SAINT-JOSEPH UNIVERSITY OF BEIRUT

FACULTY OF EDUCATIONAL SCIENCES

TOWARDS A CONCEPTUAL FRAMEWORK FOR EFFECTIVE MATHEMATICS

TEACHING IN LEBANON: A MULTIPLE CASE-STUDY

DOCTORAL DISSERTATION IN EDUCATION

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Dedication

To my Lord, Creator, and Saviour

To my precious love, Wessam, who has tolerated my ups and downs all the way through and always given me confidence. Thank you for believing in me.

To my treasure, Charbel and Michael.
Thank you Charbel and Michael for bearing with me.

To the memory of my Mom to whom I owe my life.
Thank you Mom for always watching over my family and me.

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Faculty of Educational Sciences

Table of Content

Faculty of Educational Sciences

9

Faculty of Educational Sciences

List of Tables

List of Figures

Faculty of Educational Sciences

LIST OF ACRONYMS

CERD	Center of Educational Research and Development
DOPS	Direction d'Orientation Pédagogique et Scolaire
TIMSS	Trends in International Mathematics and Science Study
PISA	Programme for International Student Assessment
MEHE	Ministry of Education and Higher Education
LAES	Lebanese Association for Educational Studies
ESDP	Education Sector Development Plan
NES	National Education Strategy
IEA	International Association of the Evaluation of Education Achievement
ZPD	Zone of Proximal Development
ME	Mathematics Education
BSU	Ball State University
TDS	Theory of Didactic Situation
LAU	Lebanese American University

D-RASATI	Developing Improvement Rehabilitation Assistance to Schools and Teacher
QITABI	Quality Instruction towards Access and Basic Education Improvement
UNRWA	United Nations Relief and Works Agency

Faculty of Educational Sciences

Summary of the Dissertation Chapters

The summary below provides a synopsis of each chapter of the dissertation.

Introduction and Background of the Study

This chapter discussed the mathematics curriculum and the strategies used in private and public schools in Lebanon. The information gathered for this chapter came from the following sources: Trends in International Mathematics and Science Study (TIMSS) results, books, journal articles, legislative decrees, national statistics, early piloting results, and other relevant documents. This chapter explored factors that affect mathematics pedagogy in grade 4. The chapter made reference to the mode of analysis of data collected for the dissertation including observation of teaching strategies the schoolteachers use in grade 4, interviews conducted with the schoolteachers and coordinators, and synthesis of the constructivist teaching strategies used in the same grade 4.

Theoretical Framework and Review of the Literature

This chapter discussed the theoretical framework of the study and reviewed pertinent literature on the constructivist teaching strategy, particularly how it relates to mathematics curriculum, the ways it sees students in classrooms, and the ways the school teachers are expected to deal with this strategy. It also reviewed literature from Lebanese context. There was little research concerning the scope of this study; however, there were some reports and studies on the development of new curricula as a whole. The information of this chapter was taken from different sources including reports, reviews, and interviews in order to understand the curriculum position in Lebanon in general and the mathematics curriculum in particular.

The discussed theories and reviews in this chapter have provided concrete realizations of what it meant that knowledge is not transmitted but constructed. Traditional

15

instructional design is the opposite of the constructivist view of learning. Constructivism does not have a goal for memorization, but it emphasizes the process of constructing knowledge based on existing ones. It encourages imagination, generalization, and manipulation of one's own constructive process. Thus, as a summary, Piaget (1969-1971) emphasized the fact that the child should reach a specific stage in order to be able to learn new and more complex knowledge, whereas Vygotsky (1978) stressed on the idea that learning leads to development and the school teacher should always be ready to challenge the students. He discussed the case that each child was born in a specific culture and that development was directly related to this culture.

Research Design of the Dissertation

This chapter discussed the research design of the dissertation and laid out the operational field measures and procedures used in data collection. In addition, it discussed the procedures in analyzing the rubrics used during the observations, and the conducted interviews helped in delineating the purpose of this dissertation. The chapter started with an overview of the research methodology and then moved to the phases of the data collection where the results are discussed from the pre-pilot and pilot studies. Details, on the interviews and observations data collection, were discussed and followed with the data analysis. The data collected from observation, interview with school teacher, and interviews with coordinators converged through a process called triangulation.

Qualitative data analysis method was used to describe details, events, school teachers, and observed classrooms. Since this dissertation sought to study qualitative research questions, it bore the characteristics of a multiple-case research. The chapter also discussed the validity and ethical consideration of the research, and provided rationale for every method used.

Findings of the Dissertation

This chapter presented and discussed the findings of the dissertation. It was divided into two main parts: The first part presented and analyzed the findings in each school separately and the second part presented and analyzed the six schools selected along the variables chosen for this study: School teachers' and coordinators' perception of traditional versus non-traditional classrooms; school teachers' and coordinators' perception of different learning theories and their effect on enhancing teaching mathematics; and coordinators' views of problems that might lie under the curriculum reform. Through analyzing the research questions and meeting the objectives of the dissertation, the findings provided analytical data that supply policymakers, schools, and curricula developers with a sharper understanding of the reasons and factors circumscribing grade 4 students' learning of mathematics in relation to the constructivist teaching strategy, the curriculum, and styles of pedagogy adopted in selected Lebanese public and private schools. The dissertation sought to provide a systematic strategy to the analyses of the classroom mathematics teaching in relation to how students learn mathematical concepts. The findings had implications on the improvement of the mathematics teaching.

Discussion of Findings

This chapter, the findings gleaned from the school teachers' interviews, the coordinators' interviews, and the conducted observations were discussed with a focus on the theories overarching the conceptual framework of the dissertation with appropriate back and forth reference to the constructivist teaching theories advocated by Piaget (1969-1975), Vygotsky (1978), and Brousseau (1997).

Conclusions and Recommendations

This chapter presented and discussed conclusions and recommendations. One of the most important issues concerning education in schools is how to improve students'

comprehension of the subject taught. Whatever the subject matter is, it is worth finding the best way to improve the students' learning. In order for the students to acquire higher-order thinking and be able to think independently, the schoolteacher should be prepared and ready to facilitate this process and introduce the students to different teaching strategies.

One of the factors to take into consideration for improving students' mathematical learning and comprehension is using teaching strategies that stress on participation of the students in the learning process where they construct knowledge and not only acquire it by rote learning. It is recommended that school teachers adapt the deductive strategy rather that inductive one. And if in case the learner finds difficulty deducing the new knowledge, then the teacher 'holds his/her hand' and shows him/her the right way.

Chapter1

Introduction and Background of the Dissertation

1.1. **Introduction**

This chapter discusses the mathematics curriculum and the strategies used in teaching in private and public schools in Lebanon upon which fieldwork was conducted. The information gathered for this chapter came from the following sources: Trends in International Mathematics and Science Study (TIMSS) results; LAES Vision document (2006), books; journal articles; legislative decrees; national statistics; early piloting results; and other relevant documents.

The chapter is outlined as follows:

- personal experience;
- context of the dissertation;
- general Information about the Situation of Education in Lebanon the purpose of the dissertation;
- significance of the dissertation;
- objectives of the dissertation;
- research questions;
- limitations;
- definitions of terms;
- contributions to knowledge;
- recommendations.

The statement and the objectives of the dissertation have been restructured based on early piloting of the research in terms of determining its objectives and identifying the underpinning problems of the study. Appendix 1 shows a correspondence table aligning the

objectives, research questions, significance of the dissertation, statement of the problem, and the methodology used.

1.2. Personal experience

Part of this dissertation was stimulated by my personal experience as an educator and a parent and the narrative provided here after can be considered anecdotal evidence. It was a very early morning when I was sitting in my T.V. room drinking my coffee and observing my children playing with their toys. My child was 5 years old then and was building models out of his building blocks made of colorful geometrical shapes. He was putting the blocks above each other trying to build a house. He was removing some blocks which he considered not necessary and adding others that he thought were important to him. He added one block because he found that one empty space fit a rectangular prism.

In the other corner of the room, my other child, who was 1 year old, was playing with his Lego. He was trying to put the same shapes together with his tiny hands. He tried to combine one square and one rectangle, but he discovered that their sides were not equal. Thus, he started searching for another shape to build. I found out what I learned from Piaget (1969 – 1975) through looking and observation at my children. I had never thought of children building their own understanding of knowledge even though my educational background is based on child development, teaching mathematics, and teaching science. I was not aware before of how children at home learn and build their own understanding of concepts. I had never taught my eldest child before how to build blocks and how to check whether the sides of a geometrical shape were equal or not. I had taught him only the different shapes and their names. As for my younger child, by observing his brother, he started imitating him without realizing that he was building new knowledge such as spatial and proportional awareness and motor skills through Lego.

From here came the idea of this dissertation to my mind. Since then, my mind has churned with ideas and I have started to brood the issue. Back when I was in elementary school, our classrooms were teacher-centered. Teachers used to lecture and often give little room for students to engage in learning and share their ideas. We used to do little

applications and rarely conduct discussions in class. Learning was first based on the teachers' own perspectives that prioritized covering the prescribed national curriculum. Our schoolteachers used to teach us in their own preferable way assuming that all of us were supposed to understand the new concepts based on their own way of teaching without taking into consideration the students' learning styles and preferences, or even alluding to pedagogy of inquiry that emphasizes learning by using higher order thinking. They gave us all the information we should get according to the prescribed national curriculum. Our mathematics teacher used to teach us mathematics without taking into consideration the students' different background and abilities. She/He had the full management power in class and the upper hand to control it, and this was legitimate, but it lacked learning-focused classroom management such as involving students in the management process itself.

I remember once I tried to talk to my mathematics teacher while writing on the board. I was nearly hit instead of being encouraged because I interrupted her lecture and disrupted what she was doing. Discussion in class was considered a source of noise and distraction. I believe this was the main reason that made some students do not like mathematics or find it difficult. However, nowadays, anecdotal evidence drawn from my personal teaching experience suggests that this concept has changed in some schools; especially when I see the teaching strategies being used in my son's class, at the same school I studied in. Recently, classrooms have become more active where students are given the opportunity of being part of the classroom discussion. I know this from my own 9-year-experience in teaching Science at a school. Then, along with other teachers, I integrated different teaching strategies in order to enhance the students' learning and in order to make sure that students of all levels understood the new concepts. The students became the main part of the classroom, and the teacher's role was more of a facilitator aiming at achieving goals and outcomes set for learning.

These ideas were still brooding in my mind until I met my advisor and engaged with him in a discussion about my research topic. We started discussing the topic and I explained to him what was on my mind. I started doing research on the way the mathematics

curriculum was developed and on the different teaching strategies used in classrooms in several grades. I believe the way children understand new concepts can help the parents and teachers understand the way they learn. Children develop their own way of understanding and constructing knowledge. It can be through playing with their toys or through playing in nature. They do not know it as a philosophy, but still they develop their own philosophy of play.

While reading, I came across the results of the Trends in International Mathematics and Science Study (TIMSS) several times. Researches were highlighting the importance of analyzing the TIMSS results in order to check the standard of mathematics in different countries along with other types of assessments such as the Programme for International Student Assessment (PISA). I checked the results of Lebanon in the TIMSS for the past years and was dismayed by the low average that consistently falls below the international mean. As such, I have decided to study the possible relationship between a constructivist teaching strategy and mathematics students' learning in one of the grades in order to see whether or not the teaching strategies used in the classrooms explain why students achieve low in international tests; especially that the mathematics content in one of the parts in the TIMSS is based on cognitive science as it will be explained in the second part of this chapter. These three cognitive domains are knowing, applying, and reasoning.

It is worth defining the term didactics in education from both different perspectives: the Francophone and the Anglophone since they differ. Didactique – didactics in the francophone world is customarily distinguished from pedagogie – pedagogy even though both study the ways to investigate the teachers-learner relationship. Didactique –didactics is referred to as the art of teaching (Tochon, 1999); however, research showed us that didactics is a science rather than an art (Bertrand & Houssaye, 1999). It is the study of the phenomena of teaching and learning from all perspectives: social, cognitive, and psychological. Conversely, the concept of didactics in English "has been associated with a disincarnated, systematic, and interdisciplinary trend of research inherited from behaviorist learning machine" (Ibid, 1999, p. 3). In other words, the researcher finds ways to understand the

22

subject matter, and how the curriculum policies and changes in schools and in classrooms are related to the systematic ways of delivering the instruction. However, the term has come to refer to the conceptualization that distinguishes the life of a discipline through the particularities of the subject matter taught. In order to understand more the different teaching strategies, especially the constructivist teaching ones, more focus on the theory of didactic situation and mathematics education will be explored later on in this dissertation.

In Lebanon, little research has examined teaching strategies even though it is one of the aims specified by the MEHE[1]. Even though I believe that constructivism views the teacher's role as a facilitator, synthesizer, and interpreter, constructivist strategies request that teachers encourage the participation of students in the learning process.

1.3. Context of the problem

To provide context to the study and familiarize readers with education in Lebanon, this section discusses general information about education in Lebanon, including distribution of schools according to sector, students, teachers, and principals, teachers' qualifications, and curriculum reform. Reference to higher education as well as vocational education and training will be excluded from the analysis as the study is primarily concerned with general education. The following information was taken from the Center of Educational Research and Development (CERD), the Vision document of Lebanese Association for Educational Studies (LAES) 2006, and MEHE.

Perhaps, two significant dimensions to look at when examining educational situations in Lebanon are the individual and the situational factors. While discussing the Lebanese context with the director of this dissertation for pre-pilot purposes, under the individualistic dimension lie the attributions and characteristics of the teacher, the student, and the principal. For instance, age, degree, qualifications, training, and the strategies used in the teaching class are attributes of teachers. When it comes to students, the director added that their abilities, background, and motivation play a significant role in shaping learning. A

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[1] http://www.higher-edu.gov.lb, accessed on November 2014

third attribute characterizing school principals includes their ascribed roles such as an authority figure, his/her leadership style, and the way they adopt strategies for administering the school. As for the second dimension — the situational, the director added that the governance, facilities, context such as social, political, economic, cultural, and the ministry influenced determining learning and teaching processes. Each of these dimensions plays a role in the promotion of education for a better stage or stymieing it from progress.

1.4. General Information about Education in Lebanon

It is worth mentioning that the MEHE collaborates with CERD. CERD's tasks include outlining academic and occupational curricula for the pre-university education stage, carrying any needed adjustments, and organizing all ways for applying these curricula, including teaching strategies. "CERD prepares the curricula in all subject areas, including mathematics and science, provides teacher training, writes textbooks, and conducts evaluations. It also carries out educational research and secures training for pre- university teachers" (CERD 2015-2016). Workshops conducted in order to enhance the teaching effectiveness are done via Direction D'Orientation Pédagogique et Scolaire (DOPS) at MEHE.

1.4.1. Distribution of Schools and Students in Lebanon

Schools in Lebanon are divided into three types: private, semi-subsidized, and public. Private fee-paying schools include grade levels from KG till secondary education. Some public and semi-subsidized schools only have basic education grades, while others include Kindergartens. There are 1177 schools that include secondary education grades (CERD, 2015 – 2016). On the other hand, public schools are financed by the government, while private schools are financed by school owners, and private semi-subsidized are partly financed by the government. However, the procedures involved in planning and adjusting curricula and supporting teacher education are "financed mainly by nongovernmental organizations, private companies, or international bodies, including the United Nations Development Programme and the World Bank" (Mullis, Martin, Minnich, Stanco, Arora, Centurino, & Castle, 2011). According to CERD (2015 – 2016), there are 2789 schools, of

which 28.4% are public, 53.97% are private fee-paying, 14.4% are private semi-subsidized, and 3.58 % are United Nations Relief and Works Agency (UNRWA) (see figure 1).

     The administration of public schools is centralized and run by the Ministry of Education (Legislative Decree number 10832, October 9, 1962). On the other hand, private schools are run either by confessional communities, or private association and individuals as legitimized by Article 10 of the Lebanese Constitution of May 23, 1926 and by Decrees number 7962 May 1, 1931 and number 7000 October 1, 1946. These students are distributed by sectors as shown in figure 1 below.

Figure 1: Distribution of Students by sector
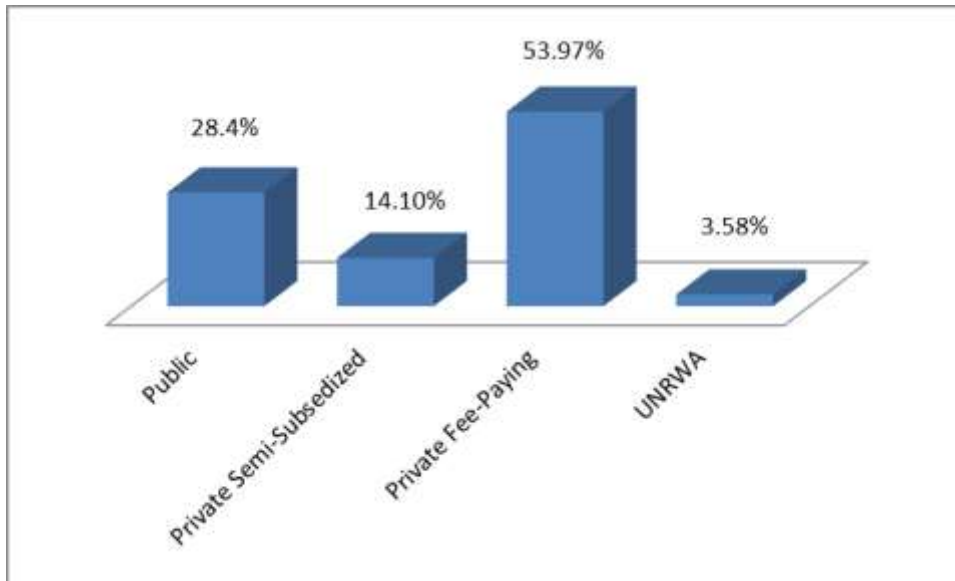
Source: CERD (2015-2016)

1.4.2. Distribution of Students by Sector

While there are more public schools than private ones both subsidized and fee-paying, the numbers of students in the private sector outnumber those in the public sector.

1.4.3. Distribution of teachers, schools, and principals

There are 96,905 school teachers distributed all over schools in Lebanon and there is a shortage in the school teachers who carry degrees in specific subject matters and teaching diplomas. According to CERD (2015-2016), the total number of school teachers during the 2015-2016 school-year was 96,905 of whom 44.1% were in the public sector, 40.6% in the private sector, and 12.9% in private semi subsidized schools, and 2.4% in UNRWA schools. One of the main problems is that one third of school teachers are not found in the school as full-timers to follow up with their students. Figure 2 shows the number of schoolteachers according to sector and status in the academic year 2015-2016.

Faculty of Educational Sciences

Figure 2: Distribution of the number of schoolteachers according to employment status on the sectors of education
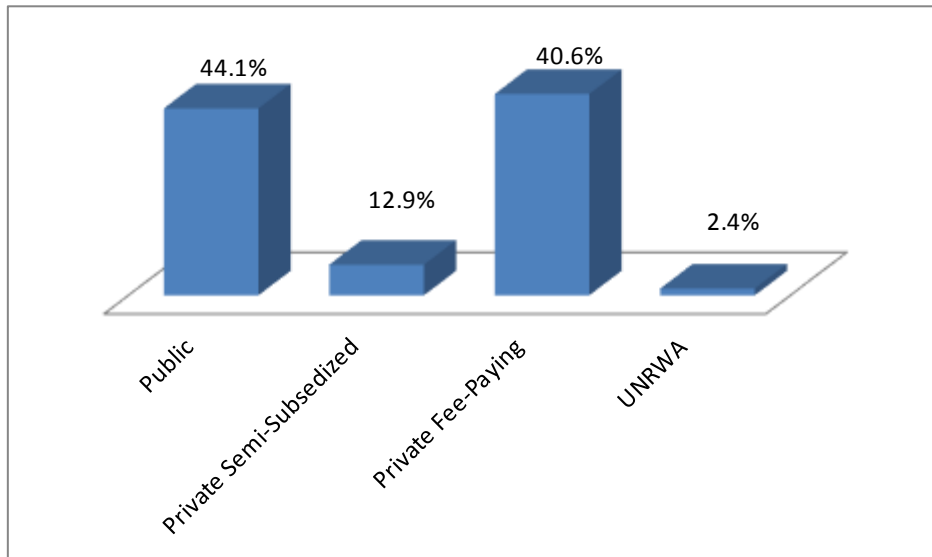
Source: CERD (2015-2016)

1.4.4. Teachers' Qualifications

When it comes to teachers' qualifications, 6.93% have doctoral degrees, 4.2% have masters, 61.61% have B.A., 2.93 % have university degrees, 16.95% have elementary education, and 16.45% have baccalaureate the second part or an equivalent degree, and 7.38% have other degrees (CERD, 2015-2016). This relatively small number of qualified school teachers is due to the absence of the essential regulations that ensure the employment of qualified school teachers in the public even though the government has recently established examinations to appoint secondary schools' specialist teachers: "These individuals were required to have university degrees in the subjects they were to teach. Once they passed the examination, these school teachers were required to complete a one-year preparatory period within a university department of education in order to become qualified for a teaching diploma in the relevant specialty" (Mullis, et al., 2011, p. 542). Based on Vision document of LAES (2006), education in public schools in Lebanon faces a major problem when it comes to teachers' qualifications. There is a lack of system for ongoing

professional development apart from the piecemeal initiatives of training undertaking by schools. Besides elementary education, secondary education faces other major problems in recruiting teachers. Like elementary education, there is a problem in giving individuals teaching positions without having educational preparation. Full-time school teachers are appointed as an option too and are given some professional preparation sessions. Finally, a newly-introduced large scale project started in 2004-2005 offering continuous training for public elementary and secondary school teachers. However, the outcome of the training is not clearly documented due to near absence of evidence-based evaluative studies.

In addition, an absence of a motivation system based on the school teachers' learning is worth mentioning. According to Mullis, et al. (2011), there is also absence of a system that evaluates the teaching process of the teaching staff. However, the CERD tends to monitor the professional growth of schoolteachers by applying the requirements for ongoing professional development. As mentioned by Mullis, et al. (2011) "Since the 1998–99 school year, all school teachers have completed professional development sessions and have been required to attend refresher courses. Mathematics and science schoolteachers attend special professional development laboratories" (p. 542). These sessions are conducted as qualification and follow-up courses in a given school year (Ibid).

1.4.5. Curricula Reforms

Besides school teachers' status and qualifications, this section summarizes the new curriculum in Lebanon which was developed 29 years after of the old curriculum of 1968 and 27 years after the reforms of 1970 which had only targeted the intermediate cycle. In other words, the new curriculum was the first initiative after the civil war to replace the stagnant 1968 curriculum. The sections that follow summarize the rationale for the reforms, the new curriculum, and prepare the ground for presenting the statement of the problem.

1.4.5.1. Rational for the reforms

As cited in Hajal-Chibani (2009), since the Ta'ef Agreement in 1989, Lebanon has initiated reforms in education under the Council of Ministers Resolution No. 15/94 of 17 August 1994, which approved the project of "Education Development Plan" prepared by the

28

CERD, as amended by the Committee designated by the Council of Ministers No. 26/93 dated 10 October 1994. The rationale for the reforms was penned by former Minister of Education, Mr. Mikhael El Daher as follows: (1) absence of public education policy, and the ambiguity of the objectives of curricula that embody them, and weak relation with life and the labor market, which led to the low level of education academic year; (2) the suffering of educational administration and by extension faculty in terms of lack of school management to the human elements of qualified principals and what has been exacerbated by events; and (3) non-compliance with the requirements of engineering and health and education should be available in school buildings and equipment.

The new plan was based on the dimensions of intellectual and humanitarian belief in Lebanon as a country of freedom and democracy enshrined in the constitution and maintained by law and belief in the values and principles that respect human rights, national and in particular; Lebanon is a sovereign, free and independent country, and the ultimate homeland for all its citizens, Arab in its identity and belonging. On 27 March, 1997, the Council of Ministers approved the new curriculum dubbed the New Framework for Education in Lebanon by Decree 10227 dated May 8, 1997. The section that follows outlines the curriculum.

1.4.5.2. The curriculum

The new framework for education in Lebanon structures the new and current national curriculum into four main cycles. The first cycle, preschool education is at the lowest educational ladder and includes kindergarten. This cycle is followed by basic education structured into two cycles: six years of primary education and three years of lower secondary education. The latter is sub-divided into two options: general education and qualification module-based vocational training. Moreover, the second cycle, primary and lower-secondary education makes up basic education which is normally completed by a student at the age of 15. As for the other two remaining main options after the successful completion of basic education, general secondary education leads to the Baccalaureate with four mainstream educational options: socio-economic, humanities, life sciences, and general

sciences, or the technical education and vocational training offered for those who would consider vocational education. After 12 years of schooling, students are eligible to apply to higher education (Hajal-Chibani, 2009). The same Lebanese curriculum is adapted at all public and private schools in Lebanon. However, if the school wants to apply a foreign curriculum (e.g., French, English, or another international language), then both Lebanese and foreign programs must be applied at the same time.

