *p* the sale price of an electronic object, in LL.
   a) Verify that *p* = 18 000 LL.
   b) Complete the table of variations of the revenue function.

c) Calculate, in LL, the cost of production of 300 electronic objects. Deduce, in this case, the average cost of production of an object.

Micro Bareme:
Part A
1) 1/4 and 1/4.
2) 1/4.
3) 1.25.

Part B
1) ¼ and ¼.
2) a) ½.
   b) ½.
   c) 1.
3) ¾ and ¾.
4) ½ and ½.
5) 1.5.

Part C
1) ½ and ½.
2) 1.
3) ½.
4) ½ and ½.

Appendix AY

Examen central posttest- classe : Economie et Sociologie
Année scolaire : 2019-2020- Durée : 120 minutes

Exercice 1 (**4 points**)

Dans le tableau ci-dessous, une seule réponse à chaque question est correcte.
Ecrire le numéro de la question et la réponse correspondante. Justifier votre choix.

	Questions	A	B	C
1	Soit f une fonction définie sur $]0;+\infty[$ par $f(x) = ax^2 + b\ln x$. Si $f(1) = 1$ et $f'\left(\frac{1}{\sqrt{2}}\right) = 0$ alors:	$a = 1$ $b = -1$	$a = -1$ $b = -1$	$a = -1$ $b = 1$
2	$\lim\limits_{x\to+\infty} \frac{\ln(6x+1)}{\ln(2x-3)} =$	1	2	3
3	L'équation : $\ln(x-2) + \ln(x-32) = 6\ln 2$	n'a pas de solution	a une seule solution	a deux solutions
4	Soit f une fonction définie par : $f(x) = -x + 2\ln x$; $x > 0$, et (C) est sa courbe représentative dans un repère orthonormé $(O;\vec{i},\vec{j})$. Une équation de la tangente à (C) en son point d'abscisse 2 est:	$y = (-2 + 2\ln 2)x$	$y = 0$	$y = -2 + \ln 4$

Exercice 2 (**4 points**)

Le tableau ci-dessous donne la masse de blé produite, en cent tonnes, dans la plaine de la Bekaa à l'année 2013.

Année	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Rang de l'année : x_i	**1**	**2**	**3**	**4**	**5**	**6**
Masse de la production en cent tonnes : y_i	**5,2**	**4,8**	**4**	**3,4**	**3,2**	**3**

1) Calculer $\overline{x}$ et $\overline{y}$, les moyennes respectives des deux variables x et y.
2) Représenter graphiquement le nuage des points $(x_i; y_i)$ ainsi que le point moyen G dans un repère orthogonal.
3) Déterminer une équation de la droite de régression $(D_{y/x})$ de y en x et tracer cette droite dans le repère précédent.
4) Calculer le coefficient de corrélation r et interpréter la valeur ainsi trouvée.
5) On suppose que le modèle précédent reste valable jusqu'en 2022. Estimer la masse de la production de blé en 2020.
6) Chaque cent tonnes de blé produit coûte 120 millions de LL et est vendue pour 350 millions de LL. Estimer le bénéfice lors de la vente de la production en 2020.

Page **1** de **2**

Exercice 3 (**4 points**)

En 2010, une chaine de télévision privée possède 4000 abonnés. Chaque année, la chaine annule 10 % de ses abonnés et reçoit 500 nouveaux abonnés.

On désigne par (U_n)le nombre d'abonnés au cours de l'année $(2010 + n)$; $n \in \mathbb{N}$ et $U_0 = 4000$.

1) Montrer que : $U_{n+1} = 0{,}9U_n + 500$ pour tout entier naturel n.

2) On considère la suite (V_n), définie pour tout entier naturel n par, $V_n = 5000 - U_n$.

   a) Montrer que la suite (V_n) est une suite géométrique dont on déterminera la raison et le premier terme.

   b) Exprimer V_n en fonction de n et déduire U_n en fonction de n.

3) Préciser le sens de variations de la suite (V_n).

4) Est-ce-que le nombre d'abonnés peut être supérieure à 5000 ? Justifier.

Exercice 4. (8 points)

Partie A :

Soit f une fonction définie sur $]1\,;+\infty\,[$par $f(x) = \dfrac{1 + \ln x}{\ln x}$ et soit (C) sa courbe représentative dans un repère orthonormé $(O\,;\vec{\imath},\vec{\jmath})$.