The educational system relies mostly on the private sector in Lebanon; however, the Ministry of Education, Youth and Sport (now MEHE) has been able to control the system through its licensing of private schools and its requirements for their graduates to pass the government baccalaureate examination at the end of the secondary cycle and also grade 9. These requirements and regulations have compelled private schools not to go very far from the national curricula in pre-university education. According to Vision document of LAES (2006), the MEHE developed a new curriculum that suffers from the following flaws: 1) unsuccessful corporation among all groups benefiting from the curricula; 2) issuance of detailed curricula by ministerial decrees which reflected itself in the imperfect suppleness of the curricula to provide the needs of schools and to react to emerging educational trends; 3) the lack of reference documents that could be used as guidelines for the development of the curricula components; and 4) not taking advantage from evaluation and research studies and experiments that were conducted.

In comparison to the previous curricula, the educational curricula issued in 1997 represented a qualitative change especially in developing the basis of objectives, starting new subject-matter areas, bringing up-to-date knowledge, and adopting active teaching strategies. However, studies carried out on the curricula showed several weaknesses in their quality because of the difference between the subject-matter areas and the organized manner, in the way general and specific objectives were formulated, and how the sequence of table of content was organized (Vision document of LAES, 2006). The lack of studies on observation with a focus on the literature on the learning rather than on the observed studies done on the effectiveness of adopting several constructivist teaching strategies; specifically

30

the theory of didactic situation should be more investigated. Another major problem was the low degree of alignment between general curriculum goals and general and specific objectives of subject matter-areas as well as the content. Another weakness was in developing a scope and sequence that fit the subject taught, the time allowed, and the learning process. And the last two weaknesses were with the suitability and validity of content and in the formulation related to precision in using technical terms and in translation which resulted in discrepancies among the Arabic, English, and French versions of the curricula (Vision document of LAES, 2006). According to Nahas (2010), curricula should not be a goal by themselves, but they should be a helping tool that aims on improving the society and serve the nation. Nahas (2010) added that the development that happened to the individual through the curriculum helped him/her improve their personality. The director of the dissertation explained that the curriculum was not only the content of the subject-matter taught, but it was a combination of all the factors that contribute to the teaching and learning process.

1.4.5.3. Brief summary of the problems that lead to the conduct of this dissertation

It has been recommended by the MEHE, mentioned in an unpublished annual report (2014-2015), that several workshops in the months of September were always planned to be conducted about the mathematics curriculum in grade 4, 6, 8, 10, and 11. The need for the workshop was deemed necessary because school teachers were facing problems to meet curricular objectives and lacked the knowledge about new teaching strategies prescribed by the new national curriculum. Thus, through workshops, specialized personnel trained the mathematics main teachers as assigned by the school, who, in turn, trained the mathematics teachers of the public sector to handle the curricular objectives and to adapt them in order to meet with the content. Yet, no workshops for mathematics improvement have been conducted so far and all other workshops for enhancing other subject-matters have been postponed till 2016. The workshop content was designed to address the following weaknesses observed in public schools:

- lack of ability of using the active board and active teaching;
- lack of using variety of teaching strategy;
- lack of classroom management skills;
- lack of the ability of dividing the instruction time in classrooms efficiently;
- lack of integrating activities in the classroom instruction. For example:
    - some schoolteachers still underline the content the students need to memorize;
    - some school teachers still dictate their students the content;
- lack of use of technology in classroom instructions and activities;
- appointing unqualified school teachers to teach mathematics only to complete their teaching schedule.

Thus, through the MEHE, the Lebanese government agreed to implement the Education Sector Development Plan (ESDP) based on the National Education Strategy (NES), which aimed at providing educational opportunities such as quality education that contributes to building a society of knowledge and promoting social integration, education available on the basis of equal opportunities, and educational governance. This is why, in collaboration with international organizations, MEHE has upgraded the quality of teaching and learning in Lebanese schools by developing teacher professionalism and classroom observation reports, creating professional standards for different parties concerned in developing school teachers' capacities - such as trainers, pedagogical, and psychosocial counselors, and designing a unique disciplinary strategic framework for all pre and in service training and all parties concerned in teacher career development.

According to the Vision document of LAES (2006), schools in Lebanon predominantly use traditional instruction, defined similar to non-constructivist classroom as presented in table 2.

To synthesize, teacher-centered pedagogy is dominant in both public and private schools. This fact leads to the absence of an active classroom where the student is the center of learning, which might be among the reasons chiefly responsible for the existing weakness

32

in the basic subject-matters such as languages, mathematics, and sciences. The CERD (2015-2016) showed that the evaluation study of students' learning in all subjects as measured by students' learning on tests was low. Furthermore, Lebanon participated in the TIMSS international study whose results showed that Lebanon ranked a weak 31 among 45 countries in mathematics and a weaker 41 in sciences. Compared to the eight Arab Countries participating in the study, Lebanon came first in mathematics and last in science. Accordingly, the president of the CERD started taking process to edit in the mathematics curriculum in order to suit the requirement needed for the TIMSS; especially that since Lebanon has started participating in the TIMSS, the curriculum was not changed or even edited (Mullis, et al., 2011). From here, one can ask the question if the CERD is teaching to the test or applying the new teaching strategies required.

There are several problems that still face the MEHE and this might be the direct reason for the poor progress in the education sector in public schools mainly. These problems lay under two categories: the framework and the management. The framework of MEHE has not yet been able to provide sufficient reference documents from which the management can benefit in order to set definitions for policies, strategies, and plans (Vision document of LAES, 2006). Even though there have been efforts for developing an educational strategy since 2000, yet the MEHE has not been able to approve such a strategy on the basis of which educational plans would be developed. According to the Vision document of LAES (2006), the latest developed plans are as follows: "The Plan for Educational Reform, the 5-year Plan for Reform of Vocational and Technical Education (1998-2002), and the Plan for Education for All" (p. 38). Moreover, it was mentioned that "[t]he monitoring systems in the Ministry are purely administrative, weak, or restricted to one educational sector while neglecting others" (p. 38).

The three plans have not been approved; however, the third plan has been in the developmental stage for a period of over three years, but it has not been made beyond the draft form. Another problem in the framework is that the MEHE still has not developed enough terms and principles to control quality in the administration or educational

institutions. The last two problems that face the MEHE in framework are quality assurance and resources of supporting cooperation within the education society and between this society and other social organizations. Besides frameworks, according to Vision document of LAES (2006), the management of education suffered from: 1) spread functions; 2) problems among the divisions responsible to perform these functions, and occasionally the lack of communication among them; and 3) traditional strategies and casing behind the educational developments in Lebanon, and existing trends in educational management. However, MEHE is working on rising management information systems so as to automate the Ministry. It is also developed in a way where some school administrations in the public sector are not given the full authority to manage their schools. Finally, the MEHE administration of public education experiences weakness in managing the financial and human resources. The latter lack qualifications needed for a proper and modern administration and functional governance. The difficulties faced in the development of the curriculum, teacher preparation, school administration, school map development, and facility of support to schools in the application of the curricula and in the consumption of public school teachers are partly explained by the lack in human resources.

While the above issues underpinning education in Lebanon usher in further investigation, this dissertation is set to examine teachers' knowledge of different teaching strategies, observe what is happening in the classroom, and examine students' responses while undertaking hands-on in class or simply listening to lecture. A detailed discussion of the methodology of the dissertation and operational field measures will be discussed in chapter 3 of this dissertation.

The following section summarizes the challenges that encounter the mathematics curriculum in Lebanon.

1.4.6. Summary of the challenges the Lebanese Mathematics Curriculum of Grade 4 encounters

In addition to the lack of research, mathematics is an interesting subject that requires reasoning more than memorizing. The researcher always recognizes students and parents

showing interest in promoting mathematics and other scientific subject-matter more than, for example, history which requires memorization. In the researcher's experience, some parents do seek to put private tutors for their children in order to promote their learning skills and have higher grades in mathematics.

In Primary and Lower Secondary cycles, the curriculum purports that students who complete Grades 4–6 would have the essential skills and a solid foundation in mathematics (CERD, 2015-2016). Eventually, students must be able to do specific tasks in the mathematical domains. Thus, students should know how to do mathematical reasoning, problem solving, communication, spatial, numerical-mastery, measurement, and statistics. However, students who complete grades 7 – 9 should be able to do the following tasks: mathematical reasoning, problem solving, communication, spatial, numerical, measurement, and statistics according to the curriculum general objectives listed by the CERD. As for the Instruction for Mathematics in Primary and Lower Secondary Grades, mathematics is taught for five periods a week throughout Grades 1 to 9 for a total of 150 periods per year. In public schools, only books published by CERD are used. On the other hand, private schools are free to use books published by private publishers according to legislative decree 1436 dated 1950. In addition to books, neither the teachers nor the students, in both public and private sectors, are required to use computers in their classes as new technology tools for supporting students' learning, but they are required to use calculators in their mathematics classes. Moreover, students of grades 1- 6 have generalist schoolteachers who can teach both mathematics and science, and sometimes, can teach other language lessons.

Teachers not having been specialized in the mathematics subject area could be detrimental to effective teaching of mathematics which requires focused specialization in teaching skills, strategies, and mathematics concepts to fulfil the nature and requirements of mathematics teaching such as the variables the Theory of Didactic Situation suggests and which will be explained in details in chapter 2 of this dissertation.

Mathematics is essential for the life and development of societies. Mathematics learning has been reformed due to its necessity based on three axes: the new formulation of

objectives, the remodeling of contents, and the suitable choice of teaching method. To start with the first axes, the formulation of objectives requires reasoning and the individual construction of knowledge and not only what is taught already. It starts with the real life situations where the students ask questions, search for problems, formulate hypotheses, and verify them. Moreover, the CERD (2015-2016) continued to explain that the objectives of mathematics were to make students communicate while "reading a mathematical text, understanding it, interpreting it, using symbols, graphs, tables etc..., writing a demonstration, explaining a situation, etc... remain essential objectives of the teaching." As for the second stage, remodeling content, the mathematics curriculum stresses on evaluating the students' application of the taught theory. The use of calculator and computer is introduced, so they benefit on the formation. As for the third axis, strategies of teaching, they should be organized in a way to suit the larger public. The methods that are recommended consist of real-life situations which show that there is no separation between mathematics and everyday life. Thus, due to the above mentioned reasons, the new mathematics curriculum seeks to help in the development of a person's personality and communication which come from an active classroom.

According to Nahas (Interview, January 17, 2014), the Lebanese curriculum lacks the constructivist teaching strategy (see appendix 2). It is only found on papers and in the general objectives of the curriculum, but in fact, few schools apply active teaching strategies where the students are encouraged to use their prior knowledge and build on it new ones. Nahas also gave an example of relating addition to transformation. He argued that when a grade 4 student was asked to give the sum of balls he/she gained considering playing with 4 balls and winning 5 extra ones, the student would add $4 + 5$ and say that he/she had 9 balls. However, if the teacher changed the way the question was asked, then the student would get confused unless he/she was shown the correct way to solve it. For example, he might be asked to consider having 4 balls and considering his friend having 5 more balls. The student would start thinking of comparison and not a simple addition equation. Nahas (2014) explained to me in the interview that I might face difficulty measuring the students' learning

36

in relation to a constructivist teaching strategy and he encouraged me to study the extent to which school teachers know about the constructivist teaching strategy and whether it is being applied in public schools and not only in private ones. According to him, the problem lies in the curriculum:

> This is where the problem lies. How do we move in a K-12 curriculum from a wishful thinking status to an efficient implementation phase? How do we audit the results of such issues? While everybody agrees on the importance of the acquisition of High Mental Skills, we were not able in Lebanon to implement adequate learning strategies for that.

As a conclusion, Nahas (2009) explained that the "curriculum and its implementation phase fail to say how and when learners will be introduced to these skills and how school teachers will be able to judge the mastery of such skills. On the other hand, the curricular content of the different disciplines does not mention how and when such skills will be efficiently used."

1.5. Summary

From all of the above challenges that face Lebanon's educational system and from the background information that the researcher has gathered while researching about the education in Lebanon, it is imperative to delve into the issue of mathematics teaching done in Lebanon in order to envision best practices in teaching mathematics in Lebanese schools. The researcher would like to conclude with what Nahas (2009) wrote regarding the Lebanese education case where he stressed again on the idea that a vision was not enough. Education decision-makers are expected to be aware of the students' needs and engage in developing an educational strategy of a due and discernible nature. This dissertation is set to examine the school teachers' knowledge of different learning strategies, and to study the environment of mathematics teaching and curriculum for grade 4 in selected private and public schools. Selecting grade 4 of cycle 2 was due to several factors such as there is no homeroom teacher and it is considered a preparatory stage for cycle 2. More details will be discussed in the chapter 3 of the dissertation.

1.6. Statement of the Problem

Mathematics and sciences are considered subject-matters that have the potential to prepare future scientific brains. Grade 4 students of cycle 2 whose age group roughly falls between 9-10 undergo reversibility (going back and forth between identifying words and looking up their meanings) and decantation (a preparatory stage that allows students to transfer the bridge between one cycle and another and prepares them to have harder objectives in the advanced classes). One teaching strategy that facilitates this transition is related to constructivism (Piaget, 1954-1973). Regardless of the subject-matter, educators strive to find ways that would improve students' learning, particularly in mathematics. The more advanced the level is, the more complex analyses are required from students. This dissertation is based on the assumption that higher-order thinking cannot be acquired by the students alone, but with the help of the teacher to improve students' evaluation and analysis of the subject taught (Vygotsky, 1978). Teachers' knowledge and application of different constructivist theories in class are essential for promoting higher-order thinking among students which are outlined in the grade 4 mathematics curriculum using active verbs such as learn, analyze and prove.

Due to several challenges schools in Lebanon have been facing regarding teaching mathematics, this dissertation aims to examine these problems centering on schoolteachers, students, and coordinators of public and private schools.

Early pre-piloting conducted to substantiate and verify the statement of the problem has shown that one of the main issues some Lebanese schools are facing is that even though the general objectives of the mathematics curriculum are based on the constructivist theory, they might not yet be applied in all the schools (Nahas, 2015). Another challenge facing the Lebanese mathematics curriculum is that the objectives gloss over terminologies that connote active verbs reflecting constructivism in the curriculum such as observe, interpret, question, expect, and classify are replaced by verbs such as know, understand, learn, and prove (Nahas, 2015).

The researcher agrees with what Skaff (2012) argued; whatever the subject-matter was, it is imperative to find the best way to improve the students' performance and leaning, and this way might be opening the teachers' eyes to different strategies, one of which the constructivist teaching strategy. According to Ferguson, performance refers to the value and capacity of knowledge, skills, techniques and positive attitudes, and behavior and attitude that learners achieve (1990).

Thus, some of the issues that should be taken into consideration are the curriculum and teaching strategies used.

1.7. Background Information on Teaching Strategies and their Relationship with Students.

One of the factors to take into consideration for improving students' mathematical learning and comprehension is using teaching strategies that stress on the participation of the students in the learning process where they are expected to construct knowledge and not only receive it (Nayak, 2013). One should study whether failing in mathematics is related to problems in the curriculum, problems in teaching, problems with the student, or a combination of them all (Carnine, 1997). Carnine went on to say that most reasons were related to the curriculum and the teaching strategies and not to the fact that the student could not learn. In traditional learning, the student is asked to memorize, conduct experiments and 'perform' mathematical calculations (Nayak, 2013). As a result, constructivist teaching requires more challenging methods for students. Constructivist theory and its effect on the curriculum design are based on Piaget's theory of learning. This theory encourages students to investigate and interact in groups. The students are expected to participate in the process of learning where they construct their own understanding of a particular knowledge based on previous ones. Details of this theory and other related ones are discussed under the theoretical framework of this dissertation in chapter 2. According to constructivist pedagogy, the students are more motivated and perform better when they are allowed to participate in the learning process (Kim, 2005). Constructivist pedagogy focuses on strategies used in classrooms with the aim at helping students depend on themselves and

think mathematically, historically and so on (Richardson, 2003). Because the constructivist teaching strategy involves all students in constructing their own knowledge, learning contributed to "intellectual, social, and psychological development of learners" (Nayak, 2013, p. 3).

Ferrara (2010), reported TIMSS results in a study he had conducted in 1995. The report stressed the importance of providing challenging mathematics in the classroom. This issue is very essential for this dissertation. The researcher wants to search, observe, and analyze whether mathematics is being challenged in the Lebanese public and private sectors. Bandlow (2001) claimed that there were a lot of elementary (cycles 1 and 2) schools that considered this stage as a continuation to the pre-school. They did not consider it as a preparatory stage towards higher school. Schoolteachers did not only need to know the mathematical material to be taught, but they also needed to know how to teach it (Ibid). Schields (2005) stressed on the fact that mathematics curriculum requires more abstract in the elementary and intermediate school.

1.8. Objectives of the Dissertation

The objectives of this dissertation are:

1- To identify the main indicators from the mathematics classroom environment as excerpted from fieldwork.

2- To examine the schoolteachers' knowledge of different constructivist theories.

3- To suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study.

1.9. Significance of the Research

There is a scantiness of information about schoolteachers' perceived knowledge of constructivist teaching strategies in mathematics. This dissertation seeks to close this gap in the literature. Early piloting of the research instruments that will be discussed in chapters two and three of this dissertation gave the researcher confidence about the need to conduct this study (see objectives in this chapter) in order to inform the public and the academic community alike about ways that would potentially enhance students' learning mathematics.

In Lebanon, the general education sector is in need for studies that would promote understanding of problems underpinning teaching mathematics. It anticipates in helping schoolteachers consider using different teaching strategies such as the constructivism in order to develop more active classrooms which might improve students' learning of mathematics.

1.10.   Research questions of the Dissertation

The preliminary research questions of this dissertation are:

1- How do grade 4 schoolteachers associate constructivism with their teaching of mathematics?

2- How can observation data yielded from fieldwork be used in identifying grade 4 mathematics teaching environment?

3- How would pedagogical models yielded from fieldwork inform mathematics teaching in the Lebanese elementary cycle?

1.11.   Limitations of the Dissertation

This dissertation has limitations.

First, teaching effectiveness and schoolteachers' job performance and schoolteachers' qualifications can certainly be assessed against many other variables such as age and gender; and the relationships of constructivist practices to these other outcomes remain to be studied in future research.

Second, many factors such as students' gender, ethnicity, poverty, self-confidence, school attitude, organizational factors, class, and peer relationship could influence the cognitive process (Bracey, 2004) and these were not taken into consideration in this dissertation.

Third, educators might be concerned with being closely observed and evaluated in terms of knowledge of the topic being taught as well as the strategy being used; despite the fact that the goal for observation was explained ahead.

Despite these limitations, it should be noted that an educational study of this kind would potentially contribute to the generation of relevant ideas and perspectives concerned with constructivist teaching strategies in Lebanese schools taking grade 4 as a case study.

Definitions of key terminologies used throughout this dissertation in relation to are presented in the section that follows.

1.12.   Definition of Terminologies

Cognition	Stresses on the "brain". It explains how the individuals process and install knowledge that was important in the learning process (Keesee & Shepard, 2011).
Constructivism	Piaget (1969-1975) defines constructivism by reference to four principles: First, he explains that learning relies on previous knowledge the learner has. In order for new ideas to occur, they should be built on old ones
Constructivist teacher	An instructor who teaches in a way that encourages students to use their previous knowledge in order to build new ones. He/she encourages analysis, interpretation, synthesis, and prediction (McGregor, 2007).
Curriculum	Curriculum as a policy artefact is the term used for policy documents enacted by authorities such as the Department of Basic Education. These documents represent the official curriculum and illustrate a nation's educational priorities (Du Preez, 2014).
Teaching strategy	A set of methods (techniques) based on the same rules and having a common aim (Henson, 1980).
Mathematics	A form of analysis consisting of logical thinking, formulating and testing conjectures, making sense of concepts, formulating assumptions, conclusions and decisions as well as explaining them (Kopsovish, 2001).

1.13.   Conclusion

Besides this chapter which presented the background of the study, this dissertation is divided into 6 chapters.

1.13.1. Structure of the Dissertation

Chapter two presents the theoretical framework of the dissertation and reviews pertinent literature on the constructivist teaching strategy and how it is correlated to mathematics curriculum, the ways it sees students in classrooms, and the ways the schoolteachers are expected to behave following this strategy. It also reviews literature from Lebanese context.

Chapter three discusses the design of the dissertation and its operational field measures. In addition, it will describe the procedures that were followed in order to analyze the data obtained from interviews and observations.

Chapter four presents the research findings of the dissertation obtained from fieldwork: Interviews and Observations. It is divided into two main parts. The first part presents and analyzes the findings in each school separately and the second part presents and analyzes all the 7 schools along with the variables chosen for this dissertation: Teachers' and coordinators' perception of traditional versus non-traditional classrooms, teachers' and coordinators' perception of different learning theories and their effect on enhancing teaching Mathematics, and coordinators' views of problems that might lie under the curriculum reforms.

Chapter five discusses the findings of the dissertation from the schoolteachers' interviews, the findings from the coordinators' interviews, and the findings from the observations conducted with special focus on the theories overarching the conceptual framework of the current dissertation with reference to the constructivist learning theories advocated by Piaget (1969-1975), Vygotsky (1978), and Brousseau (1997).

Chapter six concludes and presents recommendations for improving mathematics teaching in grade 4 in Lebanese schools and also suggests areas for future research in this domain.

Faculty of Educational Sciences

Chapter 2

Theoretical Framework and Review of the Literature

2.1.   Introduction

This chapter discusses the theoretical framework of the dissertation and reviews pertinent literature on the constructivist teaching strategy, particularly how it is related to the mathematics curriculum, the ways it sees students in classrooms, and the ways the schoolteachers are expected to teach as guided by constructivism. It also reviews literature from Lebanese context. There is little research concerning the topic of this study; however, there are some reports and studies on the development of the new curricula and its importance as a whole. The following information is basically taken from the LAES (2006; 2010), Nahas (1999; 2005; 2010), and Melhem (2010). Thus, the researcher will summarize the reports, reviews, and interviews in the following part hoping that they will help in understanding the curriculum position in Lebanon in general and the mathematics curriculum in particular and help in achieving some of the purposes of this dissertation outlined in the previous chapter.

The chapter is outlined as follows:

- theoretical framework,
- constructivist teaching strategy,
- Theory of Didactic Situation,
- literature review of the dissertation,
- constructivism and students' learning,
- constructivism and teaching strategies,
- constructivism and mathematics,
- didactic situation of mathematics,
- mathematics teaching: themes from the Lebanese contexts,
- conclusion.

2.2.   Theoretical framework and Literature of Reviews Related to the Theories

2.2.1. Theoretical Framework

Before discussing the two main theories relevant to this dissertation, i.e., constructivism and the Theory of Didactic Situation, it is worth differentiating between behaviorists and cognitivists because educational objectives and strategies of teaching change according to new social needs. Lately, there have been deviations among teaching theorists about which strategies will prove most effective in achieving today's educational objectives.

To begin with, educators come from two different schools. Some come from a behaviorist school and others come from cognitivist school. Ideas about learning have started with the behaviorists who stress on the movement of the body focusing on animals such as rats, whereas cognitivists studied the human mind modeled on computers (Bredo, 1997).

Directed instruction is grounded primarily in behaviorist learning theory and the information-processing branch of the cognitive learning theories. The constructivist view, on the other hand, evolves from other aspects of the cognitive learning theory.

There are several theories for learning which encourage independency of thought. Such theories encourage rewarding schoolteachers and negatively rewarding the students, a matter that affects the students' experience, thoughts, and behavior. Such theories encourage teacher's response which in return can lead to positively reinforce some behaviors. The behaviorist theory in education was established by John Broadus Watson in 1913 as preceded by the law of effect— a psychological principle advanced by Edward Thorndike in 1905, and was further refined and ameliorated by Skinner's (1968) operant conditioning psychology extrapolated from experiments conducted on rats and pigeons as cited in McGregor (2007). Tolman (1932) spoke about feedback where motivation plays a big role to reach cognitivist with Piaget. Tolman states that what an individual acquires serves as "the lay of the land," which gradually develops a picture of the environment known as the

"cognitive map". Once the individual is given a problem, he uses the cognitive map to explain the problem by selecting several ways and means.

Behaviorists believe that learning includes stimuli, responses, reinforcements, and consequences (McGregor, 2007). Thus, Behaviorist views of teaching and learning do not encourage the process of cognitive sense. There are several domains for constructivism that support the ideas of learning and instruction. The two relevant domains to educators to be able to understand the literature behind constructivism are the cognitive and the social emphasis.

McGregor (2007) explains that Thorndike (1911) developed two laws: the law of exercise and the law of the nature of the exercise. Teachers' reward and punishment could affect the students' experience, thought, and behavior. This law was called the "law of effect". McGregor adds that Skinner (1968) showed how rats could be treated in a way to push a lever to find food. He explained how response could lead to positively reinforce some behaviors. He extended this operant condition and applied it on the learners. He illustrated how stimulus, response, reinforcement, and consequence were related to learning. The laws of effect and exercise were applied in classroom. Both laws are centered on reinforced, repetitive, and observable behaviors in order to acquire skills such as mathematical tables.

Behaviorism gives a great emphasis and exclusive priority to research on lower animals. According to Phye (1997), John Watson was a student of Dewey and Mead and was influenced by Dewey. He based his research on stimulus and response disregarding the consciousness and mental behavior. Watson (1913) mentioned:

> Psychology as the behaviorist views it is purely objective experimental branch of natural science. Its theoretical goal is the prediction and control of behavior. Introspection forms no essential part of its methods, nor is the scientific value of its data dependent upon the readiness with which they lend themselves to interpretations in terms of consciousness… The time seems to have come when psychology must disregard all reference to consciousness; when it no longer need delude itself that it is making mental states the object of observation… I believe we can write a psychology...and…and never use the terms consciousness,

mental states, mind, content, introspectively verifiable imagery, and the like (p.17).

Watson (1913) explained that learning is a functional term that could change in order to fit a certain situation. It could be achieved faster when it was repeated and became a habit. Watson was concerned with the functions of behavior not the mind, so he did not view learning as occurring through conscious thought or insight. He also viewed learning as association of given stimuli and response. This means that, when a new stimulus is repeated several times before another stimulus occurs, learning takes place faster. Watson believed that "'mental' behavior is a habit, like any other, except that it involves the parts of the body used in speech, such as the larynx" (McGregor, 2007, p. 18). This means that it is significant to focus on what is done when thinking occurs rather than how it is done. Watson's strategy was too successful because responses could be accurately expected after the stimulus occurred; however, it was not successful because one could not predict responses to stimuli ahead of time. Skinner helped resolve these problems in Watson's theory. Learning for Skinner involved "a change in response rate following reinforcement" (Ibid, p. 19). For example, an animal that learns a new behavior responds faster when it is reinforced for a certain behavior. On the other hand, Skinner believed that learning differed from a performance that was observed because what was observed was a mixture of both learning and motivation. He believed that "reinforcing stimuli were consequences of responses that systematically varied the future rate of response" (Ibid). On the contrary, he explained all mental behavior in environmental terms: "reinterpreted any form of conduct showing thought or intention in purely external terms. Purposeful action was interpreted as an observed behavioral tendency" (Ibid, p. 20). All uses of mental operations were described as a result of a repetitive reinforcement.

The concepts that can be highlighted from this theory are:

- As mentioned earlier, teachers reward and punish students and this affects the students' experience, thought and behavior;

- response can lead to positive reinforcement of some behaviors;

- learning is shaped by stimulus, response, reinforcement, and consequence

48

- learning can change in order to fit a certain situation;
- when new stimulus is repeated several times, learning occurs faster.

As a summary, behaviorist views of teaching and learning do not encourage the process of cognitive sense. They limit the action of thinking under the learning outcomes. There are several domains of constructivism that support the ideas of learning and instruction. Behaviorism is a theory that affects the learning of students; however, the two relevant domains for educators to be able to understand the literature behind constructivism are the cognitive and the social emphases. Thinking does not have any effect on the learning; however, it is a repetitive sequence of stimulus that leads to a new learning that does not occur if reinforcement is not provided. Adapting the behaviorist teaching strategy should be part of the past and today, it is advised that it is replaced with new strategies which encourage the learners to think deep and depend on themselves and on their prior experiences.

This takes us to the first teaching theory this dissertation is concerned with constructivism.

A. Constructivist Teaching Strategy

This part is divided into two sections. The first section deals with theories about constructivism that are essential for the purpose of this dissertation, and the second discusses theories related to learning theories and mathematics education.

1. Brief Overview of the Constructivism Education Theories

In the constructivist educational theories, learners do not receive information passively, but they are rather engaged in the learning process and create their new knowledge based on prior ones in relation with new experiences. Constructivism contravenes traditional strategies where students undergo rote learning. The new constructivist teaching strategies have shifted the understanding of the learning process to radical conception where learners use the fresh ideas they get with them to the classroom and share them with their classmates. In a constructivist learning environment, learners learn

best by determining their own knowledge (Tolman, 1932). Constructivists believe that knowledge should not be inserted in the learners' mind but constructed through experiences and activities. Herein, the schoolteachers should encourage higher-level thinking where learners are encouraged to summarize concepts by analyzing, predicting, justifying, and defending their ideas (Bloom, 1956). In other words, in critical thinking, students can apply smart judgment or produce a reasoned critique. The goal of teaching is then to help and guide students to be wise by guiding them towards how to make good and reasonable decisions and exercise reasoned judgment (Anderson & Krathwohl, 2002).

The movement of constructivist education has been the interest of many people. Many constructivists have much impact on the educational practice. When the personal construction of knowledge is emphasized, the analysis is referred to as constructivism. Learning is based on child-centered strategy. By this, learners make meaningful connections. This occurs if the learners were given the opportunity to practice and search for results rather than being poured into them. The highest level of cognitive demand calls for doing mathematics complex; students explore and investigate the nature of the concepts and relationships. Tasks that learners are supposed to be engaged in should help them explore the relationship between the learned concepts and reality. For example, if learners are doing 'size' as a topic of study, let them explore the idea and find out how the topic can be applied in real life situations. They might be given two animals with different sizes and can be asked higher order thinking questions that allow them to relate prior gained concepts to new ones. Teachers should provide tasks that will lead the learners to explore, discover, and apply the concepts.

In a research done on the three theorists: Dewey, Piaget, and Vygotsky, Phye (1997) explained that constructivism is based on child-centered strategy. Dewey, Piaget, and Vygotsky were major theorists of constructivism as mentioned before. When studying classroom learning, one should take into consideration that both, the content and learning strategies, are not the same (Ibid). Thus, the content is when specialized people construct the meaning of a constructivist activity. However, when studying classroom learning, we

assume that students have background knowledge of the content which they have to build on in order to construct new knowledge. Since one of the purposes of this study is to investigate the schoolteachers' awareness of the importance of adopting a constructivist teaching strategy while teaching mathematics, the researcher will stress on learning which is related to constructivism directly. Gibson (1979) that classroom learning takes place as a result of affordance which is a relationship between the environment and a person. Gibson went out to state that "the environment provides opportunities and the person either provides or does not provide an action system that takes advantage of what the environment offers" (p. 51). This means that knowledge is perceived only if the person is ready to acquire it. In the level of classroom practice, personal knowledge construction is undertaken by the learner himself/herself. Thus, the constructivist views that the construction of personal knowledge is information processing where "although an individual learner may have a knowledge structure that is unique, all human beings are viewed as processing information by using a common set of processing components" (Ibid, p. 52). Thus, in order to understand how a learner develops new knowledge, it is vital to briefly explain the taxonomy outlined by Gibson (1979).

The taxonomy includes three types of knowledge: the declarative knowledge, the procedural knowledge, and the strategic knowledge. The declarative includes knowledge of "task, concepts, vocabulary, and other bits of information that are stored in memory." The procedural one is when the learners "combine, incorporate, or assimilate" the first knowledge, declarative, so it can be used in classrooms. Strategic knowledge is when "the learners know how to use the first two types of knowledge" (Ibid, p. 54). Besides knowledge, the process to learning is remembering too. A study done by Atkinson and Shiffrin (1968) shows how memory plays a big role in the learning process. Information from the short-term memory is transferred to the long-term memory only if that information is repeated over and over. If this fails, therefore, will be forgotten from the short-term memory and will not be stored and lost. Memory plays a main role in learning new information in terms of personal knowledge. In order for new knowledge to occur, we

should make sure that it is remembered and stored in one's memory. Remembering was a basic part in the classroom learning (Ibid). This entire introduction to the process of learning leads us to summarize the main three theories of Dewey, Piaget, and Vygotsky, which are directly related to the classroom learning environment.

The main concepts of the constructivism theory are:

- learning is based on child-centered strategy;
- students have background knowledge of the content;
- students build on previous background to construct new ones;
- knowledge is acquired only if the person is ready to acquire it;

If one looks at learning from Dewey's perspective, the learner continues with trying and modifying the actors until some results are achieved. Learning is more active and practical where in order for a student to learn new knowledge, the new information should be built on previous ones. The schoolteachers help the learners by providing them with suitable background in order for the conceptual change to occur.

Dewey's theory of reflective thoughts and actions was based on action. He focused on "evolving act, while viewing thinking as a kind of acting" (Bredo, 1997, p. 10). His strategy emphasized that organisms were 'engaged' in trying and undergoing. The organism continues trying and modifying the actors until some results are achieved. Dewey did not separate thinking from action. In addition, to Dewey, cognitive constructivism was a way to explain how learners acquired new knowledge (Piaget, 1971). According to Piaget (1969-1970), the individuals constructed knowledge through interacting with their own surroundings.

Piaget assigned three types of knowledge in the theory of constructivism: Physical knowledge, social knowledge, and logico-mathematical knowledge (Piaget, 1969-1970). Individuals depend on their previous personal experiences, explore new knowledge, and try to link both. Piaget (1971) said that in cognitive constructivism, the teacher's role was to help students undergo this action by providing them with the suitable background in order for the conceptual change to occur. Moreover, Piaget stressed in his theory that the child

52

learns through levels. These levels are reconstructed by the child to adapt to the environment and to become a valid knowledge. The levels are all dependent on each other. Each time a child advances in one level, the other level becomes more coherent (Paparozzi, 1998). Briefly, according to McGregor (2007), Piaget described how children experience new situations when they adapt cognitively. The development of the learning process takes place when learners develop a new experience. In the sensorimotor stage, the child undergoes progressive development from innate reflex system to the use of language. The initiative stage is superficial. The child focuses on one aspect of an object. In this stage, children can reason and identify relationships between variables; however, it is not prominent to be able to explain the relationships. The formal operation is the highest level of thinking. In it, the child develops an 'explanatory model', such as the particle theory as suggested by Piaget that is applied in many curricula. Constructivism can be seen in all schools in several subject matters. As appearing in McGregor (2007, p. 52), Figure 3 summarizes how a constructivist teacher asks reflective questions that seek to develop the personalized understandings and meanings. Figure 3 explains how students relate what they learn as new knowledge to old and previous ones. They are encouraged to reflect on their new ideas that will lead them to new understanding.

Figure 3: Prominent teacher behaviors and expectations implied by the constructivist learning theory [2]

Piaget (1975) discussed the equilibrium theory which involved according to Smith, Blakeslee, and Anderson (1993, p. 112) "realizing, reorganizing, or replacing existing conceptions to accommodate new ideas." In his study, McGregor (2007) explained that this theory involves two processes. Piaget distinguished between assimilation and

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[2] Adapted from *Developing Thinking Developing Learning: A guide to Thinking Skills in Education,* p.52, by D. McGregor, 2007.

accommodation as basics of learning development. In assimilation, the child changes the experience he/she was living to a representation he/she had. When the process becomes too great for a child, accommodation occurs where the child reorganizes his/her thoughts. In other words, to begin with assimilation, a matching should occur between the cognitive and physical environment, whereas accommodation is what we use in order to adapt the new cognitive structure with the physical structure. Both processes are important for each other; however, assimilation is central in the case of accommodation because the individual should be able to link new experiences with what he/she already knows. Piaget explains the state of equilibrium and disequilibrium as follow. He theorizes that when the individual is able to link new ideas with his/her existing cognitive structure, then the person undergoes state of equilibrium. However, if the person couldn't, then he/she is in the state of disequilibrium. Thus, according to Piaget's theory, in order to learn new knowledge, a person should pass through assimilation which leads to accommodation.

The main principles adapted from this theory are:

- the organism continues on trying and modifying the actors until some results are achieved;
- learning is more active and practical;
- to learn new knowledge, the new information should be built on previous ones;
- learning new knowledge is by reconstructing existing ones;
- schoolteachers help the learners by providing them with suitable background in order for the conceptual change to occur;
- children experience new learning through a level of hierarchy;
- students are encouraged to reflect on their own ideas that will lead them to new understanding;
- assimilation is when the child changes the experience he is living into a current representation;

- accommodation is when the child recognizes his thoughts and adapts the new cognitive structure with the physical one;

- equilibrium occurs when the child is able to link the new idea with his existing cognitive structure.

2. Social Constructivism Learning Theory

Opposite to the cognitive constructivism, social constructivism views that knowledge results from culture. Knowledge is shaped by cultural influences, and students learn throughout social activities. Higher mental functioning is related to culture. From the social constructivism learning theory's perspective, language is a very significant tool for children to learn new concepts.

Originated by Vygotsky (1978), social constructivism viewed knowledge as shaped by cultural influences. Vygotsky was interested in the social development of the mind. According to Vygotsky, children learn through social activities. Higher order thinking develops through participation in social activities (Bredo, 1997). They participate in "instrumental thinking when manipulating physical activities" (Ibid, p. 34-35). Social constructivism focuses on the context of the new knowledge. In order for children to explain what they have learned, they have to develop their language skills. When the learner is able to describe his ideas and communicate, his/her reasoning becomes effective. When the talk is encouraged, the cognitive development is facilitated (McGregor, 2007). Vygotsky argued that the instruction in educational setting does not depend on the child only, but on the environment as well. According to Fraser, Verma, and Muir (1978), Vygotsky defined the zone of proximal development as

> Those functions which have not yet matured but are in the process of maturing… "buds" or "flowers" of development rather than "fruits" of development. The actual development level characterizes the cognition development retrospectively while the ZPD characteristics it prospectively (p. 86).

Bredo (1997) explained that, in this theory, Vygotsky stated that in order for the child to learn new information, he/she should participate in constructive tasks on problem

solving and assist it with existing knowledge. Thus, the teacher's role is to relate information. The zone of proximal development uses the social origin of mental development to help identify a child's points of developmental readiness. Learning and development are related according to proximal development. Vygotsky stressed on the fact that ZPD created new level of development. This cognitive development would not be acquired and reached if the learning process did not undergo formal instruction. This formal instruction is adapted to lift the child to a higher order thinking (Fraser et al., 1978). According to McGregor (2007), "Social constructivism connects doing, talking, thinking, inter- and intra- understanding, all within a social setting" (p. 57). The way the teacher guides the learners is assumed to develop the ZPD. The learners in ZPD should be supported in their learning and problem solving process. Scaffolding is characterized by the teacher's responsiveness to the needs of the learners. Scaffolding is perceived as a skill of asking appropriate questions to organize a child's thoughts. Vygotsky's work on the nature of learning and its relation to ZPD influenced learning directly. In order to be able to learn new mathematical concepts, the child should have enough experience at the everyday level (Ibid). As schoolteachers, we should know as much as possible about the children's background experience. We should take time to observe children, listen, and talk to them as much as possible. While observing the children, we ought to think of what to observe and try to understand what they did. The children's theories should be kept as documents instead of being taken into account (Ibid).

As it appears in McGregor (2007, p. 55), Figure 4 explains the role of the teacher from a social constructivist view.

The main principles adapted from this theory are:

- knowledge is shaped by cultural influences;
- children learn through social activities;
- learning is mediated;
- learning appears twice: first on the social level, and later, on the individual level;
- higher mental functioning is related to culture;

- language is a very important tool for children to learn a new concept;

- the zone of proximal development is where the learner constructs his/her new knowledge based on old one;

- teaching responsiveness to the needs of learning is scaffolding;

- reciprocal teaching is used to improve a student's ability to learn from text through the practice of the four skills.

Figure 4: Prominent teacher behaviors and expectations implied by the social constructivist learning theory[3].

Both the cognitive and social constructivism domains allow the teacher to understand how students learn, which enhances learning and leads to higher order thinking, one of the main purposes of this study.

3. **Mathematics Education and Constructivist Theories**

In order to understand how mathematics education and constructivism are related, it is significant to understand the term mathematics. Children should be engaged in the learning process and allowed higher ordered thinking process in order to acquire new knowledge.

The pedagogy of mathematics is influenced by the philosophy of mathematics. Thus, the researcher believes that it is essential to highlight the main ideas of the philosophical theory of mathematics. According to Kopsovich (2001), "Mathematics is a form of reasoning and consists of thinking in a logical manner, formulating and testing conjectures, making sense of concepts, formulating inferences, and conclusions and judgments as well as justifying them" (p. 7). The purpose of this section is to introduce mathematics education (ME) and to relate it to constructivism. Hersh (as cited in Kopsovich, 2001) argued in the twentieth century that the formalist and logicist paradigms had an influence on the mathematics education and shaped the way schoolteachers taught and students learned what mathematics was. Behaviorists had a great role in influencing the school, mathematics curriculum, and teaching education. The quasi-empirical strategy and the socio-constructivist theory were parallel. The first focused on the philosophy of the nature of mathematics, and the second focused on the psychology of mathematics education (Ibid). Even though the two philosophies were of teaching, behaviorism and constructivism shaped and influenced the way nowadays mathematics is taught in schools (Franke & Grows, 1997). The philosophy of education directly influences schoolteachers, and this can be seen throughout the teaching practice in classrooms nowadays.

Mathematics education changed over the past year especially after cognitive science had been introduced to the education center. Education was no more focused on recitation, but more on problem-solving and hands-on activities. Theories of mathematics education

helped to build understanding of how mathematics should be taught in cognitive science perspectives (Ibid). Piaget (1954, 1973) and Vygotsky (1978) helped us understand that learners came to school with ideas and previous knowledge that could be blended within the environment. Theories of cognitive science explained to us that children should be allowed to be engaged with the thinking process in order to learn new knowledge and remember it later on and use in the correct place (Franke & Grows, 1997). Cognitive psychology helped the schoolteachers relate the individual learning to the environment. Building on Piaget "one can think about the learner gaining knowledge by interacting with his or her world, the focus here is on active individual construction and reflection" (Ibid, p. 308). We often hear educationalists say that children construct their own learning. They only help them develop a right way in order to achieve this. As educators, we always say and hear others saying that in order for children to learn, they should be engaged in the learning process.

The main principles learnt from this theory are:

- children should be engaged in the learning process;
- children should be allowed to interact in with the thinking process in order to learn new knowledge.

The mathematics curriculum is not of less importance than the teaching strategy since it is used as a tool for the schoolteachers and allows them to reach the students' level of learning. According to Grady, Watkins, & Montalvo (n.d.), theorists have not been able to come up with one particular teaching strategy for a better learning in mathematics. According to Franke and Grows (1997), the schoolteachers used the curriculum to help the students build mathematical understanding. Different schoolteachers could use the same curricula and filter them differently depending on their way of using constructivist thinking. From a point of view, the schoolteachers should think of their students, take into consideration what they knew and then decide on what the students needed. In addition, the curricula could play a role in helping the schoolteachers decide on what the students needed and another role could be in providing activities and problems that helped the students understand new mathematical concepts (Franke & Grows, 1997). For example, a grade 4

child who is solving a problem with numbers less than 20 can link the problem to everyday life experience. Thus, the selection of the curriculum plays a significant role in helping schoolteachers adopt a constructivist method of teaching. For example, in order to be able to apply the theories discussed previously in this part of the dissertation, it is recommended that the teacher chooses a curriculum that encourages "listening to children, fostering classroom communication, understanding children's background, deciding which problems to pose, and using teaching tools" (Ibid, p. 336). In other words, the teacher ought to decide on a curriculum that promotes the students' knowledge building. The teacher should ask several questions before adopting a specific curriculum in relation to the learner's social economic status, background knowledge, and special needs. Franke and Grows (1997, p. 336) provided us with several questions that the teacher could ask before adopting a specific curriculum. Here are some of these questions:

- Does the curriculum provide opportunities for the teacher to have the children discuss their thinking with their classmates?
- Does the curriculum include problems that lend themselves to multiple solutions or problems that build on one another in a manner consistent with the development of children's thinking?
- Do the suggested activities allow the teacher to easily determine the children's prior knowledge?
- Are teaching tools appropriately integrated into the curriculum?

However, not all curricula fulfill the above objectives, yet the teacher should select from several ones in order to meet the objective related to building children's mathematics concepts. "It may be that the teacher will always have to select from a set of imperfect curricula and then create and use it in ways that connect with her students" (Ibid).

As a summary of the above concepts:

- the formalist curriculum adopts the traditional strategy to mathematics construction;
- the constructivist curriculum adopts the non-traditional strategy to mathematics construction;

62

- the constructivist curriculum emphasizes action;

- the constructivist curriculum considers the teacher and the students as 'active meaning-makers';

- schoolteachers use the curriculum to help the students build mathematics understanding (p. 336).

B. The Theory of Didactic Situations

1- Brief history of the origin of the word 'Didactics'

Even though 'didactics' was a common term in Europe, the term met resistance in the English-speaking world when it came to discuss educational matters (Pramling & Samuelsson, 2011). For this reason, the researcher elaborated briefly the history and transformation of the term for the sake of this theory in the dissertation. The term 'didactics' has its roots in ancient Greek. The word 'Didaktik' stems from "the group of words connected with 'didaskein', i.e. teaching, showing something, playing out a drama" (Hopmann's, 2007, p. 110). "The suffix '-tik' or '-k' "is a Latinized ending derived from 'techne', the Greek term for 'skill', 'art', 'expertise', 'profession', 'science', 'technical knowledge' and so forth" as defined in Pramling and Samuelsson (2011). Hence, the word "didactics" was a production word from the Greek synonymy for demonstration and art. However, in the English-speaking world, 'didactics' was understood as "formalist educational practices that combine 'dogma' with 'dullness'" (Ibid). Hence, in English the term 'didactics' might have implications of what has been today often seen in education as 'a lecturing teacher and listening children', where the latter did not have a voice in their own learning. However, this was not how the term was understood in the European continent. Another key feature of the European notion of didactics was that 'didactics' opened up for the empirical fact that people with different experiences would make different understanding of the same situation. In this dissertation, 'didactics' is used to refer to the interaction and communication between the teacher and the child and educational objectives were achieved (Ibid).

2- Brief discussion of the Theory the Didactic Situations

The principal theoretical reference for the strategy of the dissertation is the Brousseau's 1978 theory of the situations.

Brousseau (1997) explained that the theory of didactic situations was a model that studied the problems related to teaching mathematics. In the theory, the term "situation" was defined at first as the student's environment handled by the teacher, but then it got expanded to include everything from the environment itself to the teacher and the educational system. A situation was itself a system; "the set of circumstances in which the student finds herself, the relationships that unify her with her milieu, the set of 'givens' that characterize an action or an evolution" (p. 214). This theory started in 1986 due to the work of Brousseau (Ibid). The idea behind this theory was to identify the main role given to the relation between students' learning process and the environment where learning happened (Manno, 2005).

Research on didactics of mathematics has studied the teaching-learning phenomenon within a triangle of teacher-knowledge-pupil (Manno, 2005). The teacher role was to make possible change from knowledge that came from research to the 'knowledge taught'. The three subjects in the triangle were to be considered at the same level (Chevllard & Johsua, 1991).

3- Principles of the Theory of Didactic Situation

Like the previous theories, the theory of Didactic situation has a set of principles, and these are the epistemic ones:

- knowledge results as the optimal solution to a certain situation or problem;
- learning is in accordance to Piaget's genetic epistemology a form of cognitive adaptation;
- for every piece of mathematical knowledge, there is a family of situations to give it an appropriate meaning;
- the student's autonomy is a necessary condition for the genuine learning of mathematics.

These principles are supplemented by a set of roles of the teacher and the student in the classroom. The role of the teacher was to be responsible of the results skilled and to provide students with all the necessary factors to learn and gain knowledge (Manno, 2005).

4- The role of the teacher:

The role of the teacher is not to show students how to solve problems but to let them deal with these problems. Radford (2008) noted that the teacher's role was rather to find out the problems or situations that would be given to the students. The teacher should be alert to what was said in the action situations where she had built an environment that helped the students learn a specific skill by the end of every activity. The teacher's role was to make possible change from knowledge that came from research. He/she had to refrain from or to choose to communicate information, questions, and teaching methods. The teacher took a re-contextualization and a re-personalization of knowledge and he/she looked for situations which could give meaning to the knowledge to be taught (Brousseau, 1997). The teacher arranged the situations to discover knowledge and then depersonalized it. The teacher produced transformation of established knowledge into situations of learning and discoveries (Ibid). As a summary, the teacher has to be alert to what is said in the action situations in order to open topics for discussion. The schoolteachers' role in the a-didactical situation is very vital. They should be in control of the situation and every change that might occur in it. The schoolteachers' role here is to give students the tools they need and provide conditions that reproduce learning.

5- The role of the student:

The student is seen by TDS as an ideal model with thinking close to that of a mathematician. The student is required to "produce, formulate, prove, and contrast models, languages, concepts and theories" (Brousseau, 1997). Manno (2005) justified that the role of the student is to accept the burden to deal with new problems no one told them about and no one taught them how to solve or told them what strategies to use.

Brousseau differentiated three situations in the teaching process. As they appear in Manno (2005), Flores and Victoria (1999) explain the following:

- non-didactical situation: with respect to knowledge S, it is that situation that is not explicitly organized to allow the learning of S. For instance, at the secondary level, all that has to do with operation with naturals may be considered as a non-didactical situation;

- didactical situation: with respect to knowledge S, it is that situation designed explicitly to encourage S. We can consider as didactical all the tasks done in a classroom with which the teacher intends to teach S, and with which the student is forced to learn S;

- a-didactical situation: with respect to knowledge S, it is that situation that contains all the conditions which permit the student to establish a relationship with S, regardless of the teacher. The actions that the student does and the answers and arguments that she produces depend on her relationship (no completely explicit) with S, i.e. with the "problem" that she must solve or with the difficulty that she must overcome. In this case, a process of devolution of responsibility is in action.