1) Calculer $\lim\limits_{x \to 1^+} f(x)$ et $\lim\limits_{x \to +\infty} f(x)$. **Déduire** les asymptotes à la courbe (C).

2) Montrer que $f'(x) = \dfrac{-1}{x(\ln x)^2}$ et dresser le tableau de variations de f.

3) Déterminer une équation de la tangente (T) à (C) au point d'abscisse e.

4) Tracer (C), (T) et les asymptotes.

5) La droite d'équation $y = x + 1$ coupe (C) en un point d'abscisse α.
   Vérifier que $1{,}7 < \alpha < 1{,}8$.

Partie B: **Dans la suite, prendre $\boldsymbol{\alpha = 1{,}75}$.**

Une entreprise fabrique un certain produit. Les fonctions de demande et d'offre sont respectivement $f(x) = \dfrac{1 + \ln x}{\ln x}$ et $g(x) = x + 1$, où $f(x)$ et $g(x)$ sont exprimés en centaines d'unités et x est le prix unitaire en milliers de L. L sachant que $1{,}1 \leq x \leq 6$.

1) Calculer la demande si le prix de chaque unité est 4000 L. L.
2) Déterminer le prix pour une demande de 500 unités.
3) Déterminer le prix d'équilibre.
4) a) Déterminer l'élasticité de la demande $E(x)$.
   b) Calculer $E(4)$. La demande est-elle élastique pour $x = 4$?
   Donner une interprétation économique du résultat obtenu.

Page **2** de **2**

Appendix AZ

Interest post-test- class: Sociology and Economics
Scholar year: 2019-2020- Duration: 55 minutes

I- (2 points)
To buy a furniture for the apartment, Walid and Samira borrowed a loan of 8000$ from a bank at an annual simple interest rate of 10% for 10 months.
1) How much money the couple has to pay to pay back the loan?
2) Calculate the simple interest gained by this couple.

II- (2 points)
A person wants to buy an apartment. The owner demanded a down payment of 100 000$. For the remaining amount, considered as a loan to be paid, the owner suggested that the person pays it according to one of the two plans:

Plan A: 60 monthly equals payments of 1500$ each.
Plan B: 3 annual payments of 30 000$ each.

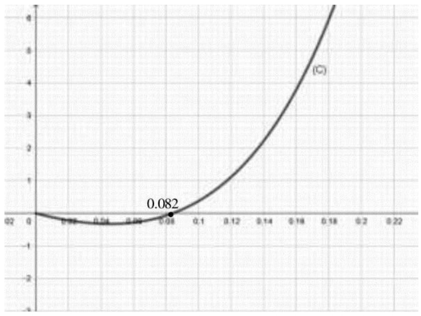
Knowing that the annual interest rate of each plan is 6%, determine the one that is more favorable for this person to pay the remaining amount of money.

III- (5 points)
Rami placed in a bank B_1, on the first of October 2012. A sum of 30 000$ at an annual interest rate of 8% compounded annually.

1) What is the amount of money in his account on the first of October 2016?
2) Denote by $U_0 = 30000$ and U_n the sum of money in his account on the first of October of the year (2012 + n).
   a) Prove that (U_n) is a geometric sequence, and deduce that $U_n = 30000(1.08)^n$ for every natural integer n.
   b) Starting from the first of October of which year Rami will dispose the double of his initial placement?
   c) Calculate the sum of money in his account on the first of October 2020. Deduce the interest gained by Rami.
3) A bank B_2 announced the following: " special investment: double your capital in 8 years ".
   a) Is the special investment more profitable for Rami than that of the bank B_1 for a period of 8 years? Justify your answer.
   b) Determine the annual interest rate of this special investment knowing that it is of a compounded annual interest.
   c) On the first of October 2020, Rami will withdraw the 60 000$ and place them all at once in a bank B_3 to double them.
   If the annual interest rate is of 12%, calculate the number of years needed for Rami to realize his goal.

IV- (1 point)

The curve given here is that of the function f defined over $[0;+\infty[$ as $f(x) = (1+x)^{15} - 1 - 28x$.



The acquire (future) value of a series of 15 annuities is 56 000 000 LL.