This research is interested in studying the role of the teacher in the a-didactical situation. The focus here will be on this situation. Again, Brousseau defined a-didactical situation to be a situation in which the student was enabled to use some knowledge to solve a problem. Brousseau (1997) gave a new role for the teacher-pupil system. He explained that the teacher had to build an environment which allowed students to learn something new at the end of each learning situation. If the process of learning was not produced autonomously by the student, learning couldn't happen. The student should engage with a fundamental situation which gave rise to what was called "a-didactic" situation which was characterized by the student's autonomy where the teacher refrained from interfering. The problem chosen by the teacher leads the student to an 'a-didactical' situation in which the teacher refrains from or chooses to communicate information, questions, and teaching methods with the student who describes a broader situation called didactic situation. The a-didactical situation is designed in a way where the students are given a new problem where they continuously try on and on to find the most suitable way to win without the

66

schoolteachers' support. By building their understanding, by playing, and by giving a rich context, the students are promoted to a new awareness level. In this situation, the students construct their own knowledge, and they are given responsibilities by the schoolteachers. Brousseau explained (as cited in Bikner-Ahsbahs & Prediger, 2014) that in a-didactical situations, the students accept to take the mathematical responsibility of solving a new problem and then the teacher tries to interfere or suggest the target mathematical knowledge for making such adaptation possible. In order to learn a new mathematical learning, the 'a-didactical' situation needs some major steps: 1- Action situation, 2- Formulation situation, 3- Validation situation, and 4- Institutionalization situation. As adapted from Manno (2006):

- Action situation: an action situation is into the environment and makes easy to build implicit theories that work as proto-mathematical models.

- Formulation situations: it makes easy to gain new explicit languages and models, if its social shape is explicit, then we talk about communication situation.

- Validation situation: students are required to solve problems and they make clear and full explanations about theories and any means they have used to solve the problem.

- Institutionalization situation: this situation gives value of truth to knowledge learnt in a classroom; it is usually related to concepts, symbols, and knowledge likely to be used at different times and to different purposes. These situations go together with the act of "devolution"; the institutionalization of knowledge is basically a process that allows students changing their previous knowledge into a new official knowledge thanks to the approval of the teacher that gives them a value of truth and makes it possible to use the acquired new knowledge to solve future problems.

As a result, the schoolteachers' role in here is central. They should be in control of the situation and every change that might occur to it. The schoolteachers' role here is to give students the tools they need and provide conditions that reproduce new knowledge.

It is worth mentioning that according to Radford (2008), the "didactical contract" was a relationship that determined what each partner was responsible to the other for. In contrast

to constructivism, neither the mathematical meanings nor the forms of proving were negotiable, but the fluctuating borders of a teacher-student division of labor were negotiable.

6- The Paradox of Learning

The schoolteachers have to make sure that the learning is taking place, and if they find that the students fail to learn, the schoolteachers should provide them with more details, but that might risk obtaining learning as explained earlier in this section of the chapter. Brousseau does not consider this paradox as a contradiction. As cited in Radford (2008), Brousseau argued "if the teacher says what it is that she wants to obtain, she can no longer obtain it" (p. 7).

Another paradoxical situation that Brousseau (2008) describes is when it is not possible to find a fundamental situation that fits the students' intellectual possibilities. In this case, the teacher should teach knowledge directly. The students are also put in a paradoxical situation where they must understand and learn. However, in order to learn, they must to some extent give-up understanding, and in order to understand, they must take the risk of not learning.

7- The Idea of Learning

According to the theory of Didactics Situation, unaffected learning comes from the individuals' needs and experiences. Knowledge acquisition is the result of the students' personal relationship with the object of knowledge. This is a common aspect between the theory of didactic situation and constructivism. The difference lies in the epistemic role of the problem which in constructivism, may lead to equally genuine pieces of knowledge. In contrast, the design of the problem should lead to specific target knowledge according to the theory of didactic situation.

8- Summary

In summary, the theoretical idea the researcher aligns with is the one from Guy Brousseau who in "Theory of Situation" defines the milieu: the environment where the student and his knowledge building process happen. The a-didactical situation can be built/produced when students find themselves into a situation where they are not sure of the

strategies to use in order to learn. Also, this situation shows its effectiveness, so the students can come to a new winning strategy modifying their knowledge. Finally, the situation has to be repeatable. The schoolteachers' role in here is very significant. They should be in control of the situation and every change that might occur.

From this theory:

- the schoolteachers have to make sure that the learning is taking place and if they find that the students failed to learn, they should provide them with more details;

- the teacher should not show students how to solve problems but to let them deal with these problems;

- the teacher's role is to find out the problems or situations that will be given to the students;

- positive role of the person in building the knowledge;

- the teacher should teach knowledge directly when it is not possible to find a fundamental situation that fits the students' intellectual possibility;

- knowledge acquisition is the result of the students' personal relationship with the object of knowledge;

- the teacher has to build an environment that helps the students learn a specific learning by the end of every activity;

- the teacher role here is to make possible change from knowledge that comes from research to the 'knowledge taught' to the knowledge that has been taught;

- the teacher should be in control of the situation and every change that might occur. The schoolteachers' role here is to give students' the tools they need and provide conditions that reproduce;

- the teacher has to be alert to what is said in the action situations in order to explicit topics for discussion. The schoolteachers' role in the a-didactical situation is very central.

Table 1: Theories and Variables/Conceptions that Inform the Dissertation

Theory	Variable/Conceptions	Relationship between variables and objectives
Constructivism Teaching Theory	1. Disequilibrium brings about: -Assimilation -Accommodation 2. Developed cognitive structures into schema(s). 3. Learning is based on child-centered strategy. 4. Students have background knowledge of the content. 5. Students build on previous background to construct new ones. 6. Knowledge is perceived only if the person is ready to acquire it. 7. Learning is more active and practical. 8. Schoolteachers help the learners by providing them with suitable background in order for the conceptual change to occur.	The variables are related to the first two objectives of this dissertation which to identify the main indicators from the mathematics classroom environment as excerpted from fieldwork and to examine the schoolteachers' knowledge of different constructivist theories.
Social Constructivism Learning Theory	1. Zone of Proximal development (ZPD). 2. Meditation and scaffolding. 3. Understanding social development on an individual plane. 4. Knowledge is shaped by cultural influences. 5. Children learn throughout social activities. 6. Language is very important tool for children to learn new concept.	The variables are related to the first two objectives of this dissertation which to identify the main indicators from the mathematics classroom environment as excerpted from fieldwork and to examine the schoolteachers' knowledge of different constructivist theories.
Mathematics and	1. Children should be engaged in the learning process.	These variables are related to the third objective of the dissertation which is to

70

Constructivism Theories	2. Children should be allowed to interact in with the thinking process in order to learn new knowledge. 3. Action 4. 'Active meaning-makers'. 5. Curriculum helps the students build mathematics understanding.	suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study.
Theory of Didactic Situation	1. The schoolteachers have to make sure that the learning is taking place and if they find that the students failed to learn, they should provide them with more details. 2. The teacher is not to show students how to solve problems but to let them deal with these problems. 3. The teacher's role is to find out the problems or situations that will be given to the students. 4. Positive role of the person in building the knowledge. 5. The teacher should teach knowledge directly when it is not possible to find a fundamental situation that fits the students' intellectual possibility. 6. Knowledge acquisition is the result of the students' personal relationship with the object of knowledge. 7. The teacher has to build an environment that helps the students learn a specific learning by the end of every activity. 8. The teacher role here is to make possible change from	These variables are related to the third objective of the dissertation which is to suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study.

knowledge that comes from research to the 'knowledge taught' to the knowledge that has been taught.

9. They should be in control of the situation and every change that might occur. The schoolteachers' role here is to give students' the tools they need and provide conditions that reproduce.

10. The teacher has to be alert to what is said in the action situations in order to explicit topics for discussion. The schoolteachers' role in the a-didactical situation is very central.

2.2.2. Summary

The preceded conceptual framework emphasizes the main points for the objective of this dissertation to be accomplished. The two main explained theories are linked directly to the objective of this dissertation which is to construct a list of indicators for identifying the mathematics classroom environment as excerpted from fieldwork, to examine the schoolteachers' knowledge of different constructivist mathematics theories, and to suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study. The researcher believes that explaining constructivism is a must; especially that mathematics schoolteachers should learn how to help learners acquire new knowledge in the suitable conditions for the conceptual change to occur. Moreover, since the learners are not separate from their society and since they are influenced directly by their culture, the social constructivism learning theory is also a must to be discussed in this dissertation. Several factors such as the teacher, the curriculum, and the teaching strategies affect the learning

process, and in order for the learner to acquire new knowledge effectively, the three should be taken into consideration.

From all of what have been discussed earlier, several questions were inspired. The researcher intends to observe classes to see which strategy the schoolteachers will follow and whether the taught lessons will be based on active learning or just teacher-centered. The researcher wants to do a study that will help in providing recommendations to people responsible in the education sector to enhance teaching; especially in the mathematics subject matter since it is considered one of the main subjects to both the school and the parents. As a result, the following research questions are developed. Thus, this dissertation proposes a diverse strategy that enables us to use many theories well-matched with its objectives, research questions, and propositions. The theories discussed discussing the dissertation and the variables derived are shown in table 1.

2.2.3. Literature Review

This part deals with the literature review of constructivists' strategy to learning, the constructivism and teaching methods, and constructivism and mathematics. In line with the purposes of this dissertation, it is very significant to emphasize the different ways the constructivist teaching strategy views the learning and how they explain the ways the students learn. Thus, the following part of this review will emphasize the way constructivism views students' learning, which helps answering mainly research questions 1 and 2: 1. How do grade 4 schoolteachers associate constructivism with their teaching of mathematics? and 2. How can observation data yielded from fieldwork be used in identifying grade 4 mathematics teaching environment?

2.2.3.1. Constructivism and Students' Learning

According to constructivists, Ramelhart (1980) concluded in his research about schemata that learning occurred in a constructive way where new knowledge was always based on old ones, and where new information were linked to old ones. Schema theory assumes that when students gain knowledge, they try to fit it in some structure in their previous memory to fit previous knowledge. Schema theory proposes that the students try to

breakdown the new information acquired into chunks which can be stored in the brain to be recalled later. As new knowledge is acquired, it is coded and stored. Schemata are organized mental structures that allows the learners to understand and associate what is being presented to them.

 Enck (2011) argued that students used what they knew in order to learn new material. As the students constructed their knowledge, the teacher coached them in order to help them build on the previous knowledge by 'constructing mental scaffolding' in class to build new knowledge. In scaffolding, the teacher helped students by using a planned activity and encouraging them to move back and forth to solve a problem. While using constructivism strategy, the teacher should take the social aspects of learning (Ibid).

Ramelhart (1980) argued that the person is the one who created the meaning. It was not the teacher who transmitted knowledge. Constructivism is becoming a major task in education. Constructivism required building knowledge by selecting actively and cumulatively by constructing. Since learning was student-centered, learning was a process the student should conduct (Ibid). The student created the meaning of information and he/she interpreted it and elaborated on it. Recommendations for appropriate teacher support could be gained from examining the Teaching Principle in the document, Principles, and Standards for School Mathematics (Ibid).

It is significant to understand that since the student is the center of the constructivist teaching strategy, the schoolteachers should design their lessons in a way that help this strategy to occur. Thus, the next part of this review discusses how constructivism and teaching strategies are related.

2.2.3.2.   Constructivism and Teaching Strategies

Classrooms today have stepped forward and are no more just a copy of the traditional classrooms where the learning is teacher-centered and where the teacher is responsible to transform the information. On the contrary, the classrooms are now more active and are student-centered where the student is involved in the process of understanding new information. According to Yackel, Cobb, and Wood (1992), learning in

constructivist vision was active when the learning-teaching process was interactive in nature and needed negotiation of mathematics and other subject matters as it was shown in McGregor's (2007) diagram (see figure 3 & 4). Since the aim behind this dissertation is to explore whether the schoolteachers are aware of the constructivist teaching strategies, the review will stress on the part of constructivist methods. According to Kim (2005), the strategies of how students learn and how the schoolteachers teach were a great concern when it came to education. "The construction of knowledge is a very important task when it comes to the complex process of thinking and learning underpinned by constructivist teaching" (p. 7). There were differences between the traditional understanding of knowledge and the constructivist understanding of knowledge. It was essential to understand the role of the teacher in education in the constructivist way of teaching which was made up of creating, synthesizing, and interpreting information (Novak & Gowin, 1984). It was also imperative to understand that the teacher should behave as a facilitator while using strategies other than the traditional one such as constructivist strategy (Moore, 2009). According to Moore (2009), the constructivist strategy was a good way to engage students in reliable, meaningful experiences. It encouraged the participation of students who had a difficulty in learning (Ibid). A teacher who facilitated learning and led class to a more student-centered, friendly, and relaxed followed a teaching skill that helped students build their knowledge. Student-center teaching methods were related directly with constructivism. Constructivism strategies were related directly to both learning and teaching, which included several ways of instruction such as 'anchored instruction', 'situated learning', discovery learning', 'task-based learning', and 'scaffolding' (Oliva, 2009; Rowe, 2006). Thus, Rowe added that the student should be a part of the learning process where he/she is motivated and actively involved in the process. The subject matter taught eventually should also be authentic, interesting, and relevant. The students should be independent and motivated. They should acquire enough prior knowledge and skills to be engaged in the learning process in order to build on them. Like other researchers wrote about constructivism, the main element in constructivism is that "the learner is an active

75

contributor to the learning process, and that teaching methods should focus on what the student can bring to the learning situation as much as what is received from the environment" (Ibid, p. 3). This kind of learning that builds on the prior knowledge of the learner was related directly to Vygotsky's ZPD that "establishes what the learner already knows, and can do with minimal assistance by a teacher or peer" (p.3). Thus, the schoolteachers' role was to be a guide, helper, and facilitator of learning. They should provide the learner with opportunities to build new knowledge based on previous ones. Westwood (1999), explained that direct teaching was old fashioned and that it should be replaced by students-centered enquiry and activity-based learning.

According to Grouws and Cebulla (2000), in order to achieve better results in mathematics, the schoolteachers should seek to change their teaching strategies. They should take into consideration the context and type of students taught. They should not judge the outcome from a single session. Instead, the schoolteachers should rely on several outcomes because they should take into consideration the students' circumstances that may be the reason in decreasing the impact of the practices they are implementing. Research has shown that students can learn new materials, skills, and concepts when they are given the chance to build on some basic previous knowledge. Moreover, schoolteachers can benefit from their students' prior knowledge in order to build on it useful new knowledge. Thus, it is not only important to decide what mathematical content to teach only, but also to design its application the way to apply it. According to Brooks and Brooks (1999), constructivists believed that teaching mathematics required constructing knowledge. Brooks and Brooks (1993) discussed several principles that dealt with constructivist teaching. Kim (2005) has summarized these principles as follows:

> 1) Posing problems of emerging relevance to students; 2) structuring learning around primary concepts: the quest for essence; 3) seeking and valuing student's points of view; 4) adapting the curriculum to address students' suppositions; and 5) assessing student learning in the context of teaching.

The constructivist teacher encourages students to ask questions and ideas. He/she accepts and encourages students to ask questions and present ideas. He/she accepts

cooperation between students and leadership. The teacher bases his/her explanation on students' interests. He/she encourages discussion on how new ideas and answers are obtained. Prediction, testing new ideas, and accepting others' ideas were highly encouraged by the constructivist strategy (Yager, 1991). In addition, Fast and Hankes (2010) stated in their study about improving the effectiveness of instruction in constructivist pedagogy in a college elementary mathematics education course through intentional integration of instruction in mathematics content that constructivism required "hypotheses, explorations, observations, discoveries, reflections, and finally tentative conclusions" (p. 331). Results in their study showed significant improvement in mathematics content knowledge and confidence in that knowledge with a better understanding of constructivist pedagogy. Brooks and Brooks (1999) suggest that the teacher should not give the students answers, but should lead them to the answers by using their previous knowledge. In this way, the students get to "own" the new knowledge and information rather than "rent" it. Grouws and Cebulla (2000) argued that a comparison between the American classes and the Japanese classes showed that the American classes based their instruction on more traditional procedures whereas the Japanese classes were based on applying new materials and analyzing them. Data showed that over 90% of mathematics class time in United States Grade 8 classrooms was spent on working routine processes while the remainder of the time were generally spent with applying procedures in new situations. There was rarely time spent creating new procedures and analyzing new situations (Ibid, p.17). Thus, one could understand that students needed opportunities to practice and invent, and in this way, they achieved better. When they construct on their prior knowledge and are given the choice to analyze and invent, they understand better and perform better too. Several programs include time for students to practice and revise what they have learned and discovered because this strategy is successful and allows students to perform better in the mathematics outcomes (Ibid).

To summarize, schoolteachers in constructivism should edit the students' way of thinking by trying to find a model that fit with the students' own thinking (Paparozzi, 1998). Schoolteachers should always use a new strategy in their teaching methods and should

frequently allow students to build new knowledge based on their innate knowledge and easy procedures. Thus, student learning and understanding were considerably improved when schoolteachers were aware of how students construct knowledge and utilized this knowledge when developing and conducting instruction in mathematics (Grouws & Cebulla, 2000). This improvement started in primary classes and was shown in higher-grade levels. Schoolteachers should structure their instructions in a way where they allow students to interact with when solving a problem and should give them the chance to share their solution methods which resulted in improving the learning. Studies showed that when students had the chance to develop their own solution methods, they were able to apply mathematical knowledge better in new problem situations (Ibid).

As a conclusion, constructivism, originally developed by Piaget, explains that learning of mathematics occurs when the meaning is constructed and when the understanding is based on the reality. Table 2 summarizes the differences between non-constructivist classrooms and constructivist classroom. The table is taken from Brooks and Brooks (1993, p. 17) as cited in Kim (2005). Children should build mostly on their play and natural relationship between learning and life in their daily actions, interests, and inquiries (Clements & Surama, 2004).

This takes us to the other part of this review which is constructivism and mathematics.

Table 2: Differences between non-constructivist classrooms and constructivist classrooms

Non-constructivist classrooms	Constructivist Classrooms
Curriculum is presented part to whole, with emphasis on basic skills	Curriculum is presented whole to part with emphasis on big concepts
Strict adherence to fixed curriculum is highly valued	Pursuit of student questioning is highly valued
Curricular activities rely heavily on textbooks and workbooks	Curricular activities rely heavily on primary sources of data and manipulative materials
Students are viewed as " blank slates" onto which information is etched by the teacher	Students are viewed as thinkers with emerging theories about the world
Schoolteachers generally behave in a didactic manner, disseminating information to students	Schoolteachers generally behave in an interactive manner, mediating the environment for students

78

Schoolteachers seeks the correct answer to validate student learning	Schoolteachers seek the student's point of view in order to understand students' present conceptions for use in subsequent lessons
Assessment of student learning is viewed as separate from teaching and occurs almost entirely through testing	Assessment of student learning is interwoven with teaching and occurs through teacher observations of students at work and through student exhibitions and portfolios
Students primarily work alone	Students primarily work in group

Source: As cited in Kim (2005) from Brooks and Brooks, p. 17, 1993.

2.2.3.3.   Constructivism and Mathematics

From all what was previously examined, one can synthesize that students should be provided with mathematics instruction based on higher-order thinking.

To be able to fulfill the purpose of this dissertation, the concept of mathematics and how constructivism views it should be understood. According to Kopsovich (2001), mathematics was not only calculating and memorizing symbols. When students try to solve a problem, they do not only manipulate symbols, do not follow rules, yet they apply what they have been taught and invent solutions accordingly. Again, Kopsovish (2001) added that according to Piaget's Cognitive Theory of Development, students construct the learning of mathematics and try to make sense of "solutions, communications, and written symbols". Piaget emphasized on the idea of abstraction and reflection of knowledge as a must in the learning process of mathematics.

In constructivist learning, students build their knowledge based on previous ones. According to Ishii (2003), there were many significant and essential features of constructivism in classrooms that allowed the lesson to be effective. First, students used their prior knowledge to learn new ideas. Second, students built lessons based on a big concept. Third, students' comments were taken into consideration in order to make learning meaningful. Fourth, the curriculum was tweaked to match students' hypotheses. And fifth, the learning process was accessed while students were engaged in the comprehension tasks. According to Brooks and Brooks (1999), the teacher should have the necessary characteristics of a constructivist teacher where she/he "encourages student initiative, evaluates data, responds to student learning by adjusting instructional strategies, encourages

student dialogue and engages students in discussions, constructs connections to prior lessons, and nurtures curiosity and encourages inquiry" (Ferrara, 2010, p. 25). Students should be involved in activities rather than just being lectured. The teacher should be encouraged to create an environment feel students were responsible for their own learning rather than passively receive information from the teacher. More communication ought to occur between the teacher and the students (Lane, 2007; Karns, 2008).

According to Confrey and Kazak (2006), constructivism created a reason to study mathematics from new dimensions which were the "eyes, minds, and hands of the child" (p. 306). In mathematics, the origin of constructivism was located in three traditions according to Confrey and Kazak (2006). These traditions believed that studying mathematics involved more than logic.

As a result, one may summarize that the new standards and principles of education emphasize on several qualifications the schoolteachers and the learners should acquire. Schoolteachers are encouraged to help the students find several and different opportunities to help them reflect on the mathematics that ascends from daily activities such as conversations and play. Children build mostly on their play and natural relationship between learning and life in their daily actions, interests, and inquiries. Schoolteachers should attempt to comprehend every child's ability and mathematical understanding, and in return, use them while planning their curriculum content. Moreover, schoolteachers are ought to use a variety of teaching strategies in order to enhance the children's learning. They benefit from carefully planned sequences of activities and integrated strategies that occur every day. Also, effective schoolteachers build on children's prior knowledge and everyday activities taking into consideration the children's background, language, and mathematical skills.

2.2.3.4. Mathematics Teaching: Themes from the Lebanese Context

As mentioned earlier, there is not much research concerning mathematics teaching from a constructivist perspective in Lebanese schools. However, there are some reports and studies concerning the development of the new curricula and its importance as a whole. The following information are basically taken from the LAES (2006; 2010), Nahas (1999; 2005;

2010), Melhem (2010), and interview conducted with Nahas (see appendix 2). Thus, the researcher will summarize the reports, reviews, and interviews in the parts that follow hoping that they will help in understanding the curriculum position in Lebanon in general and the mathematics curriculum in particular and helping in achieving some of the objectives of this dissertation as outlined in chapter 1 of the dissertation.

The following section presents piloting results of the research question 2 of this dissertation as received from relevant documents and respondents: "How can observation data yielded from fieldwork be used in identifying grade 4 mathematics teaching environment"? The rationale for early piloting of research questions is discussed in chapter 3 of this dissertation.

In Spring 2000, LAES conducted a comprehensive field-work assessment of the 1998 curriculum and presented the results to former Minister of Education Mr. Muhammad Baydoun. Partly, the assessment sought to provide data on the learning of the skills in the different subject matter of the new curriculum in Lebanon including mathematics. It also sought to compare learning of students that studied in the old curricula to students that studied in the new one. In addition, it provided recommendations to improve the curricula. However, the report, according to LAES (2010), was prepared on January 2002, a year after, and was submitted to the UNESCO on 12/6/2002. As a conclusion, the LAES was asked by the UNESCO to undertake an evaluation study for the new curricula. The whole study took three years and included 6 studies with a total of 6,919 pages.

According to Nahas (2005), a member of the committee responsible for this study, whom the researcher interviewed and will specify the outcomes of the interview in a later part of this dissertation (see appendices 4 and 5), one of the main concerns of education nowadays is how to improve the productivity of education. According to Nahas, the term curriculum does not only involve the list of courses that form its content, but also the teaching strategies, objectives, and assessment strategy. Nahas explained that the pedagogues are now more concerned with a curriculum that is based on a cognitive psychology that is related directly with Piaget and Vygotsky, his two favorites. The question

that Nahas asked was whether the adoption of a cognitive strategy improves the results and enhances productivity. His study was related directly to the "cognitive strategy and its relation to the curriculum." According to Nahas, when developing their techniques, pedagogues should not only adopt one strategy to fill the gaps of the problems of the curriculum content. He went on to suggest that a "horizontal dimension of a specific conceptual fields comes in" (2010, p. 4), adding that "the case of physics as it relates to mathematics is obvious, but it is also the case of mathematics regarding the memorial experience of the learner and his [Sic] mastery of language" (2010, p. 4). According to Nahas, with mastering both components, a new mathematical concept is uncertain. This is where assimilation of a given concept relies on combining the two dimensions while the acquisition of knowledge disappears and others emerge. The pedagogues should take this into consideration. However, Nahas (2010) argued that one was encouraged not to forget that the learner was an individual who lived in society and the experience he was exposed to play a significant role in the development of concepts. Concepts would not develop independently. They were constructed and linked with language. We could not separate the language acquisition from other subject matters. The language should be a base for all other knowledge and information. Since the purpose of the schoolteachers should be to improve the productivity of their teaching and to achieve maximum efficacy, the schoolteachers should consider themselves educators and not only instructors. They should take into consideration "the inter-disciplinary strategy, the development of different conceptual fields, and the importance of adequate learning and communicative situation" (p. 7).

In terms of curriculum development, Nahas (2010) explained that developing a curriculum was not separate from the vision as whole. Development of aim was very vital because it aimed at building independent personalities. The main problem that we face nowadays is that the new cognitive strategies are not being accepted by some educators at a time when it should be part of the curriculum. The cognitive strategies stress on the idea that the previous knowledge of a person should be taken into consideration and new knowledge should be built upon. According to Nahas (Interview, January 17, 2014), these cones each

82

represent a subject matter in which education does not exist as a cylinder. It starts somewhere and new knowledge is built on previous ones. All these subject matters are intersected in a place where some close in a certain period of time while others never finish, like the concept of numbers. In his opinion, students are not achieving because there is no construction of knowledge in the Lebanese classes even though the curriculum appears to have it as part of the general objectives (Nahas, Interview on January 17, 2014).

Nahas (2005) added that the teaching should be more interactive. He presented figure 5 in his article. The researcher asked him about the diagram and how it could be implemented in schools. He explained that the diagram was a general one where one should transfer from the classical progress to a cognitive progress. The student should use the information they got with them from real life situation and conceptualize them in order to come up with new theories. The theories should not be given directly from the teacher.   In learning, when the educators take the constructivist strategy into consideration, they should take also the different development aspects into consideration (Nahas, 2009). He quoted:

> The importance of the K-12 curriculum is its being the basis of and the source for any future development of skills related to higher education. By minimizing the role of the K-12 formation, educators in fact are minimizing any further education by taking for granted the discontinuity in knowledge building and by reducing any higher education formation to its specific technical material (skills and content).

According to Nahas (2009), constructivism emphasizes the different stages of building the knowledge and how gaining new information never stops. This new information is integrated into the previous knowledge of the person.

Figure 5: A comparison between classic progress to cognitive progress 4
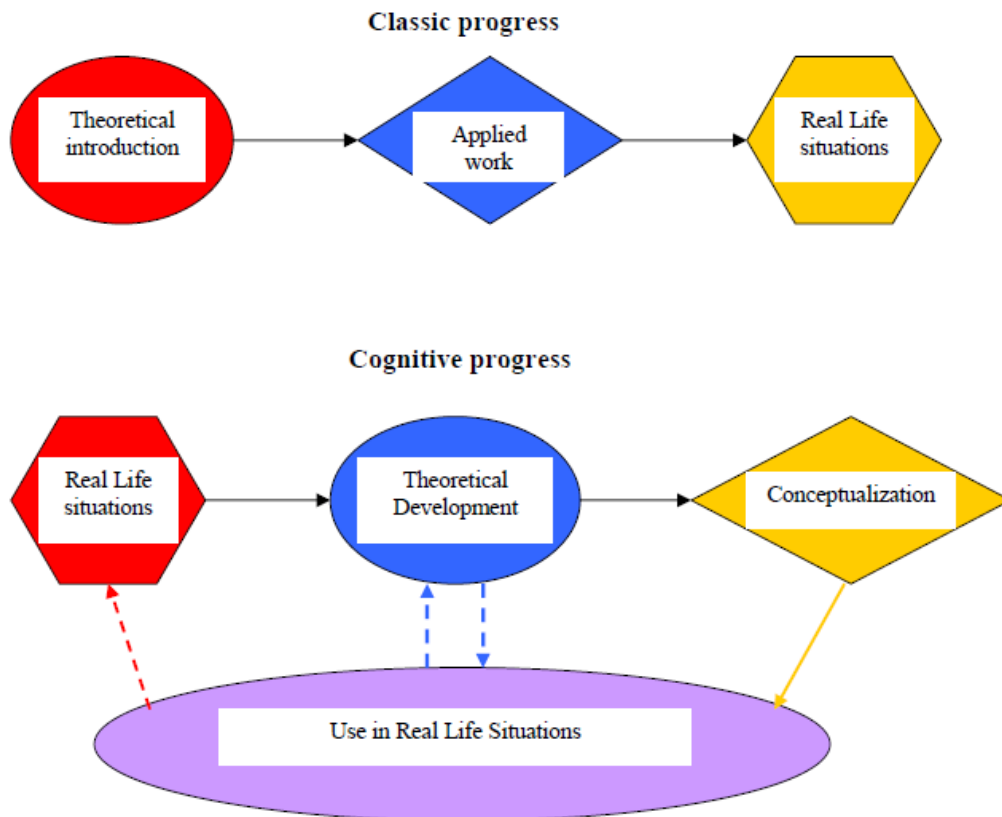
Nahas (2010) added that Lebanon had its own peculiarities that differentiate it from different countries experiences. This particularity is evident in the mathematics curriculum which is a scientific subject, and is significant to the development of the individual and the curricula. Nahas explained that the objectives of the curriculum were very essential but were directly related to the content and not strategy.

Moreover, according to Nahas (1999), it was declared in legislative decree 10227 of 7 May 1997 that the Lebanese curriculum should develop the Lebanese personality,

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[4] Note: Adapted from *The Cognitive Strategy as a Basis for Enhanced Curricula,* p. 12, by Nahas, 2005.

consider him [Sic.] a person and a good member, and has knowledge about the citizenship. In order to achieve this, those who were responsible for developing the curriculum should have taken into consideration that the individual ought to be taught to respect his/her country and its rules and be ready to serve the country. In his article, Engineering Education in the K-12 curriculum, Nahas (2009) said:

> The new curriculum was based strategically on a document calling for renewing the whole system. This document, adopted by the Lebanese Parliament, specifies that the main vision of the educational system is to *produce* citizens with critical thinking potentials, able to adopt scientific strategies and strategies while dealing with national issues.

In the mathematics curriculum, Nahas (1999) stated that the objectives missed some of the most main active verbs such as observe, interpret, question, expect, classify, and they were replaced by verbs such as know, understand, learn, prove, etc... As for the content of the mathematics curriculum, there is no evidence of the existence of calculus and other tasks that might enhance the students' understanding.

Like Nahas, according to Melhem (2010), the curriculum could not only build our education based only on theories that have been established because the theories were generalized and could not only taken for special cases. Melhem explained that besides considering the student the center of education, it was essential to take into consideration the schools' environment, teacher, and facilities. Melhem started the first part of his article by explaining how the curricula were developed. Melhem said that the position of the Lebanese curriculum was weak then and should take initiative to revise it. According to Melhem (2010), the curriculum should not be final. It should always be subject to change in terms of new researches and studies done in the education. The Lebanese curriculum lacked several important points. Melhem (2010) suggested to CERD that the proposed curriculum should be tested, and studies should be done on it to see how well it was and how long it could serve before editing was implemented on it. While developing the mathematics curriculum, Melhem explained that the new strategies of teaching that enhance education were taken into consideration. The mathematics subject was given a total of 5 hours per week for a10

years period as mentioned in the Lebanese part in chapter 2. This meant 5 periods x 36 weeks x 10 years = 1800 math periods from grade 1 to the first secondary. The new mathematics curriculum was based on active learning where the student was the center of education. Mathematics was essential to a good living and this was what one should take into consideration while developing the objectives and methods taught. According to Melhem (2010), there were educational programs for mathematics, and they were incoherent. This curriculum has been surviving for 27 years, and this was why one could not just change it all together or improve it directly, but one should work gradually to change it and this could be achieved with time. Melhem (2010) proposed the general objectives to be part of the mathematics curriculum that help the student learn and be part of the society. The student, according to Melhem, should be able to analyze mathematical concepts, solve them, and appreciate mathematics. While Melhem (2010) has adeptly underpinned the importance of curricula updates based on periodic reviews, Nahas and Melhem have glossed over political constraints, meager funding allocated for the general education sector, and inadequacy of capacity building of that would enable the change and reform to resonate with schoolteachers rather than on them, mainly by external experts.

2.3.   Summary

All of the above theories and reviews provide concrete realizations of what it means that knowledge is not transmitted but constructed. Mathematics schoolteachers are expected to understand this fact. Traditional instructional design is the opposite to constructivism view of learning (see table 2). Constructivism does not have a goal for memorization, but it emphasizes on the process of constructing knowledge based on old ones. It encourages imagination, generalization, and manipulation of one's own constructive process. Thus, as a summary, Piaget emphasizes that the child should reach a specific stage in order to be able to learn new and more complex knowledge whereas Vygotsky stresses on the idea that learning leads to development, and the teacher should always be ready to challenge the students. He discusses the case that each child is born in a specific culture and that

development is directly related to this culture. Table 3 provides a summary of the basic theories related to constructivism strategy.

Table 3: Brief description of some prominent features and implicit assumptions in various theories of learning.

Theoretical perspective	Behaviorist	Constructivist	Social Constructivist
Prominent features	Transmission of knowledge. Modeling of skills. Passive learner. Absorption of knowledge. Extrinsically motivated.	Disequilibrium brings about: -Assimilation -Accommodation Developed cognitive structures into schema(s).	Zone of Proximal development. Meditation and scaffolding. Social origins of mental development. Understanding social development on an individual plane.
What is knowledge?	New behavior(s), observable actions and transmitted information.	Schemata. Acquiring knowledge that is scientific reality. Concrete to Abstract	Intrapsychological construct(s) or internalization derived through social interaction. Has historical, social and cultural influence.
Characteristic teaching	Transmission of information. Modeling of new skills. Systematic reinforcement of correct behaviors.	Teacher providing opportunities for learners to develop their own individual understanding. Reflective questioning of learners. Language and interaction with learners not as significant as social constructivist.	Teacher mediation and scaffolding. Social interaction and negotiation between expert and novice. Dynamic process between schoolteachers and learners.

How does learning happen?	Uncritical retention of information. Mimicking or copying new skills and behaviors. Schoolteachers reward correct behaviors and chaises incorrect behaviors.	Actively experimenting with materials, objects and ideas. Developing own personalized understandings of world around them. Accommodation and assimilation into cognitive structures.	Through social interaction while engaging in problem solving or task resolution. Action = speech and other physical activity. Scaffolded, teacher/expert most important initially, gradually dependence decreased. Discourse essential to verbalize activity (action and thought).

Note: Adapted from Developing *Thinking Developing Learning: A guide to Thinking Skills in Education,* p. 48, by D. McGregor, 2007.

2.4. Conclusion

It is worth noting again the purpose of this dissertation which is to identify the mathematics classroom environment as excerpted from fieldwork, to examine the schoolteachers' knowledge of different constructivist theories, and to suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study.

The researcher would like to conclude and agree with what Nahas (2009) wrote regarding the Lebanese education case where he stressed on the idea that a vision was not enough. All the education system should know and be aware of the needs and act as decision makers. They should be makers, educators, and administrators. The content of this chapter about constructivism may provide a trove of theoretical and guidance for schoolteachers to consider as they plan their teaching. However, it is imperative to examine the way schoolteachers understand, perceive, and apply constructivist theory in teaching. Thus, as a prelude to understanding the latter, the chapters that follow were designed to uncover teaching mathematics in grade 4. Particularly, the chapter that follows discusses the design of the dissertation and its operational field measures. In addition, it describes the procedures that were followed in order to analyze the data obtained from interviews and observations.

Chapter 3

Research Design of the Dissertation

3.1. Introduction

The previous chapter presented and discussed the theoretical framework and literature review of the dissertation. It also discussed the Lebanese context and reviews related to the purpose of the dissertation as supported by early interviews data. This chapter shifts emphasis to discuss the design of the dissertation and its operational field measures. In addition, it discusses the procedures that were followed in order to analyze the data obtained from fieldwork.

The chapter is outlined as follows:

- Introduction**;**
- overview of the research methodology;
- rationale for the research methodology;
- subjects for multiple case-study;
    - participants;
    - interviews;
    - observation;
    - Validity and reliability;
    - member checking;
    - access and ethics;
- methodological steps;
    - phases of data collection;
        - pre-pilot study;
        - pilot study;
        - data collection;
- data analysis;
- limitations of the study;

- conclusion.

3.2. Overview of the Research Methodology

This section is set to discuss the research design of the dissertation, i.e., "the plan and process of how the research is conducted" (Polit & Beck, 2004). Particularly, it describes the focus of the dissertation and the research questions upon which the dissertation is based. It discusses the methodology and the sampling process and provides justification for each method used in data collection that helps answering, after being analyzed, the research questions of this dissertation. The limitations of the research and the trustworthiness of the data are discussed. Finally, the section demonstrates reporting of the research findings.

As mentioned earlier in this dissertation, the preliminary research questions were the following unless a change is required after studying the findings of the dissertation:

1- How do grade 4 schoolteachers associate constructivism with their teaching of mathematics?

2- How can observation data yielded from fieldwork be used in identifying grade 4 mathematics teaching environment?

3- How would pedagogical models yielded from fieldwork inform mathematics teaching in the Lebanese elementary cycle?

When the researcher decided to conduct this study, she wanted to conduct both a quantitative and a qualitative study. However, after the researcher read about the topic and the reviews related to her study, ideas started to get clearer in her mind, and she started seeing how her study is going to be. The researcher learned a lot about the research design steps after she had read Creswell (2003) "Research Design: Qualitative, Quantitative, and Mixed Methods Strategies." Creswell's way of writing is very simple where he gives relevant examples from several dissertations and clarifies every choice to be taken by the researcher.

To serve the purpose of this dissertation, the researcher decided to use the qualitative methodology because she sought to use the data collected to describe details, events, schoolteachers, and observed classrooms. The qualitative approach was the most suitable option to study institutional structures, teachers' knowledge, and coordinators' understanding about constructivism as one vital option for engaging students with learning mathematics based on higher-order thinking. A study based on a natural setting analysis away from controlled experimentation and learning environments was deemed necessary to chime with the nature of constructivism itself rather than with quantification as an attribute of the behavioral research design methodology.

The research of this dissertation was scientific rather than artistic in nature (Eisner, 1981). It was tied to scientific inquiry in case study (Yin, 2002). The case-study strategy adopted in this study was tied to naturalistic inquiry. Denzin & Lincoln (1994) defined qualitative research as "multimethod in focus, involving an interpretive, naturalist strategy to its subject matter." They explained furthermore that the 'multimethod in focus' was illustrated as "the combination of multiple methods, empirical materials, perspectives and observers in a single study; a strategy that adds rigor, breadth, and depth to any investigation" (p. 2). In addition, Creswell (2003) defined qualitative research as follows:

> an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The research builds a complex, holistic pictures, analyzes words, reports detailed views of informants, and conducted the study in natural setting. (p. 15)

Patton (1980) clarified that when we deal with qualitative measurement, we should take into consideration the kind of data gathered. He explained in his book "Qualitative Introduction Method" that the qualitative data is made up of detailed events and situations performed by people concerning their situation. The researcher also chose to use a qualitative method because she wanted to capture what people said about different learning strategies, about the strength of a particular situation they had, and about anything the people concerned with the purpose of this dissertation could help her examine with an in-depth reading of the topic at hand. According to Patton (1980), in qualitative methodology,

the research sought to know and understand deeply what people had to say. In qualitative strategy, the researcher had the chance to study the person's experiences in details. The researcher wanted to get into the open-ended interview questions and into the schoolteachers' teaching experience and to the methodology they used while teaching to understand to which extent they comprehended the different learning strategies and the way the coordinator understood the teachers' needs and the curriculum used. Moreover, she wanted to observe the relationship between the teacher and her/his students. One of the main purposes of the qualitative research design was to allow the researcher to understand more and capture other people's point of view. Even though the qualitative measures are time consuming and longer than the quantitative ones, they were more detailed and variable in content than quantitative measures (Ibid). In qualitative methodology, Patton (1980) says "qualitative methodology seeks to understand the perceptions, feelings, and knowledge of people" through interviewing them (p. 29). This was what the researcher wanted to do in her study.

Due to the above reasons, the researcher had to reformulate the research questions that she first wrote when she was preparing for a mini-proposal to apply for the doctorate program. After the researcher read about both Yin (2003) and Flick (1998), she understood that it was very important to have a clear idea of the study research questions and their nature in order to be able to anchor at the most suitable methodological decision. Flick (1998) suggested the following questions to be taken into consideration after developing the research questions: "Which methods are necessary to answer the questions? Is it possible to study the research questions without the chosen methods at all? Is qualitative research appropriate strategy to answer these questions?" (Flick, 1998, p. 47). Thus, as a summary, figure 6 shows the elaboration of the research questions in the research process which the researcher used and referred to after she had written the first set of research questions as mentioned earlier. When she started reading more and when she decided on the appropriate research groups with which she wanted to study the research questions, she edited a lot in the questions and even changed the type of method from mixed research to qualitative

because she wanted to spend more time with the participants.

Figure 6: Research questions in the research process

Formulation of the overall question

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Formulation of specific research question

↓

Formulation of sensitizing concepts

↓

Selection of research groups with which to
study the question

↓

Selection of appropriate designs and
methods

↓

Evaluation and reformulation of the specific
research questions

↓

Collection of data

↓

Evaluation and reformulation of the specific
research questions

↓

Analyzing the data

↓

Generalization and evaluation of the
analyses

↓

Formulation of the findings

Source: Adapted from *An Introduction to Qualitative Research,* p. 48 by U. Flick, 1998

95

3.2. Multiple Case-Study

This dissertation corresponded with the characteristics of multiple-case study research. Case studies could be either single or multiple-case designs where a multiple design ought to follow a replication rather than sampling logic. When no other cases were available for replication, the researcher was limited to single-case designs. Multiple cases strengthen the results by replicating the pattern-matching, thus increasing confidence in the strength of the theory (Yin, 2003).

In general, case studies could be either single or multiple-case designs. Single cases were used to confirm or challenge a theory or to represent a unique or extreme case (Ibid). Single-case studies were also ideal for revelatory cases where an observer might have access to a phenomenon that was previously inaccessible. Single-case designs required careful investigation to avoid misrepresentation and to maximize the investigator's access to the evidence. These studies could be holistic or embedded, the latter occurring when the same case study involved more than one unit of analysis. The researcher felt more conformable with using a multiple-case study rather than a single-case study because multiple-case studies followed replication logic (Ibid), and hence could help enhancing the validity of the dissertation. However, this was not to be confused with sampling logic where a selection was made out of a population for inclusion in the study. That type of sample selection was improper in a case study. Each individual case study consists of a "whole" study, in which facts were gathered from various sources and conclusions were drawn on those facts as this dissertation has sought to do.

Yin (2003) asserted that a case study investigator ought to be able to operate as a senior investigator during the course of data collection. There should be a period of training which should begin with the examination of the definition of the problem and the development of the case study design. If there were only a single investigator, this might not be necessary. The training would cover aspects that the investigator needed to know, such as: the reason for the study, the type of evidence, and the expected variations. This could take the form of discussion rather than formal lectures. The researcher received this training

during the supervision process of this dissertation and further learned from the case study protocol followed in the pilot study. In fact, a case study protocol contained more than the survey instrument; it also contained procedures and general rules that should be followed in using the instrument. It was to be created prior to the data collection phase. It was essential in a multiple-case study and desirable in a single-case study (Ibid). Yin presented the protocol as a major component in asserting the reliability of the case study research. A typical protocol should have the following sections:

- An overview of the case study project (objectives, issues, topics being investigated)
- Field procedures (credentials and access to sites, sources of information)
- Case study questions (specific questions that the investigator must keep in mind during data collection)
- A guide for case study report (outline, format for the narrative) (Yin, 1994, p. 64).

The overview should communicate to the reader the general topic of inquiry and the purpose of the case study. The field procedures must mostly involve data collection issues and be properly designed. The investigator did not control the data collection environment as the researcher did in this study; hence the procedures became all the more important (Yin, 2003). These procedures will be detailed in the appropriate section of this chapter. Moreover, this study took place in a rather natural research setting without controlling variables or manipulating them.

3.2.1. Research Questions in Multiple Case-Study

Yin (2003) explained that the case study strategy was preferred when 'how' and 'why' questions were being posed in the research questions. Table 4 showed what Yin believed concerning the relevant situations for different research strategies. He said that when the study required more "knowledge of individual, group, organizational, social, political, and related phenomena", then a case study research was used (p. 1). This was where the researcher wanted to understand more about the learning process and what kind of strategies mathematics schoolteachers used in their classrooms. The researcher wanted to understand more about whether the schoolteachers' use of the curriculum got adopted in several schools to the benefit of the students. In addition to Yin, Creswell (2003) suggested

97

that qualitative research questions "begin the research questions with the words 'what' and 'how' to convey an open and emerging design" (p.106). However, this did not mean that we did not use the word 'why' in formal research question regarding case studies according to Yin (2003). Table 4 explains the relevant situations for different research strategies.

Table 4: Relevant Situations for Different Research Strategies

Strategy	Form of Research questions	Requires control of behavioral events?	Focuses on Contemporary events?
Experiment	how, why?	Yes	Yes
Survey	who, what, where, how many, how much?	No	Yes
Archival analysis	who, what, where, how many, how much?	No	Yes/No
History	how, why?	No	No
Case study	how, why?	No	Yes

Source: Source: Adapted from *Case study Research: Designing and Methods,* p. 5 by R. K. Yin, 2003

3.2.2. Case Study Methodology

A research, and especially this one, required the researcher to conduct fieldwork and explore what was happening through observations and interviews (Nahas, interview, January 17, 2014). Adopting a case study method, which was of course qualitative, helped the researcher get a holistic idea of the real situations that were occurring in the organizations being studies for example (Yin, 2003). According to Yin (2003), a research design in a case study was necessary. It was when a logic plan was set. The five components of a research design were: 1-A study's questions; 2- proposition; 3- written analysis; 4- the logic thinking of the data to the prepositions; and 5- the criteria for interpreting the findings (Yin, 2003). Figure 7 summarizes the case study method as provided by Yin.

Figure 7: Case Study method
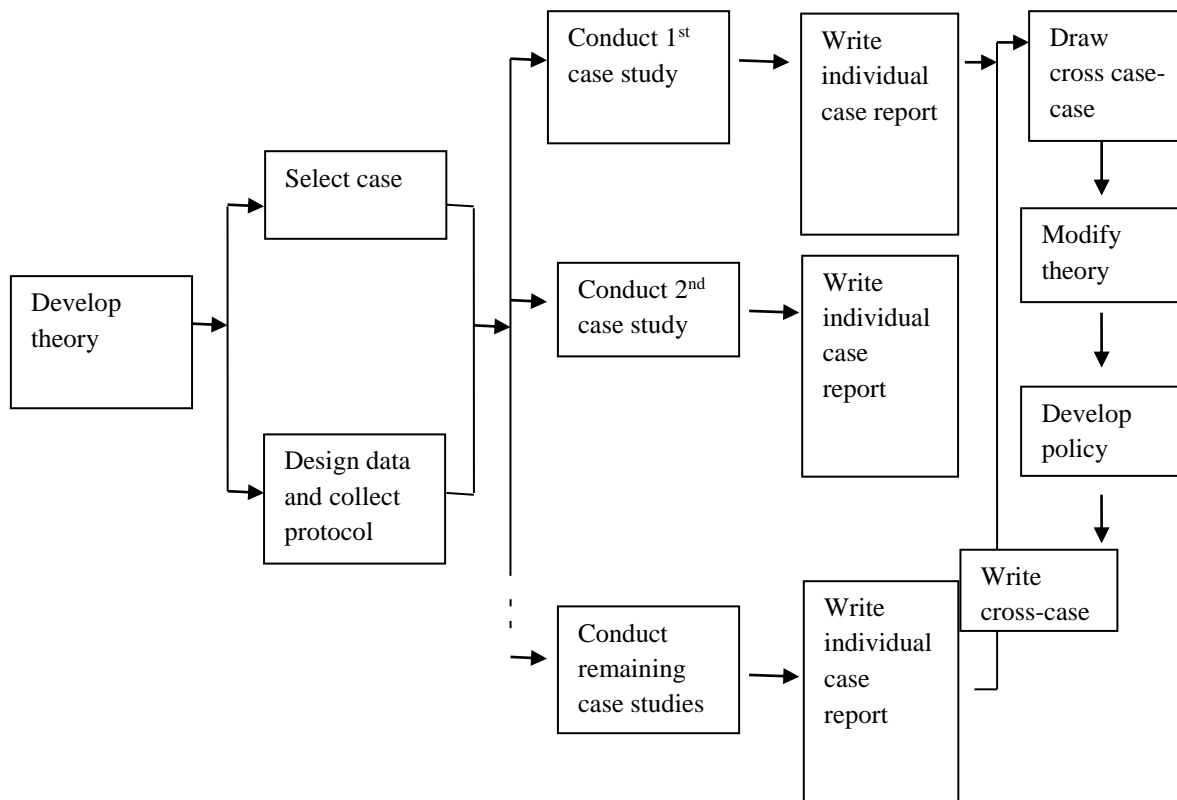
Source: Adapted from *Case study Research: Designing and Methods,* p. 50 by R. K. Yin, 2003.