Knowing that each annuity equals 2 000 000 L.L, Calculate the annual interest rate.

Intérêt posttest- Classe : Sociologie et Economie
Année scolaire 2018-2019- Durée : 55 minutes

I- (2 points)
Pour acheter une fourniture pour l'appartement, Walid et Samira ont emprunté 8000$ d'une banque à un taux d'intérêt simple annuel de 10% pour 10 mois.

1) Combien d'argents le couple marié doit payer pour amortir la dette ?
2) Calculer l'intérêt simple payé par ce couple.

II- (2 points)
Une personne veut acheter un appartement. Le constructeur lui demande un premier paiement de 100 000$. Pour le reste, considéré comme une dette à payer, le constructeur suggère que cette personne paie suivant l'un des 2 plans suivants:

Plan A : soit de 60 versements mensuels constants de 1500$ chacun.
Plan B : soit de 3 paiements annuels de 30 000$ chacun.

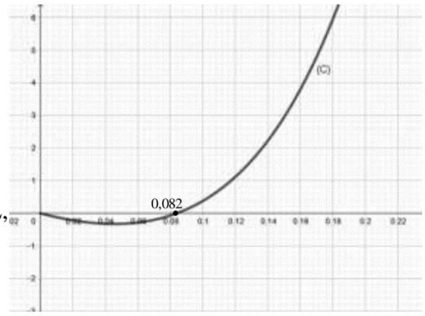
Sachant que le taux annuel pour chacun des deux plans est de 6%, trouver le plan le plus favorable pour cette personne pour payer le reste d'argents.

III- (5 points)
Rami a placé dans une banque B_1, le 1er octobre 2012, une somme de 30000 $ à un taux d'intérêt annuel de 8% capitalisé annuellement.

1) Quelle somme aura-t-il dans son compte le 1er octobre 2016?
2) On pose $U_0 = 30000$ et on désigne par U_n la somme qu'il aura dans son compte le 1er octobre de l'année (2012 + n).
   a) Montrer que (U_n) est une suite géométrique, et déduire que $U_n = 30000(1,08)^n$ pour tout entier naturel n.
   b) A partir du 1er octobre de quelle année Rami disposera le double de son déposé initial ?
   c) Calculer la somme qu'il aura dans son compte le 1er octobre de l'année 2020. Déduire l'intérêt gagné par Rami.
3) Une banque B_2 lance la publicité suivante : " placement spécial: doublez votre capital en 8 ans ".
   a) Le placement spécial est-il plus rentable pour Rami que le placement dans la banque B_1 pour une période de 8 ans? Justifier la réponse.
   b) Déterminer le taux d'intérêt annuel de ce placement spécial sachant qu'il s'agit d'un placement à intérêts composés avec capitalisation annuelle.
   c) Au 1er Octobre 2020, Rami va retirer les 60 000$ et les placer dans une Banque B_3 pour les doubler.
      Si le placement est fait par un seul versement sous un taux d'intérêt annuel de 12%, calculer le nombre des années nécessaires pour que Rami réalise son but.

IV- (1 point)

La courbe ci-contre est celle de la fonction f définie sur $[0;+\infty[$ par $f(x) = (1+x)^{15} - 1 - 28x$.



La valeur acquise par une suite de 15 annuités est 56 000 000 LL.

Sachant que chacun annuité égale à 2 000 000 L.L, calculer le taux de capitalisation annuel.

Appendix AAA

Saint-Joseph University

Faculty of Education

Research Interview Consent Form

Purpose:

The researcher is trying to examine the impact of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the word problem solving domain in mathematics.

Additionally, the researcher is trying determining the effect of employing WhatsApp on students' mathematical performance in the problem solving and communication domain in the secondary level.

The researcher here is pursuing an in-depth understanding and analysis of the study results. Therefore, you are hereby invited to participate through one on one interview to support the researcher with your knowledge and enlighten him on what might not be clear for him if it is possible.