Yin added that in order to be able to adopt a case study research, the investigator should have specific characteristics as mentioned earlier in this chapter. According to Yin (2003),

> …a good case study investigator should be able to ask good questions and interpret the answers. An investigator should be a good 'listener' and not be trapped by his or her own ideologies or perceptions. An investigator should be adoptive and flexible, so that newly encountered situations can be seen as opportunities, not threats. An investigator must have a firm grasp of the issues being studied, whether this is a theoretical or policy orientation, even if an exploratory mode. (p. 59)

Yin added that each tool used in collecting the data had its strength and weakness which were mentioned in the limitations of the study in chapter 1. The researcher will

99

attempt to take this into consideration while collecting the data. Table 5 summarizes the weaknesses and strengths of each tool used in a case study.

Table 5: Six sources of Evidence used in case-studies: Strengths and weaknesses

Source of Evidence	Strengths	Weakness
Documentation	-stable: can be reviewed repeatedly -modest: not created as a result of the case study -exact: contain exact names, references, and details of an event -broad coverage: long span of time, many event, and many settings	retrievable: can be low -based selective, if collection is incomplete -reporting bias: reflects bias of author -access: may be deliberately blocked
Archival Records	-same as above for documentation -precise and quantitative	- same as above for documentation -accessibility due to privacy reasons
Interviews	-targeted: focuses directly on case study topic -insightful: provides perceived causal inferences	-bias due to poorly constructed questions -response bias -inaccuracies due to poor recall -reflexivity: interviews gives what interviewer wants to her
Direct Observations	-reality: covers events in real time -contextual: covers context of events	-time consuming Selectivity: unless broad coverage -reflexivity: event may proceed differently because it is being observed -cost: hours needed by human observation

Faculty of Educational Sciences

Participant Observation	-same as above for direct observations -insightful into interpersonal behavior and motives	-same as above for direct observations -bias due to investigator's manipulation of events
Physical Artifacts	-insightful into cultural features -insightful into technical operations	- selectivity -availability

Source: Adapted from *Case study Research: Designing and Methods,* p.86 by R. K. Yin

The researcher used multiple sources of evidence, and triangulation, which helped her answer the research questions of this dissertation. The researcher conducted her research in several schools in Lebanon where each grade 4 class was a case study by itself. The first source of evidence was observation. The researcher observed the teaching strategies used in class. The second source of evidence was the interviews. The researcher interviewed, discussed in details later in this chapter, the grade 4 class schoolteachers after the researcher observed their classes in order not to give these schoolteachers the chance to edit their teaching strategy after being interviewed. The third source of evidence was the interview with the grade 4 mathematics coordinator/assigned mathematics teacher, and several questions, as it will be elaborated more later in this chapter, were asked in order to get a deep understanding of how the schoolteachers and the coordinators/assigned mathematics teachers worked collaboratively in order to fulfill the needs of the grade 4 mathematics objectives. Figure 8 shows a summary of how the researcher collection of the multiple case studies was. As mentioned earlier in this chapter, it is imperative not to forget the interviews conducted with the people responsible for the design of the curriculum which answers research questions of this dissertation.

Figure 8: Summary of the multiple sources of evidences that will be used in this dissertation: Triangulation

Observation will be done in grade 4 math classes

Guided semi -structured interview with grade 4 math schoolteachers will be conducted after the observation

Guided semi-structured interview with grade 4 math coordinators
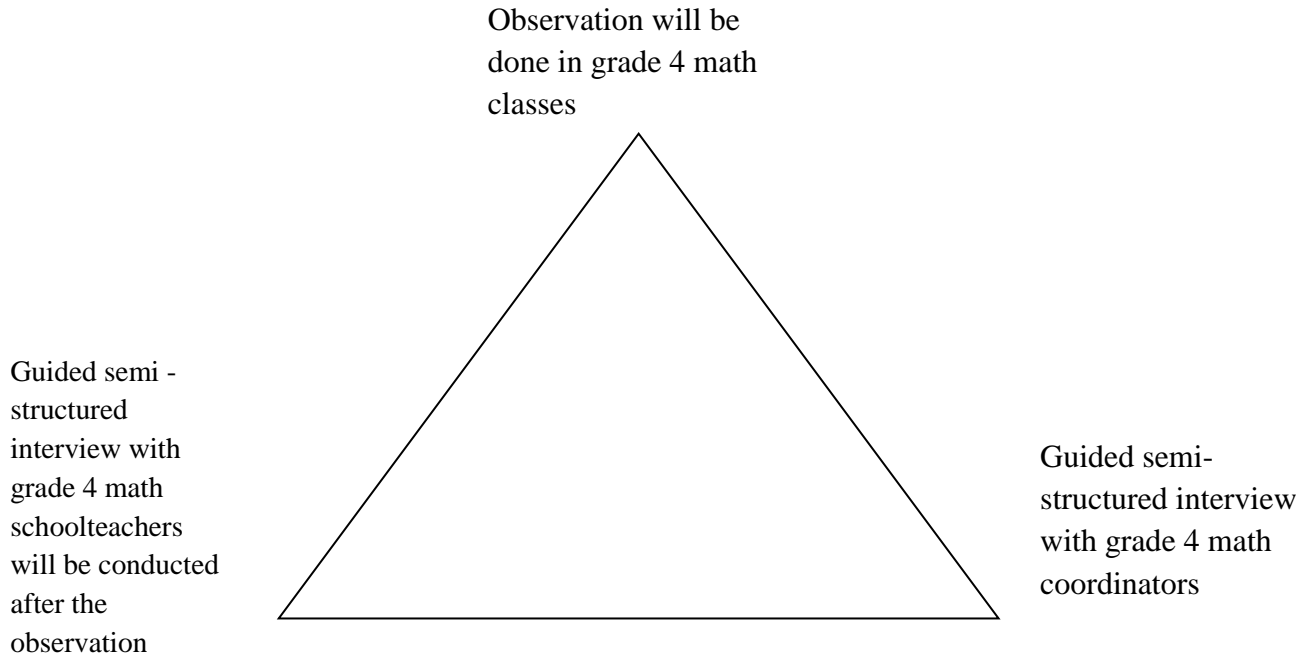
As a result, in this dissertation, the researcher observed classrooms, conducted interviews, and analyzed documents. Each of which will be explained in details later on.

3.2.3. Subjects for Multiple Case-Study

This dissertation was carried out in 7 public and private schools in Lebanon of which 6 were situated in Mount-Lebanon and Beirut Governorates and one in the Bekaa plain. These cases of schools allowed for variability in answering the research questions of this dissertation and eventually meeting its objectives.

3.2.3.1.   Participants

The sites of this dissertation were 4 private and 3 public schools in Lebanon. Since it was a multiple case study, each selected school was considered a case study by itself. The selection of the schools wasn't random because the researcher did not want to conduct the research in 'well-known' private schools which followed the American system. The

Faculty of Educational Sciences

researcher wanted to delve into newly developing schools were supposed to be following the new strategies of teaching. As for the public schools, the choice was random, and the researcher conducted the study in schools where she had easy access to.

1. **Selection of the participants**

The researcher interviewed several coordinators/assigned mathematics teachers, schoolteachers, and responsible persons for developing the mathematics curriculum. It was determined to stop the interviews when saturation occurred. Glaser and Strauss (1967) defined saturation as "no additional data are being found whereby the sociologist can develop properties of the category" (p. 66).

2. **Interview**

While collecting the data, the researcher thought, as mentioned earlier, that she wanted to find out what was on the participants' mind. The researcher wanted to ask open-ended questions in order to access what she couldn't while observing the classes. According to Patton (1980), "The fact of the matter is that we cannot observe everything. We cannot observe feelings, thoughts, and intentions" (p. 196). Patton continued to explain that the purpose of interviewing was to enter one's mind and perspective. Open interviews require both the researcher and the person interviewed to be closely involved and share ideas and feelings that are usually hard to open like when one simply hand over a questionnaire (Flick, 1998). Thus, as mentioned in the limitations of the study in chapter 1, it was an important factor to be taken into consideration. According to Creswell (2003), the limitations of the interview tool was that it "provides 'indirect' information filtered through the views of interviewees" (p. 186). Moreover, Creswell (2003) explained that another limitation was that it "provides information in a designated 'place' rather than the natural field setting" (p. 186). In addition to the setting, the presence of the researcher might affect the credibility of the interview.

There are three types of interviews: the informal conversational interview that relied on spontaneous questions, the general interview guide strategy that involved a set of main ideas and the standardized interview that consisted of set of questions carefully worded and

arranged (Patton, 1980).This dissertation adapted the second type, the interview guide, because the participants should be given the chance to explain their thoughts freely without any interruption with some guidance to stay on the right track. However, it was necessary to ensure that the main issues this dissertation was concerned with were covered. According to Patton (1980), the advantage of this type of interview was to make sure that the interviewer knew how to use the limited time and helped her do several interviews in a short amount of time. In addition, Flick (1998) mentioned that the "…interviewee has a complex stock of knowledge about the topic under study. This knowledge includes assumptions that are explicit and immediate and which he or she can express spontaneously in answering an open question" (p. 82). The study's aim behind the interview was exactly this. The researcher wanted the interviewee to get out everything he/she had known about the subject he/she introduced. The researcher did not want them to be limited. The researcher did not want to compress their ideas and feelings because sometimes interviewees ought to go into details that might open a new issue which might better answer the research questions. Table 6 summarizes the characteristics, strength and weakness of each type of interview according to Patton (1980).

Table 6: The characteristics, strength and weakness of each type of interview

Types of interview	Characteristics	Strengths	Weakness
Informal conversational interview	Questions emerge from the immediate context and are asked in natural course of things; there is no predetermination of question topics or wording	Increase the salience and relevance of questions: interviews are built on and emerge from observations: the interview can be matched to individuals and circumstances	Different information collected from different people with different questions. Less systematic and comprehensive if certain questions don't arise "naturally." Data organization and analysis can be quite difficult.

Interview Guide	Topics and issues to be covered are specified in advance, in outline form: interviewer decides sequence and working of questions in the course of the interview.	The outline increases the comprehensiveness of the data and makes data collection somewhat systematic for each respondent. Logical gaps in data can be anticipated and closed interviews remain fairly conversational and situational.	Important and salient topics may be inadvertently omitted. Interviewer flexibility in sequencing and wording questions can result in substantially different respondents. Thus reducing the comparability of responses.
Standardized open-ended interview	The exact wording and sequence of questions are determined in advance. All interviewees are asked the same basic questions in the same order.	Respondents answer the same questions. Thus increasing comparability of responses: data are complete for each person on the topics addressed in the interview. Reduces interviewer effects and bias when several interviewers are used. Permits decision makers to see and review the instrumentation used in the evaluation. Facilitates organization and analysis of the data.	Little flexibility in relating he interview to particular individuals and circumstances: standardized wording of questions may constrain and limit naturalness and relevance of questions and answers.
Closed quantitative interview	Questions and response categories are determined in advance. Responses are fixed: respondent chooses from among these fixed responses.	Data analysis is simple: responses can be directly compared and easily aggregated: many questions can be asked in a short time.	Respondents must fit their experiences and feelings into the researcher's categories: may be perceived as impersonal, irrelevant, and mechanistic. Can distort what respondents really mean or experienced

Faculty of Educational Sciences

by so completely limiting their response choices.

Source: Adapted from *Qualitative Evaluation Methods,* p.206 by M. Q. Patton, 1980.

In the interviews, the researcher asked respondents to spell out their experience in teaching mathematics and the strategies they adopted to explain the mathematical lessons. She asked them to explain and elaborate the problems they faced and encountered that prohibited them from integrating the constructivism and socio constructivism teaching strategies. Moreover, the researcher questioned their knowledge to such teaching theories and to which extent they felt they were applicable and applied to the Lebanese grade 4 mathematics curriculum. The researcher asked the mathematics coordinators/assigned mathematics teachers, for example, about their decision on integrating different kinds of strategies in the mathematics classroom and to which extent they, the administration, and the coordinators, might work on improving their schoolteachers' qualifications in registering them in professional growth workshops. The researcher asked the respondents such as Nahas about the difficulties he encountered while trying to set the general objectives for the mathematics curriculum and whether they were being implemented by all the schools in Lebanon. For the set of questioned she used during the interview, see appendix 3.

a) **Content of the Interview Guide**

The mathematics schoolteachers and coordinators/assigned mathematics teachers were interviewed after each observation. The content of the questions were divided into three phases:

- Schoolteachers' and coordinators' perception of traditional versus non-traditional classrooms.
- Schoolteachers' and coordinators' perception of different learning theories and their effect on enhancing teaching Mathematics.
- Schoolteachers' and coordinators' views of problems that might lie under the curriculum reforms.

This interview guide (see appendix 5) was used as mentioned earlier in this section to avoid losing focus and to ensure that the entire intended questions were asked. The interview questions were replicated in the observation rubric.

3. Observation

The researcher wanted to be part of how the teacher taught and what coordinators/assigned mathematics teachers expected from the mathematics learning in grade 4. She wanted to see whether the problems that face Lebanon mentioned earlier in chapter 1, were being faced by the private and public schools visited. According to Patton (1980), "observation data, especially participant observation, permits the evaluator to understand a program to an extent not entirely possible using only the insights of others obtained through interviews" (p.30). According to Creswell (2003), there are several advantages of the observational tool used in qualitative methodology. First of all, the researcher would have a primary experience with participants. Second, the researcher could keep the information recorded. Third, while observing, things that were not usual could be noticed. Fourth, it was useful in synthesizing things that might not be uncomfortable for participants to discuss. Whereas, the limitations of this type would be that the research might be "seen as intrusive, private information may be observed that the researcher cannot report, researcher may not have a good attending observation skills and certain participants may present special problems in gaining rapport" (p. 186).

While attending mathematical classes, the researcher had a rubric (see appendix 6) used for observation. This rubric helped the researcher identify what she wanted to observe in order not to be subjective and to lose focus. For example, she observed the teaching strategy used in class, the students' responses to the strategy used, and the schoolteachers' variety of teaching strategies used in one session, not the content of lessons being taught.

b) Content of the Observation Rubric

1. Rubric used for pilot study

Each copy of the observation rubric included 19 criteria (see appendix 4) where a check should be put under 'yes' or 'no'. Each criterion was developed based on the main

concepts adapted from the Theory of Didactic Situation after synthesizing the theoretical framework. Space was provided at the end of each criterion in case any further comment was needed.

2. Rubric edited for data collection

After the pilot study was conducted and after the researcher used the rubric she had prepared to use while observing the classroom, she felt that some criteria were repeated in several observation variables which distracted her attention and focus. Thus, the researcher decided to restructure the observation rubric and make it easier to read and follow while the observation process was taking place. Thus, the researcher had to assemble some criteria, delete others, and add new ones based on concepts adapted from the Theory of Didactic Situation after synthesizing the theoretical framework (see appendix 6). The new rubric included 17 criteria.

3. Validity and Reliability

Construct validity was especially problematic in case study research. It was a source of criticism because of potential investigator subjectivity. Yin (1994) proposed three remedies to counteract this: using multiple sources of evidence, establishing a chain of evidence, and having a draft case study report reviewed by key informants. In line with Yin (1994), this dissertation used observations, interviews, and documents analyses to create a connected chain of evidence that would enhance the external validity and concatenate the bits and pieces of information gathered for analyses. In addition, the rubric used in the pre-pilot study was reconsidered and was tried again several times during training sessions. The results were compared with other trainers' results until saturation occurred. Moreover, in qualitative validity, the researcher looked out whether the findings were accurate. However, the qualitative reliability indicated that the strategy was consistent throughout the data collection.

4. Member Checking

Creswell and Miller (2000), Merriam (1998), and Creswell (2003) discussed several aspects of trustworthiness which were taken into consideration in this dissertation. The

researcher took several aspects of trustworthiness into account such as audit trial, thick and rich description, triangulation, and member checking. The participants did not agree to record the interviews conducted; however, a detailed journal and interview notes were used in order to keep the reliability and trustworthiness and for the researcher to get details later while transcribing. According to Carlson (2010),

> Creating an audit trail refers to keeping careful documentation of all components of the study, should be external auditor to be utilized keeping field of observation notes, interview notes, journal, records, calendars, and various drafts of interpretations are all parts of creating audit trail. (p. 1103)

The researcher wanted to avoid being viewed as an external reviewer. According to Carlson (2010), "some researchers do regularly bring in auditors who are external to the study. Many do not, but will keep careful documentation that they reveal in their research report" (p. 1103). In addition to audit trail, the researcher used thick and rich description of the observation and the interviews conducted in order to "sustain findings over time across similar situations" (Ibid). The researcher kept thick and rich description (see Chapter 4) in order to provide understanding of 'relevance to other settings'. The researcher wanted to be closer to the story in order to increase coherence and a sense of connection with the participants. Along with the thick and rich description, triangulation was conducted. Interviews and observations were collected and then interpretations during the data analysis showed the trustworthiness. Finally, the researcher did a member checking which was not easy at the beginning since the researcher had to get in contact with the 12 participants for another time to share the findings of the study with them and take their consent that all the transcriptions were accurate. This procedure demanded time and follow up from both the researcher and the participants alike. The researcher had to visit some of the schools again in order to get the phone number of some of the participants whose email addresses were not available with the researcher. After that, the researcher had to call the participants and ask their permission to send them an email in order to verify the interview findings and to give their opinion and feedback. Here, the researcher made sure not to show the participants'

names or the school name on the attachments in the appendix as mentioned under ethics and codes.

This procedure enhanced the credibility of the study and allowed the researcher to feel comfortable to disclose the findings and make sure that the transcriptions of the conducted interviews reflected exactly what the participants wanted to say. "Member checking is often a single event that takes place only with the verification of transcripts or early interpretations" (Carlson, 2010). Thus, in order for the data to be revised as suggested by Creswell and Miller (2000), the researcher wrote a summary of the findings and sent it as email inviting participants to comment and give their feedback in order to ensure reliability and credibility. The participants were promised again that anonymity was still a priority, and as a protocol of the qualitative methodology, none of their names and the school names was to be mentioned. All the names and contact information such as the email address would be covered. An original document of each email was kept with the researcher in case any clarification or cross-checking was needed.

a. **Summary of the emails' content sent to the participants (see appendix 12).**

Each of the participants received an email with an attachment that contained a summary of the findings discussed in this chapter and analyzed by the researcher (see appendix 12). The participants were asked to read the summary carefully and comment on it saying whether the content of the summary reflected what was observed or said during the conducted interviews.

b. **Summary of the participants' feedback (see appendix 14)**

The participants had to read each summary of the findings and comment on the content clarifying whether they agreed that the analysis reflected them or whether any information should be edited. As a synthesis, all of the participants who replied to the e-mail sent agreed that the findings reflected what was observed in the class and that the summary of the interviews conducted was consistent with what was described hoping that the teaching and school would improve:

"لا مانع لدي *[Sic]* ربما تتحسن طرق التدريس على يدك"

Moreover, some of them agreed with the analysis and insisted on what was discussed in the interview about the fact of how much it would be helpful if the schools provide them with facilities: *"I would like to stress that if i [Sic] had more facilities it would be more easier [Sic] for me to use nontraditional teaching. i agree with ur [Sic] analysis".* However, several schoolteachers and coordinators/assigned mathematics teachers insisted that their name not be mentioned especially those who work in the public sector. One of the participants mentioned in the e-mail the following: *"I have looked all the files and I [Sic] agree with ur [Sic] analysis. I wish you the best. i [Sic] only ask you not to say my name since i [Sic] work in public school".*

c. Action done

Since almost the majority of the participants that replied to the researcher e-mail for member checking agreed that the content of the summary of the findings reflected what really happened in the classroom and during the interview, the researcher was satisfied with the findings, analysis, and summary, and she proceeded with the discussion of the findings.

5. Access and Ethics

As mentioned earlier in this section of this chapter, the population of this study is 3 public and 4 private schools in Lebanon. A letter signed by the director of this dissertation was sent to the rectors/directors of the schools asking them for permission to conduct interviews with the grade 4 mathematics schoolteachers and coordinators/assigned mathematics teachers and to observe some of their classes (see appendix 11). The researcher made sure to promise to be ethical and keep the school privacy into consideration. The researcher provided the divisions' school principals sample questions and the rubric the researcher was planning to use while interviewing and observing the participants. Creswell (2003) encouraged the researchers to show their research plan to the responsible people of the institution where the research was being done. In addition, the researcher would not put the participants at risk and would respect their answers and preserve the confidentiality of the research findings. Moreover, the researcher made sure not to disturb or interrupt the schoolteachers while they were explaining their lessons. The researcher also anticipated not

Faculty of Educational Sciences

using any harmful information that the researcher might encounter while collecting the data. Creswell provided the researchers several ethical issues. A summary of the ethical issues were as follow:

- don't push participants at risk;
- gain the permission of individuals in authority;
- respect research sites so that the sites are left undisturbed after a research study;
- collect data so that all participants and not only an experimental group, benefit from the treatment;
- means such as authority need to be considered for reciprocating between the research and the participants;
- anticipate the possibility of harmful information being disclosed during the data collection process such as parental abuse (p. 64-65).

Example of Coding Interview Data

Therefore, data was gathered from:

- The comparison between what was reported by the schoolteachers (in interview) and the coordinators (in interview).
- The comparison between what was reported by the schoolteachers (in interview) and what was practiced (through observation).
- The schoolteachers' and the coordinators' perspectives about the curriculum reform.

All these helped in understanding the purpose of the dissertation which was to identify the mathematics classroom environment as excerpted from fieldwork, to examine the schoolteachers' knowledge of different constructivist theories, and to suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study.

As mentioned earlier, according to Yin, it was very important to combine multiple sources of evidences since they led the data to be "stable, exact, and cover a long spam of time" (2003, p. 86).

However, there are some disadvantages that might encounter the study when multiple sources of evidence are used. For example, the information can be deliberately hidden or

made hard to access by decision makers such as the power of coordinator on the teacher in this study's case.

3.3.   Phases of Data Collection

There were several steps taken in this dissertation while collecting the data. The steps were divided into three main phases: The preparatory phase of the data collection, the final phase of the data collection, and the data analysis. The phases will be discussed later in the appropriate part of the chapter; however, a small outline would be presented to show the methodological steps:

During the preparatory phase top generate the research questions:

- Literature review
- Pre-Pilot Study (see appendix 2 and 3)
- Pilot Study (see appendices 6, 7, 8, 9, and 10)

During the final data collection to answer research questions:

- Step 1: Observing grade 4 math classes in 3 public and 4 private schools in Lebanon considering each observed class a case study.
- Step 2: Interviewing each teacher teaching the observed class after the observation directly.
- Step 3: Interviewing the mathematics coordinators of the grade 4 classes observed.

During the data analysis:

- Step 4: Triangulation method was adapted. The data from each individual classroom observation, teacher interview, and coordinator interview were analyzed, and common and uncommon data and data were also analyzed. This confirmed the research findings and reliability of the research.

In this dissertation, the schoolteachers' way of teaching observed in each classroom was compared with their feedback during the interview. Also, the schoolteachers' perceptions of constructivism learning theory were compared to those of the coordinators.

3.3.1. Methodological steps

Before describing the three phases of the methodological steps, the researcher would like to share what she had learned from Dr. Mulvihill[5], Professor of Social Foundations of Education/Higher Education, while attending one of her lectures on qualitative research at Ball State University (BSU) at Indiana in the United States of America in order to enrich her understanding about epistemology and ethnography. In her stay at Ball State University in summer 2015, the researcher expanded her research about the study and met many other researchers in the field of research especially those who were specialized with qualitative research. Thus, Dr. Mulvihill indicated that in qualitative research, researchers slowly got to know the participants exactly like visiting a new neighborhood where everyone from the neighbors got to know each other. In ethnography, researchers made observations and engaged with the culture or sub-culture. They built thick description and integrated what they saw, felt, questioned, and noticed. They also integrated themselves. They asked themselves questions such as why or what questions. They made meanings by narrating. They were scientists, artists, story tellers, and interpreters. They sought to understand what the culture was. Dr. Mulvihill added that qualitative research propels us forward to do more research. It drags us to do slow thinking and focus on an interest. Researchers were busy and the quality they did from the data was way more and was of high level. Maybe, no one thought of an ethnographer as an artist or scientist. People usually thought that researchers either had immediate respond or else they doubted the results. The researchers would be integrating the peoples' feelings and themselves too. They asked themselves questions such as "what do I notice?" and "why do I notice?" The researcher would be a narrator making meaning of reality. They would be writing and speaking at the same time. They would become artists or scientists. They would become a story teller and recognize their role as story tellers. They would recognize that as ethnographers or qualitative researchers, they

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[5] Learn more about Dr. Thalia Mulvihill.
http://cms.bsu.edu/about/administrativeoffices/studentaffairs/graduateprogram/faculty/graduatefaculty/mulvihillthalia, accessed on September, 2015.

should be taught how to see and walk with others in order to learn what they saw, felt, questioned, and interpreted. All systems of thought showed how epistemology was used to see how new systems of knowledge were perceived. The way the researchers saw the epistemology, they found the way they wanted to present and use in their study. The researchers should be conscious in the way by saying that knowledge was absolute and it was from an idealistic study. Moreover, if the researchers wanted to say that their study was from a constructivist epistemology and that studies were built on previous ones and built on each other, then they wanted to make a study that meant to them and to the people and that identified others.

What the researcher learned from the short lecture she attended was rich. From the professors' style of describing epistemology and ethnography methods, the researcher became more mature and interested on digging more into her participants' thoughts. From the way the professor described qualitative research, the researcher became aware that she should be part of the study in a way what she should have her own diary which she should fill with love. In other words, the researcher visited the field of study and searched, observed, and listened to the participants' thoughts, ideas, and concerns. She tried to comfort them and to make them trust her. She filled the dairy she used later while analyzing the data with care and not from her own perspective, but from the participants' perspective.

The following section provides a discussion of the conduct of the pre-pilot study and the pilot study.

a. Phase one: Pre-pilot Study

The measures used in the data collection through observation rubric and interview questions were firstly developed through analyzing data collected from the pre-pilot study (see appendix 3). The pre-pilot study was conducted prior to the actual pilot study. Brief reports were written on the interview conducted with Dr. Nahas. The report written from the interview helped and provided the researcher with the first frame for the research variables and redirected the researcher's research questions. As a summary, Nahas considered the study to be of great importance for the improvement of pedagogy in general and of

mathematical pedagogy in particular. He explained his interest in the interview to understand more to which extent the schoolteachers were aware of the importance of the constructivist teaching strategy and to which extent it was taken seriously by both, schoolteachers and coordinators/assigned mathematics teachers, while setting their lesson plans. He explained about the importance to try to expand the literacy behind the different types of methodology in order to be able to fulfill the general objectives of the mathematics curriculum that was set in 1996 and that the members of the committee working on those objectives stopped their work due to political issues. The researcher believed that this remained inadequate because she needed to do observations in the real life in order to prove what was discussed to be true. From here, the researcher became more interested in her topic and she decided on digging more into the curriculum, the objectives of taught lessons, the strategy the schoolteachers used through explaining, observing classrooms, and interviewing schoolteachers and other personnel.

b. **Phase 2: Pilot Case Study**

As part of the case study protocol, this dissertation piloted the research instruments before their actual administration to ensure the reliability and validity of the data. According to Yin (2003), the last step before data collection was to conduct a pilot study. The researcher wanted to conduct a pilot study in order to make sure that there was a real problem facing the mathematics curriculum in the Lebanese schools. The researcher wanted to conduct at least one or two interviews with mathematics schoolteachers to see and understand how much they knew about the constructivism and socio constructivism strategies. The researcher wanted to take an idea that would help her build the rubric that would be used while observing the classes and build reliable questions that would guide the interviews later on. Thus, she chose a convenient school which she had access to which according to Yin (2003) would lead to a less structured and more expanded relationship to develop between the "interviews and the case study examiner that might occur in the 'real' case study sites" (p. 79).

The researcher also interviewed Dr. Iman Osta (Assistant Dean of Department of school of Arts and Sciences in Lebanese American University) in order to have an idea about the Lebanese case and the problems both the government and the schools faced while trying to implement the objectives of the mathematics grade 4 curriculum (see appendix 10). In the following part of this section, the researcher wrote the reports clearly obtained from both the interview with the grade 4 mathematics schoolteacher and coordinator from a school in the Shouf area (see appendix 7), the observation detailed report (see appendix 8) and the interview with Dr. Iman Osta (see appendix 10), which as promised earlier in this chapter, was interviewed in order to build a strong research piloting which allowed this dissertation to start from with a solid base. The researcher did not need to do another piloting as required by Yin (2003) since a sufficient comprehension was obtained to understand the context of the problem. According to Yin (2003), if more need was required to understand the context of the problem, another pilot study should be conducted in order to modify in it. Yin (2003) stated that

> If more than a single pilot case is planned, the report from one pilot case also can indicate the modifications to be attempted in the next pilot case. In other words, the report can contain the agenda for the ensuing pilot case. If enough pilot cases are done in this manner, the final agenda may actually become a good prototype for the final agenda may actually become a good prototype for the final case study protocol. (p. 80)

During the pilot study, the researcher took into consideration all the feedback she had learned from the pre-pilot study. She reformulated the list of questions that were used to guide her in the interview. She created a rubric based on the factors she had learned while reading for the literature review and while conducting the interview with Dr. Nahas. As mentioned earlier, Dr. Nahas drew the researcher's attention to several variables, and she took all these into consideration while working on the classroom observation rubric. Once the researcher started the observation of a grade 4 mathematics class in a school in the Shouf area in Lebanon, she started focusing on the used teaching strategies instead on the teacher her/himself. The researcher started seeing each student as a separate individual and focused on the way he/she built his/her new knowledge. The process will be explained later in the

117

coming section that discusses the results of the pilot study. The feedbacks collected from the respondents during the pilot study were significant to help the researcher verify the reliability of the study. Not only was it useful in checking the research variables, but also in reforming and re-constructing the research questions.

c. Results from the Pilot Study

Before the researcher started the data collection, she decided that she wanted to conduct a pilot study in a region far from where she wanted to conduct the actual research and collect the data from. As mentioned earlier, the researcher chose a school which she had access to since according to Yin (2003) that would lead to a less structured and more expanded relationship to develop between the "interviews and the case study examiner that might occur in the 'real' case study sites" (p. 79). The researcher spoke to the school director and took permission to observe only one grade 4 mathematics class and then interview the mathematics schoolteacher of this class and the mathematics coordinator after. During that day, she went earlier to the school and waited in the schoolteachers' lounge. She heard them chatting, so she tried to blend in order to break the ice and make the teacher feel at ease for the teacher not to feel as if the researcher were there to pick on her work. Before the observation, she explained to the teacher that the purpose of the observation was to see the teaching strategies used in the lesson plan and to try to understand how the mathematics pedagogy was promoted in order to require the objectives of the curriculum and not to observe the teacher's teaching skills and knowledge of the taught content.

i. Report on the observation of the grade 4 math class

As mentioned earlier, the researcher explained to the teacher that her purpose from the observation was to see the teaching strategies used in the lesson plan and to try to understand how the mathematics pedagogy was promoted in order to require the objectives of the curriculum. The researcher stressed on the idea that she was not going to observe her teaching skills and knowledge of the taught content. Thus, she sat in the back of the classroom in a corner where she was able to see the entire classroom without disturbing anyone. She silently filled out the criteria in the rubric she prepared.

From the observation, it was obvious that the teacher involved her students with different techniques such as integrating the power point presentation and hands on activities. However, the teacher did not seem to have a clear idea of how to implement the constructivism teaching strategy. She did not rely on the students to elicit what they knew from previous information in order to build new ones on them. On the contrary, she explained for the first 10 minutes the new method and then asked them to apply it (see appendix 8).

ii. Report of the interview conducted with the grade 4 mathematics teacher

After the class observation, the researcher was accompanied to the coordination room where schoolteachers and coordinators met. The researcher re-explained to the teacher that she was not in a position to evaluate her teaching skills. However, one of the study's purposes was to see to which extent the schoolteachers in Lebanese schools knew about different teaching strategies.

The conversation started with the following question intending to elicit all what the teacher knew concerning the profession of teaching. The researcher asked her "Can you please describe your classroom?" The way the teacher described her classroom and the way she was explaining how she used different strategies while teaching showed the researcher that the teacher was familiar with different teaching methods which she might be integrating in her daily classroom lesson plans. However, the researcher did not hear a clear explanation or understanding of what constructivism or socio-constructivism might be. The teacher did not clearly mention that she depended on the student's background knowledge to build on them new ones. She kept on repeating that she used nontraditional techniques such as integrating technology, hand-on activities, pair work, and cooperative work. She thought that these might be what constructivism teaching strategy was, but unfortunately, it was not (see appendix 7).

iii. Report of the interview conducted with the grade 4 mathematics coordinator

The interview with the mathematics coordinator was similar to the teacher's. The researcher expected that the coordinator to be more aware of the constructivism teaching

119

strategy. The coordinator was asked at the beginning to describe the best class she had observed which she considered effective to promote the students' learning in mathematics. Her answers were similar to those of the teacher (see appendix 7).

iv.   **Report of the interview conducted with Dr. Iman Osta (Assistant Dean and Associate Professor of Mathematics Education at Lebanese American University-LAU).**

On the 8th of January, 2015, the researcher met Dr. Iman Osta in her office at LAU at 11:30 a.m. In order to stay on the right track, the researcher had several interview questions that she had prepared and taken them with her in order to make sure that the purpose of the interview was accomplished (see appendix 9). The researcher started the interview by introducing the purpose of the dissertation. The researcher introduced her to the objectives and research questions of the dissertation. As a summary, Dr. Osta believed that the topic was very interesting and beneficial and up to the new research demands. It contributed a lot to the pedagogical knowledge of the schoolteachers since it dealt with the awareness of the schoolteachers to different teaching strategies; especially the constructivist one. However, Dr. Osta advised to edit one of the research questions in which the researcher should change the word 'assess' from research question 2 to the word 'identify' since the purpose was to do a fieldwork observation to check what was happening in the Lebanese context in mathematics classes. Moreover, she advised the researcher to add details about the sample that she was not going to conduct the study. She advised her to specify the reason behind choosing specific schools and how many observation the researcher was going to conduct in each. She also suggested that the researcher should explain in details about the rubric that she was going to use while observing to make sure that all the variables were related to the research questions. Finally, she suggested that she should decide on how she was going to use the collected data in order not to face any problems later on while advancing in the study (see appendix 10 for details).

v. **Summary**

The results from both the observation and the interviews conducted were used in the development of the rubric and the interview questions. The researcher had to adjust some criteria in the rubric that she did not feel relevant or important while observing and she had to reformulate the interview questions. The researcher edited some words in the research questions taking Dr. Osta's advice into consideration.

The results from both the pre-pilot study and the pilot study opened many perspectives for research and revealed many gaps which had to be investigated at grade 4 in 3 public and 4 private school classes.

d. Phase 3: Data collection

vi. Triangulation

In this study triangulation method was adapted in order to check for internal adapted consistency (Yin, 2003). There were several types of triangulation, but this dissertation adapted the "data triangulation" which allowed and pushed the researcher to get data from different sources (Patton, 1980). Figure 8 represents how the data were analyzed in a triangular way and explained in details under the section of data collection. After the data was collected in individual cases as shown on each corner of the triangle in figure 8, the researcher did a cross-case study analysis in order to look for common or different aspects.

vii. Selection of schools

This following section discusses the selection process of the schools surveyed.

a. Access to schools

The researcher met with the dissertation advisor and discussed the schools that she would conduct her study on the 26th of March, 2015. The selection was based on one of the dissertation's purposes to choose the schools according to the different geographical areas and diverse or unique variations. In such a case, one could point early while observing the similarities and differences. The researcher got from the CERD a list of private and public schools in Beirut and Mount Lebanon[6]. Based on the geographical areas, population,

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[6] http://www.crdp.org/ar/schools-download-pdf

economic status, and availability of English language schools, she chose 3 public schools and 4 private ones. She asked the dean of the education department at Saint Joseph University to provide her with a letter in order to submit it to private schools and use it to get the approval of conducting a study in public schools (see appendix 11).

b. Schools

In a case study, the sample size cannot be large. The researcher chose a limited number of schools and if satisfaction did not occur, the researcher would proceed with the dissertation with a new case study. That was why the researcher decided to limit the sample size to seven schools where each grade 4 class was a case study by itself. Each school was given the moniker that referred to a planet to secure confidentiality as a qualitative study requires. The resulting sample was as follow:

- Public Schools
    - Earth,
    - Mars,
    - Venus,
- Private Schools
    - Jupiter,
    - Saturn,
    - Mercury.

At the beginning of this dissertation, the researcher had the intentions to cover as many schools as she could and cover as many areas as possible since she had the enthusiasm to observe, study, learn, and recommend from different types of schools all over Lebanon with its different geographical areas, religions, cultures, beliefs, and economical status. Thus, it seemed more practical to limit the study to seven grade 4 classes in 4 private and 3 public schools in Lebanon. Thus, as mentioned before, the type of this research did not require a large sample.

It was decided with the advisor of this dissertation to limit the study to seven schools. Moreover, as mentioned earlier in this dissertation, the selection of the grade 4

Faculty of Educational Sciences

classes was based on the fact that it was a preparatory stage that allowed students to bridge from the 1st cycle to a more advanced cycle where the general objectives of the classes became more advanced. Moreover, this did not mean that the students of the 1st cycle did not know how to build their own knowledge, but dealing with grade 4 students, whose age ranged between 9 and 10, allowed the researcher to observe more interactions. Since one of the purposes of this dissertation was not to generalize (Patton, 1980), selecting a schools from which one could mostly learn and benefit from was desirable. Thus, while the researcher was choosing the schools she wanted to conduct the research in, she faced some difficulty while trying to choose from the public schools in Beirut and Mount Lebanon. There were few schools that taught math in English. Eventually, the researcher choice became more limited, and she had to choose from the few available schools. As for the private schools, it was a bit easier because she knew she wanted to choose not very well known schools because the researcher thought that in these schools one could learn more the school's needs and could observe the student-teacher communication transparently. This was why she chose the mentioned 4 private and 3 public schools and kept in mind, as mentioned earlier, that if saturation did not occur, then she would proceed with the dissertation in several more schools where new grade 4 classes would be considered new cases to be studied.

c. **Classes**

One grade 4 class from each of the 7 private and public schools in Beirut and Mount Lebanon was included in this dissertation since it was considered a preparatory stage to a more advanced levels of mathematical concepts. Moreover, it was assured that more communication could be observed between the students and the schoolteachers than in lower classes.

d. **Schoolteachers and coordinators/assigned mathematics teachers**

The 7 mathematics schoolteachers of the observed classes were interviewed in the 7 private and public schools in Lebanon and were included in this dissertation. It is worth

Faculty of Educational Sciences

mentioning that the interview conducted in the pilot study had been conducted in a different school than that of the chosen ones from the schools involved in this dissertation.

3.4. Data Analysis

The data for this dissertation was collected from May through June 2015. It included 20 minute interviews with 6 grade 4 mathematics schoolteachers and 6 mathematics coordinators/assigned mathematics teachers. Seven classroom observations were conducted too prior to every interview. While analyzing the data collected, many categories as possible were used to identify and describe patterns and themes from the perspectives of the participants, and then the researcher attempted to understand and explain these patterns and themes (Yin, 2003). The interviews were all transcribed as a diary. The researcher started analyzing the data in each school from the start of data collection. She gathered them and compared them in order to start with a tentative analysis. This helped while proceeding with the data collection where the researcher used to go back after each interview or observation and ask more questions. The researcher worked on filtering all the data collected from each school.

3.4.1. Interviews

The researcher used questions prepared ahead of time as mentioned earlier in this part of the chapter. Before each interview, the researcher filled specific components to make sure she tackled every single record and explained the interviewee that the interview would be recorded. The components were the date, place, and name of interviewer. The researcher referred to the questions from time to time to make sure the respondents covered all the intended objectives behind the interview. She also posed after each question in order to give the interviewee a chance to answer, and she used a final thank you statement to acknowledge the time the interview had taken as Creswell (2003) advised in his book entitled "Research design: Qualitative, Quantitative, and Mixed Methods Strategies". Finally, it is worth mentioning that even though the researcher explained for the interviewer that the interview was going to be recorded, the researcher took permission to take notes in case the recording equipment failed (Ibid).

3.4.1.1.   Process of the interview

The researcher started the interview as she started the pilot dissertation interview with the following question intending to elicit what the entire teacher and coordinators/assigned mathematics teachers knew concerning the profession of teaching: "Can you please describe your classroom?" As the interview proceeded, the researcher used the interview guide in order to make sure the conversation would not get out of control and to make sure that all the objectives of the interview were covered. As mentioned earlier under the ethics part, the researcher tried not to be biased and not to interfere with the teacher or coordinators/assigned mathematics teachers' opinion or interrupt them, since almost all the schools did not give her permission to record. The researcher was trained to record the interview systematically using symbols and abbreviations whenever needed. According to Creswell (2003), there were three types of field notes one should learn before conducting any data collection. The first one was the field jotting. It was when the researcher use specific abbreviations or symbols she could use later on and remember details from them. The second one was the diary, and this was personal. It was when the researcher wrote the notes above integrating some of the emotions and impressions that showed up during the interview or observation. The third one was the log, and it was done when the researcher planned the upcoming procedure alone at her house ahead of time such as a day before.

The researcher also used abbreviations and symbols that allowed her later on while transcribing the interviews conducted, and that helped her remember some details especially in the schools where she was not given the chance to record the interview. This led to the third field note which is the dairy. According to Creswell (2003), a good researcher should have several characteristics in order to achieve his/her goal which he/she was trained to adapt. The researcher was trained to be adaptive and flexible. She tried to be a good listener and ask the right questions. The researcher expected and was ready for any accident that might occur and was ready with plan B in case accidents occur. Sometimes, she had to rephrase the questions or translate them to Arabic. Other times, she did not follow the

interview guide and built on some respondents to learn more about their feedback. She sought answers and feedback from schoolteachers and expected them to be transparent and honest. However, she always had to guide the interview in order to stay on the right track, and she had only 20 minutes to interview each of the coordinators/assigned mathematics teachers and the schoolteachers. At first, each interview as mentioned earlier lasted for approximately 20 minutes. This was why the researcher had to digress to other issues trying to lead the interview to a different question. Of course, the schoolteachers and the coordinators/assigned mathematics teachers were in a hurry and each interview was followed by the observation directly on the first recess or in their free period. Since it was their free time, this made them want to finish quickly. However, in two private schools, this was not the case.

The researcher had the chance to interview the schoolteachers and the coordinators/assigned mathematics teachers during the coordinating hour they had on the observation day which made the job done easier. Other than that, the interviews went smoothly, and the objective behind them was accomplished. The schoolteachers elaborated freely and stressed on some issues they faced while designing their daily lesson plans such as the interference of the coordinators/assigned mathematics teachers or some facilities the school did not supply them with… the interview guide that the researcher had prepared was very useful where she referred to more often. The schoolteachers' opinions were written on the spot and every word they said was taken into consideration using symbols and abbreviations. To reiterate, all the notes were written as a diary the day after or on the same day. Then, the within case study analysis was performed as soon as possible while the information was still fresh in mind.

3.4.1.1. Analyses of the Interviews

The data collected from the interviews were manually coded and categorized. The researcher started analyzing the interviews from each teacher and coordinator/assigned mathematics teacher. Transcriptions from the field notes in separate schools were thoroughly studied and chunks of coded sections were grouped. Thus, the researcher coded

all the common characteristics observed in the interview from each of the schoolteachers and coordinators/assigned mathematics teachers (see table 7).

Table 7: Example on the Codes from the schoolteachers' interview data

	Earth	Mars	Venus	Jupiter	Saturn	Mercury
*NFCTS	/	/	/		/	/
**DTNTT	/	/	/	/	/	/

*Not familiar with the constructivist teaching strategy (NFCTS): 5 schoolteachers
**Know the difference between traditional and non-traditional teaching (DTNTT): 6 schoolteachers

3.4.2. Observations

After finishing from all the observations, the rubric data were entered into the Statistical Package for the Social Sciences (SPSS) to analyze how they went along with the interviews conducted with the same schoolteachers and the coordinators/assigned mathematics teachers. While analyzing the data, the researcher took into consideration that the process of data analysis included understanding the data. It included "preparing the data for analysis, moving deeper and deeper into understanding the data, representing the data, and making an interpretation of the larger meaning of the data" (Creswell, 2007, p. 23).

3.4.2.1. Procedure of the observation

Each grade 4 class was observed for around 50 minutes where the mathematics teacher was explaining a new concept or following up a previous one. In these observed 6 classes, the researcher was not given permission to record any of them since the principals of the schools preferred not to put the schoolteachers under stress in the presence of a camera or a tape recorder. During the observations, the researcher sat in a suitable place in the classroom where she could see the students and the schoolteachers and at the same time would not be bothering them and be able to follow the interaction occurring between them. The researcher filled out the observation rubric during class session (see appendix 6). The

result was 6 observations rubrics. In the first observed classes, the researcher was observing a slight difference, but after the 3rd observed class in both sectors, no additional data was located; however, the researcher insisted on going further and observing another class and interviewing new schoolteachers before she confirmed that saturation occurred and the researcher thought that the data collection from observation should be stopped with the absence of any further useful data (referenced under data collected from **Star** school in the coming section of this chapter and detailed in chapter 4). Thus, the researcher believed that the classroom observation was worth noting in this dissertation because one of the objectives of this dissertation was to observe the different teaching strategies the schoolteachers used in their classrooms and whether they underwent the constructivist teaching strategy and that was found out.

Conducting the observation in the public schools was not easy at the beginning. When the researcher first called the schools, she heard negative comments and some replied "we are about to finish with our curriculum." Others said "Ok. You can come and observe, but we decide which class to observe." Other schools said that they had a replacement mathematics teacher for grade 4 because the class teacher was on a maternity leave. However, after the researcher insisted and took access permission from the Ministry of Education that mentioned which classes to be observed (see appendix 11), the researcher conducted her observations, and no one interfered. As for the private schools, they did not have any problem. The researcher just called the people in charge and took an appointment to meet with the principals. Then, she took another appointment to conduct her observation and interviews. In all the classes she observed, she did not see a negative teacher-student relation. On the contrary, the atmosphere in the classroom was well-going. The only negative aspect was that the time the researcher chose to conduct her research at was inconvenient. It was May and June which fell at the end of the academic year where both the students and the schoolteachers were already exhausted and the hot weather making the classroom environment quite uncomfortable. Limitations will be presented in the section that follows.

3.5. Conclusion

This chapter provided the research design of the dissertation. It discussed the instruments and procedures of data collection and described how data were analyzed. It also presented the validity and ethics of the dissertation, and rationale for every single method used. The chapter that follows presents the findings of the dissertation.

Chapter 4

Findings of the Dissertation

4.1.   Introduction

The previous chapter discussed the methodology and methods of the dissertation. This chapter deals with the findings of the dissertation, and it is divided into two main parts. The first part presents and analyzes the findings in each school separately, and the second part grants and examines all the seven schools along with the variables chosen for this dissertation: schoolteachers' and coordinators' perception of traditional versus non-traditional classrooms, schoolteachers' and coordinators' perception of different learning theories and their effect on enhancing teaching Mathematics, and coordinators' views of problems that might lie under the curriculum reforms.

The chapter is outlined as follows:

- introduction;
- introducing the subject and the findings from individual cases;
    - findings from individual cases;
    - data collected from Star school;
- general findings;
    - analyzes all the seven schools along with the variables chosen for this dissertation;
    - cross-case study analysis using the triangulation method;
- summary;
- conclusion.

However, the chapter starts with newly formulated research questions derived from the fieldwork.

The research questions

1- How do grade 4 schoolteachers associate constructivism with their teaching of mathematics?

2- How can observation data yielded from fieldwork be used in identifying grade 4 mathematics teaching environment?

3- How would pedagogical models yielded from fieldwork inform mathematics teaching in the Lebanese elementary cycle?

Adding to the above, the following research question was deemed necessary to include given the qualitative nature of this dissertation and the emergence of themes during data collection.

The new research question is:

4- How does the researcher's role as a qualitative tool participate in identifying mathematics teaching in the elementary cycle?

4.2. Introducing the Subject and the Findings from Individual Cases

4.2.1. Findings from Individual Cases

Each school was given a moniker that referred to a planet to secure confidentiality as a qualitative study required enhancing the respondents' authentic discourse. The resulting sample was as follow:

- Public Schools
    - o Earth;
    - o Mars;
    - o Venus;
- Private Schools
    - o Jupiter;
    - o Saturn;
    - o Mercury.

1- **Earth**

   a. **Results of the observation of the Grade 4 mathematics class in Earth school**

Earth, a public school located in Beirut, has 9 sections distributed between the elementary and intermediate division. A total of 247 students are enrolled in this school. Elementary 1 and 2 has 178 students distributed among 6 sections and the intermediate division has 69 students distributed in 3 sections. The school has 12 full-timer (ملاك) administrators. 24 schoolteachers teach in the school of which 10 are full-timers (ملاك) and 14 are part-timers (متعاقد). Grade 4 class observed by the researcher has 12 students; 9 girls and 3 boys. On the 13th of May, 2015, the researcher visited the school in order to observe a grade 4 mathematics class and conduct an interview with the mathematics class teacher and the mathematics coordinator/assigned mathematics teacher. On the observation day, 3 students were absent. The researcher accompanied the mathematics schoolteachers into the class. The researcher sat on a chair at the back of the classroom in a position allowing her to easily and fully monitor both the schoolteacher and the students. The schoolteacher saluted the students, but she did not introduce them to the researcher. She started the lesson by making the students recall the previous lesson. She held a discussion with the students and did not allow them to answer unless they had the permission to speak. After finishing from the 10 minute recalling section of the previous lesson, the schoolteacher turned towards the board and wrote the objectives of the lesson on it which was about finding the area of geometric shape. she said, "Today, we are going to discuss the different equations to find different geometrical shapes." While using code switching between English and Arabic as she explained the difference between the shapes and how to use the formulas to get their areas, the schoolteacher drew on the board a rectangle, a square, a circle, and a triangle on the board. After 20 minutes, she asked the students to copy the information written and asked them to open a specific page in their book and solve the given problems, which were applications of what was explained during the lesson. Five minutes before the bell rang, the teacher asked the students to stop working, so they would continue in the next session.