Research title: Impact of Employing the WhatsApp Platform, Via Its Interaction Features, On Secondary Students' Mathematical Performance

Note that:

- I agree to participate in the interview carried out by Mohammad Anouti from the Saint-Joseph University for a better understanding of the study results.
- I adequately understand the aims of the research entitled impact of employing the WhatsApp Platform, via its interaction features, on secondary school students' mathematical performance.
- I am fully aware of the topics to be discussed in the interview.
- I am fully aware that I will remain anonymous and I have the right to leave the interview at any point.
- I am fully aware that data collected will be stored securely, safely and in accordance with Data Collection Act.
- I am fully aware that I am not obliged to answer any question. I do so at my own free will.
- I agree to have my answers written or recorded by the researchers. In addition, I can even keep a copy at the end of the interview.

______________________________________ ______________________

Participants Signature **Date**

______________________________________ ______________________

Researchers Signature **Date**

Contact Information

If you have any further questions or concerns about this study, please contact:

Name of researcher: ---

Full address: --

Telephone number: --

E-mail: --

You can also contact Researcher's name Supervisor:

Name of researcher's supervisor: ---

Full address: ---

Telephone number: ---

E-mail: ---

Appendix AAB

Research Interview Consent Process

Thank you for agreeing to participate. We are very interested to hear your valuable opinion on of smartphones with a touch screen and social media platforms, like WhatsApp and others, on students' math timed exams anxiety, behavior in class and competencies in the word problem solving domain in mathematics.

In addition, we are very interested to hear your valuable opinion on the effect of employing WhatsApp on students' mathematical performance in the problem solving and communication domain in the secondary level.

- *The information given here is completely confidential and private, and no one will be associated with anything said in the interview;*
- *You are free not to answer any question or withdraw from the study at any time.*
- *The researcher is willing to record or write down all your answer on a sheet. You can review them at the end of the interview and demand for any necessary changes;*
- *The researcher is able to discuss your answers freely and you may even present documents that enforce your opinion and answers.*

For any questions now or after completing the interview, the interviewee can contact the researcher and/or the advisor whose names and phone numbers are on this form.

Participant's name: ________________________ **signature: _____________**

Appendix AAC

تنبيه مهمّ: ما سيردُ في هذه الورقة بعيد عن أيّ عاطفة أو مجاملات.

• سلّم التقييم:

ممتازة ← مرتبة التّجربة الّتي خضعت لها.

جيّدة

مقبولة ← مرتبة التّجربة مع قدرة فنّيّة، إبداعيّة، تقنيّة منخفضة عند الأستاذ.

سيّئة

سيّئة جدًّا ← مرتبة التّجربة مع انعدام إبداع الأستاذ وانعدام إمكانيّة التّواصل معه.

• إنّ تجربة الصّفّ المعكوس هي تجربة تتلاءم مع كافّة الأوضاع،

① ⇐ في مثل حالتنا (الكورونا) ومع غياب الدّراسة العمليّة من قبل الوزارة، أثمر الصّفّ المعكوس على عدّة مستويات:

تخفيض الضّغط الصّفّيّ بنسبة ٧٠٪

على الأستاذ:
- تقليص وقت الشّرح بما يناسب
- الوقت الكافي للحلّ والمناقشة

على الطّالب:
- معلومات مرسّخة
- قدرة على التّطبيق
- الوقت الكافي لطرح الأسئلة

تيسير المعلومات بعيدًا عن الجمود (PowerPoint) + خبرة الأستاذ

تحصيل الطّالب فكرة عامّة عن الموضوع

• العامل الأساسيّ لنجاح التّجربة:
← التّواصل مع الأستاذ.
← قدرة تعامل الأستاذ مع الواقع.

• العوامل الثّانويّة: ← التزام الطّلاب.
← الوعي الكافي عند الطّلاب.

Appendix AAD

إيجابيّات: • بناء سلسلة من المعارف عن الدرس،

• عدم "تطفيش" الطلّاب.

• بناء ثقة متبادلة بين الطلّاب والأستاذ.

• حصول كلّ طالب على ما يكفيه حسب قدرته الاستيعابيّة

③ ← في الحالات الطبيعيّة، أرى أنّ الصفّ المعكوس هو الطريقة الأنسب للعمل خاصّة في المجال العلميّ ونتائجه ستكون مضاعفة، وإن تُرك لي الخيار، أختار اعتماد الصفّ المعكوس طريقة معتمدة في كلّ وقت وحين،

سلبيّات: • الإرهاق الذي سيطال الأستاذ.

• لا أرى سلبيّة (من وجهة نظري)

أنيس

Appendix AAE