Then, the researcher and the schoolteacher left the classroom to the coordination room where the interview was planned to be conducted.

b. Analysis of the rubric used while observing grade 4 mathematics class in Earth school

The schoolteacher from Earth school showed more traditional teaching than non-traditional strategies. Her teaching skills did not show any adoption to the constructivist teaching strategy. She focused more on transmitting the new concept via lecture than trying to elicit from the students' background knowledge and built on them. The results indicated that 7 teaching criteria adopted by the schoolteacher showed that she engaged the students with the learning process whereas 10 criteria showed that she followed a traditional strategy where she did not allow the students responses to drive the lessons, shift instructional strategies, and other content (see appendix 6).

c. Results of the interview with the mathematics teacher and coordinator/assigned mathematics teacher from Earth

Analysis of the Interview with schoolteacher A from Earth school

The first question was: "Can you please describe your classroom?" According to the respondent, her class was a mixture of students with different academic abilities. The students' parents' educational background differed although they were almost all from a low socio-economic class which according to the teacher affected the students' ability to study: "If a student parent does not have time to spend beside his child teaching him his homework, then for sure, the student will not care a lot to achieve his best." After drawing the schoolteacher's attention to the fact that she did not answer the researcher's question in terms of describing her classroom's lesson and the way she taught, she started explaining that she used a lot of cooperative work and introduced several methods in her lesson plan preparation such as group work and power point presentation. Obviously, the schoolteacher knew that there were two ways of teaching: the traditional and the non-traditional, but she did not believe that students could build new integration based on their prior knowledge gained from a previous lesson. The schoolteacher said, "Children cannot build on

knowledge without having a pre-taught one. Without the help of an elder, the students will lose focus." Throughout the conversation, the schoolteacher favored behaviorism learning strategies. She did not mention it in that way, but she explained that student mainly studied only to receive high grades on their exam. She also claimed, "I believe that students learn for a purpose. They study to achieve in their exams. One of the rewards is the grade they earn. This is why I am with the reinforcement." She wrapped up the interview by clarifying that students should always have a helping hand. They did not come with full knowledge. They might have some prior ones; however, they needed a helping hand to acquire all the new knowledge taught: "...I believe that all students should be taught by someone. Yes, we can be helpers sometimes and not give them answers directly. However, they need someone to direct them," the schoolteacher said. (see appendix 13 for details for transcription)

Analysis of the Interview with coordinator/assigned mathematics teacher A from Earth school

The first question was: "Can you please describe your classroom?" According to the respondent, the classroom was a mixture of both traditional learning and non-traditional learning depending on the objectives of the lesson taught. The schoolteachers were expected to always consider the students as the center of the teaching process; however, when there was no need for non-traditional methods, then the schoolteacher was not expected to integrate any non-traditional strategy; "When the schoolteachers prepare lessons, they are expected to think of the student as the center of the classroom. They shouldn't prepare the lesson in a way where they are the only providers of information," the coordinator/assigned mathematics teacher said. When asked about asking the schoolteachers to adopt a specific teaching strategy, such as constructivism, the coordinator/assigned mathematics teacher made it clear that she did not impose any strategy to be adopted by the teacher: "I don't ask the teachers to adopt any. Not all the teachers are trained to use several teaching strategies. They come from the old school." However, during the interview, the coordinator/assigned mathematics teacher believed that students came to the classroom with previous knowledge, yet they could not build on it on their own. The teacher was a main part of the learning

process too: "Student do [Sic] learn from the society; however, this is not enough. The schoolteacher is a main part of the learning process," the coordinator/assigned mathematics teacher said. Also, she also added that since the schoolteachers worked in a public school funded by the state, they could not ask for a lot of facilities that made integrating nontraditional strategies easy: "We work in a public institution funded by the state. So it is not easy to ask for a lot of facilities as it requires a lot of process," the coordinator/assigned mathematics teacher said. (see appendix 13 for details for transcription)

2- Mars

      a. Results of the observation of the Grade 4 mathematics class in Mars school

Mars, public school located in Beirut, has a total of 250 students distributed among the primary, elementary 1, and elementary 2 divisions in 10 English and 2 French sections. The preschool has 78 students distributed among 5 sections, and the elementary division has 172 students distributed among 7 sections. The school has 3 full-time (ملاك) administrators, 18 schoolteachers as 8 full-timers (ملاك) and 10 part-timers (متعاقد). Grade 4 class observed by the researcher has 17 students: 8 girls and 9 boys. On the 20th of May, 2015, the researcher visited the school in order to observe a grade 4 mathematics class and to conduct an interview with the mathematics class teacher and the mathematics coordinator/assigned teacher. On the day of the observation, 4 students were absent. The researcher accompanied the mathematics schoolteachers into the class after the first recess. The researcher sat on a chair at the back of the classroom in a position allowing her to easily and fully monitor both the teacher and the students. The teacher saluted the students and introduced them to the researcher. She started the lesson by trying to let the students recall the previous lesson. She called the students' names to make sure everyone participated. After finishing from the 8 minutes of recalling the previous lesson, the teacher started brainstorming what the students already knew about tens, hundreds, and thousands. She turned and wrote on the board while explaining at the same time. She was drawing bars and dividing them into tens, hundreds … "Today we are going to join categories we see in the book into groups of tens," the

schoolteacher said. She drew on the board 25 stars. She was code switching between English and Arabic while explaining to the students that the 25 stars could be divided into several equal sections. She did not give the answer directly. She asked the students to think of how many groups of ten the stars could be divided. After pausing for 2 minutes, she asked a student raising his hand up to give her an answer. "So what do you think? [Sic] كم group can we have?" the teacher asked. The students answered her by pointing 2 fingers out. He said, "We can have 2 groups and 5 will remain out." So the teacher drew a circle around each 10 stars. After 18 minutes, she asked the students to copy the information written on the board to their copybooks and then she asked them to open on a specific page in their book and solve the given problems previously assigned by the schoolteacher for the students to apply what was explained during the taught lesson. The students had to apply the formulas they learned and to find the areas of geometrical shapes. 10 minutes before the bell rang, the schoolteacher wrote on the board the answers to which the students compared. When the bell rang, the researcher, accompanied by the teacher, left to the coordination room where the interview was planned to be conducted.

b. Analysis of the rubric used while observing grade 4 mathematics class in Mars school

The schoolteacher from Mars school adopted a traditional strategy. She did not engage the students in the learning process and did not show any sign of any constructivist teaching strategy throughout the lesson. For example, she was using direct teaching and was not using ay technology or group work The results indicated that the schoolteacher neither posed problems allowing students to use prior knowledge to understand new ones, adapted the curriculum to address students' suppositions and development of new knowledge , nor used any different strategy to make sure the students' understood new concepts. However, the students were given the ways to solve problems and asked to apply what they learned. As a conclusion, almost all the criteria show that the schoolteacher did not use any constructivist teaching strategy in order to promote students' learning (see appendix 13).

c. Results of the interview with the mathematics schoolteacher from Mars

Analysis of the Interview with schoolteacher B from Mars school

The first question was: "Can you please describe your classroom?" According to the respondent, her classroom was a mixture. She tried to implement some activities such as group work and hand-on exercises as much as she could. She cannot be that much creative in designing her lesson plans since the school did not support the schoolteachers with facilities to simplify this issue. The schoolteachers said, " ...I cannot be that much creative. I do not have a lot of facilities which can allow me to teach in a pure nontraditional way. Even though I know how to apply methods that are student centered; yet, the school does not help in this area." She added that even though she liked to be creative and to step out from the traditional classroom, she found it difficult because she did not find any support from the school and her colleagues: "The public schools lack facilities such as LCD projectors and internet connections. How can a schoolteacher get rid of the lecture method if the minimum requirement of the nontraditional methods is not available?" the schoolteacher asked. As for the knowledge of different learning theories, the schoolteacher clarified that she was not familiar with specific names. However, she knew the student-centered strategy which considered the student as the center of the classroom: "I am not familiar with names, but I know that there is the student-centered strategy which stresses on the student being the center of the learning process. I do not like to be traditional all the time. I feel bored and the students too. This is why I implement group work and hands-on activities as much as I can to be creative" (see appendix 13 for details for transcription).

Analysis of the Interview with coordinator/assigned mathematics teacher B from Mars school

The first question was: "Can you please describe your classroom?" In order not to face the same problem the researcher had with the first coordinator/assigned mathematics teacher she interviewed at Earth school, she elaborated more on the question and added to it;

> "I want to think of the classroom in terms of students and lesson plans. I want to get an idea of how you design with the teachers the lesson plans. Do you take the students into consideration while working on the lesson plan?"

The coordinator/assigned mathematics teacher responded clearly that the schoolteachers were expected to think of the students while preparing their lesson plans; however, they should take into consideration achieving the objectives of the lesson: "When the schoolteachers prepare lessons individually, they are expected to think of the students. However, the more main thing is for them to think how to deliver the information to the students and achieve the objectives of the lesson." The coordinator/assigned mathematics teacher was extremely clear that she did not believe in integrating new strategies to the learning process especially if the schoolteachers were not trained to do so: "Not all the teachers are trained to use several teaching strategies. We prefer to stick to the strategies we are familiar with." She was not familiar with the constructivist teaching strategy and did not believe that students could build on their prior knowledge without the schoolteacher being the main part of the classroom and the lesson taught: "The teacher's presence is essential. Learning does not occur without her presence. She should always be around for the learning process to occur." As for supporting the schoolteachers with new materials that allowed them to shift from the traditional teaching strategy to the non-traditional one, the coordinator/assigned mathematics teacher stated that it was not easy to ask in a public institution for new materials throughout the academic year because all the demands should be set before the start of the academic year and not all of them would get approved. "Usually it is not easy to require new materials except at the beginning of the academic year since we work in a public institution," the coordinator/assigned mathematics teacher said. From the interview with coordinator/assigned mathematics teacher B from Mars school, it was clear that she encouraged the schoolteachers she worked with to stay in the old school and not learn new strategies which might enhance the teaching skills (see appendix 13 for details for transcription).

3- **Venus**

   a. **Results of the observation of the Grade 4 mathematics class**

Venus, a public school located in Mount Lebanon, has a total of 178 students distributed among the primary and the elementary divisions in 8 English sections. The

primary cycle has 54 students distributed among two sections and the elementary has 124 students distributed among 6 sections. The school has 2 full-time (ملاك) administrators and 17 schoolteachers teaching in the school; 16 full-timers (ملاك) and 1 part-timer (متعاقد). Grade 4 class observed by the researcher has 18 students: 10 girls and 8 boys. On the 22nd of May, 2015, the researcher visited the school in order to observe a grade 4 mathematics class and conducted an interview with the schoolteacher mathematics class and the mathematics coordinator/assigned teacher. On the day of the observation, 2 students were absent. The researcher accompanied the mathematics schoolteachers into the class after the second recess. The schoolteacher started the lesson by asking the students to put the homework of the previous day in front of them on the desks. She called the students' names in order to correct the exercises some were corrected orally, and others were corrected on the board. She called on some students to correct them while writing the solution on the board. After finishing correcting the homework, which took 15 minutes of the 45 minute session, the schoolteacher started brainstorming what the students already knew about equilateral triangles. She asked some short-ended questions such as: "Who can remind me what a triangle is?", "how many sides does a triangle have?", and "how many angles does the triangle have?" While asking the students, she was drawing the students' answers on the board. For example, she was circling the three angles of the triangle on the board. Later, she turned towards the board and drew an equilateral triangle and explained that an equilateral triangle had three equal sides and angles. She was code switching between English and Arabic while explaining to the students frequently. After 25 minutes, she explained to students in these 25 minutes to work in pairs and solve a problem from the book. The problem was to calculate angle 'z' if angle 'x' and angle 'y' was 45 degrees each. 10 minutes before the bell rang; the schoolteacher asked one pair to give the answer without asking for any justification. Before leaving the class, she assigned homework by writing the page number on the board. When the bell rang, the researcher left the room accompanied by the schoolteacher to the coordination room where the interview was planned to be conducted.

139

b. Analysis of the rubric used while observing grade 4 mathematics class in Venus school

The schoolteacher from Venus school adopted a traditional strategy. Even though she put the students in pairs yet she did not show any enthusiasm to encourage the students to construct on previous knowledge. She neither posed any problem that challenged the students' to think in a constructivist way nor did she use different strategies to make sure the students' understood the new concept. However, the schoolteacher encouraged and accepted students' autonomy and initiative. She asked the students to apply what they have learned through having them engaged in experiences that might allow them to construct their new knowledge based on prior ones. In general, the results indicated that the schoolteacher adapted more criteria that fit under the traditional teaching strategy (see appendix 13).

c. Results of the interview with the mathematics schoolteacher from Venus

Analysis of the Interview with schoolteacher C from Venus school

The first question was: "Can you please describe your classroom"? According to the respondent, her classroom was a combination of several 'things'. She tried to achieve the objective of the taught lessons by implementing some activities after taking the approval of the coordinator/assigned mathematics teacher. "I see from the yearly plan the objectives behind the lesson and I design it according to it and gets approval from the mathematics coordinator," the schoolteacher said. She added that due to working parallel with the coordinator/assigned mathematics teacher, she could not be very flexible. Together they came up with several activities that made the class nontraditional. The schoolteacher said, "I have to work parallel with the coordinator. We sometimes try to implement some new activities." She added that the school did not support them with facilities to make it easier for them to adapt a pure nontraditional strategy: "…The school does not support us with what we need easily and it takes forever to order new material… This is why no my classes are neither pure traditional nor nontraditional. They are combination of the two. Whenever I can I try to put the students in groups. I don't have a lot of facilities which can allow me to teach in a pure nontraditional way," she said. The schoolteacher was not familiar with the

constructivist teaching strategy. She made it clear that she knew that it was a nontraditional strategy. She said that constructivist teaching strategy might be related to 'constructing things'; however, she showed positive attitude towards the strategy and categorized it under nontraditional strategies. The schoolteacher said, "Maybe…it is related to students constructing things! From its meaning, I can tell that it is not traditional, but I am not familiar with the strategy itself." She mentioned in the interview that she was familiar with student-centered strategy. The researcher drew the schoolteachers' attention to the fact that student-centered strategy was a type of constructivist teaching strategy. The schoolteacher showed a positive attitude towards the strategy even though she lacked knowledge about it and suggested that workshops for them should be conducted in order to learn about different learning strategies in order to improve the teaching process: "I would like to give the teachers workshops regarding this issue and draw their attention to several ways to apply it," she claimed. (see appendix 13 for details of transcription)

Analysis of the Interview with coordinator/assigned mathematics teacher C from Venus school

The first question was: "Can you please describe your classroom? I want you to think of the classroom in terms of students and lesson plans. I want to get an idea of how you design the lesson plans with other schoolteachers. Do you take the students into consideration while working on the lesson plan?" The coordinator/assigned mathematics teacher responded that the schoolteachers were expected to think of the students while preparing their lesson plans. She added that the schoolteachers were expected to integrate different teaching strategies in the appropriate lessons, and then she approved the teaching strategy: "When the schoolteachers prepare lessons, they are expected to integrate different strategies such as cooperative work. Then, I add my comments and approve the work," the coordinator/assigned mathematics teacher said. When asked about whether she considered the lessons she coordinated to be traditional or non-traditional, she indicated that they were mixture of both depending on the purpose of the lesson and whether the schoolteacher was introducing new concept or not: "They are mixture of both. Some lessons require traditional

strategies where the schoolteacher needs to lecture in order to introduce new concepts; however, when the students are applying concepts, the class then can be held in a non-traditional way," she added. The coordinator/assigned mathematics teacher made it clear that it was not easy in a public school to order new material and that it was not easy to integrate several teaching strategies into the classrooms: "It is not easy to do such work in a public school," the coordinator/assigned mathematics teacher said. Concerning constructivism, she clarified that "not all the teachers are trained to use strategies that are far from the traditional ones. However, if they were trained, it would make the learning process easier," she added. Finally, when asked about what she had to say regarding the student-centered strategies versus the teacher-centered ones, the coordinator/assigned mathematics teacher indicated that the schoolteacher was the main part of the learning process the same as the students. They both were imperative and completed each other: "The teacher presence is very important. Learning does not occur without her presence. However, I am not saying that the students should be the center too. I believe a bit of each does not harm. The schoolteacher should control the teaching situation and at the same time take the students into consideration," the coordinator/assigned mathematics teacher said. (see appendix 13 for details for transcription)

4- **Jupiter**

   a. **Results of the observation of the Grade 4 mathematics class**

Jupiter, a private school located in an area beside Beirut (ضواحي بيروت القريبة الشمالية), has a total of 380 students distributed among 15 French and English sections in the primary, elementary, and intermediate division. The primary has 94 students in 4 sections, elementary 1 and 2 have 242 students distributed among 14 sections, and the intermediate division has 44 students distributed among 3 sections. The school has 14 full-time (ملاك) administrators and 60 schoolteachers: 53 full-timers (ملاك) and 7 part-timers (متعاقد). Grade 4 class observed by the researcher is one of 2 sections and has a total of 15 students: 7 girls and 8 boys. On the 27th of May, 2015, the researcher visited the school in order to observe a grade 4 mathematics class and to conduct an interview with the mathematics class

Faculty of Educational Sciences

schoolteacher and the mathematics coordinator/assigned mathematics teacher. On the day of the observation, all students attended. The researcher accompanied the mathematics schoolteachers into the 8:00 a.m. The schoolteacher started the lesson by asking the students to put the homework of the previous day in front of them on the desks. She called 5 students with their copybook to step towards the board. She asked the students to write the answers of the 5 assigned homework exercises. After 5 minutes, she started asking the other students in the class whether they agreed with the solution their classmate suggested. After agreeing on one answer, she asked the students to copy the correct answer. After finishing correcting the homework which took 15-20 minutes of the 45 minute session, the schoolteacher drew a square and a cube on the board. She passed around two geometrical shapes that represented the cube and the square and asked the students individually to write down what they saw as similarities and differences. Meanwhile, she called on the students that finished with their observation to step to the board and write down one difference or one similarity under each shape. She was not code switching between English and Arabic while addressing the students frequently. After 15 minutes, she briefly compared the two shapes and asked the students to copy the information. Before leaving the class, she assigned homework and wrote the page number on the board. When the bell rang, the researcher left the classroom, accompanied by the schoolteacher, to the coordination room where the interview was planned to be conducted.

b. Analysis of the rubric used while observing grade 4 mathematics class in Jupiter school

The schoolteacher from Jupiter school showed more willingness to shift to the non-traditional strategy. Even though she did not use several strategies showing extreme commitment to non-traditional strategy yet she tried to engage the students more in the learning process. The schoolteacher were aware that the students' point of views was windows into their reasoning. She did not show clear understanding and practice of building on students' prior knowledge. However, the schoolteacher encouraged and accepted students' autonomy and initiative; she used raw data and primary sources, along with

143

manipulative, interactive, and physical materials. Moreover, she allowed the students to find new ways to solve problems. The results indicated that the schoolteacher sometimes engaged the students in experiences that might allow them to construct their new knowledge based on their prior ones. An example on this is that she asked them to use what they had learned from previous lesson and brainstormed new concepts. The schoolteacher from Jupiter school showed more criteria that fit under the non-traditional strategy (see appendix 13).

c. Analysis of the Interview with schoolteacher D from Jupiter school

The first question was: "Can you please describe your classroom"? According to the respondent, when preparing lesson plans, the schoolteacher should always think of the students as the main part of the learning process: "When we prepare lessons, we always think of the student as the center of the classroom," she said. She also identified that she tried to implement her beliefs in the student-centered strategy and convince her coordinator/assigned mathematics teacher to apply what she studied in her teaching diploma. She said, "At least this is what I do and I try to share with my responsible. This is what I learned while working on my teaching diploma." As for the schoolteachers' knowledge of the two main types of teaching, she was able to differentiate between the traditional and the nontraditional strategy. She made it clear that she made her students work in groups which according to her lied under nontraditional strategies. She said,

> My lessons vary. I cannot all the time make the students work in groups. Sometimes I have to lecture in a way where I introduce the lesson and the new concepts. But when it comes to applications, I tend to put the students to work collaboratively.

The schoolteacher explained that the school helped a little for this to occur. She explained that depending on the budget, the school supplied the schoolteachers with the minimum requirements to shift from the traditional to the nontraditional strategy. "…It depends on the budget. We don't get all of what we ask for. At least today, we can at least integrate technology into the classroom," she said. As for the issue concerning the teacher's knowledge of several teaching strategies especially the constructivist teaching strategy, the schoolteacher did not show any clear understanding of the strategy. All of the discussion

144

was showing that the schoolteacher knew some nontraditional teaching strategies, but she did not have a clear idea of the constructivist one: "I have no idea, but from the words 'teaching strategy' I suppose it is a strategy the schoolteacher can use," she said. Nonetheless, she also added throughout the discussion that she did not believe in a strategy that the students came to class with prior mathematics knowledge. Maybe, in her opinion, the students learned from the society some concepts that helped them while receiving the information from the teacher. She said,

> Student do [Sic] learn from the society but not mathematics. They might see for example some geometrical shapes around them but they cannot link theories and calculate their perimeters, for example, if the schoolteacher did not teach them how to do it.

Thus, the schoolteacher wrapped up the discussion by saying that the teacher was a main part of the learning process even in a student-centered strategy (see appendix 13 for details for transcription).

Analysis of the Interview with coordinator/assigned mathematics teacher D from Jupiter school

It is worth mentioning that the coordinator/assigned mathematics teacher responses were short. She was answering the questions using the fewest words possible, so the researcher needed to do extra effort to pull out some ample answers from the coordinator/assigned mathematics teacher. The first question was: "Can you please describe your classroom?" The researcher wanted him/her to think of the classroom in terms of students and lesson plans. "I want to get an idea of how you design the lesson plans with the schoolteachers. Do you take the students into consideration while working on the lesson plan?" the researcher asked. The coordinator/assigned mathematics teacher's answer was that the schoolteachers took the students into consideration while preparing lesson plans: "The students are very important when it comes to the lesson plan along with the objective," the coordinator/assigned mathematics teacher said. She added that the strategy the schoolteachers she coordinated with used non-traditional strategies. They asked the students to work in groups more often. From the interview, it was clear that the coordinator/assigned

mathematics teacher believed that the constructivist teaching strategy and the non-traditional strategies were linked with group works and technology: "They are more non-traditional. We try to integrate more group work these days," she added. When asked about her opinion about student-centered strategy and the teacher-centered one, the coordinator/assigned mathematics teacher indicated that both were important and that one couldn't eliminate one from the learning process by saying,

> The teacher presence is very important. Learning does not occur without her presence. However, I am not saying that the students should be the center too. I believe a bit of each does not harm. The teacher should control the teaching situation and at the same time take the students into consideration. However, the schoolteachers should also be open and welcome new strategies and offers offered by the school to improve their teaching skills (see appendix 13 for details for transcription).

5- Saturn

a. Results of the observation of the Grade 4 mathematics class

Saturn, a private school located in the far Mount -Lebanon (ضواحي بيروت البعيدة المتن), has a total of 397 students distributed among 27 English sections in the primary, the elementary, the intermediate, and the secondary divisions. The primary has 3 sections and a total of 113 students, the elementary 1 and 2 have 170 students distributed among 6 sections, the intermediate division has 71 students distributed among 3 sections, and the secondary division has 43 students distributed among 4 sections. The school has 1 full-time (ملاك) administrator and 29 schoolteachers: 15 full-timers (ملاك) and 14 part-timers (متعاقد). Grade 4 class observed by the researcher had a total number of 22 students: 12 girls and 10 boys. On the 3rd of June, 2015, the researcher visited the school in order to observe a grade 4 mathematics class and conducted an interview with the mathematics class schoolteacher and the mathematics coordinator/assigned teacher. On the day of the observation, 3 students were absent. The researcher accompanied the mathematics schoolteachers into the class at 10:30 a.m. after the first recess. The teacher started the lesson by writing the objectives of the lesson in the corner of the board. She asked the students if they could still remember the difference between a fraction and decimal number. "Who can remind me of what is the

146

difference between a fraction and a decimal number?" she asked. Then, she started calling on some students who raised up their hands. After 7 minutes she asked them: "What can you say about those two numbers [5/10 and 0.5]?" The majority of students answered out loud that the two numbers were equal. She asked one student to justify his answer. After 15 - 20 minutes of discussion, the schoolteacher assigned an exercise from the book and asked the students to individually solve it in 5 minutes. After 5 minutes, she asked the two students sitting close to each other to work in pairs and compare their answers. Before leaving the class, she corrected the exercise by writing the solution on the board and she assigned homework by writing the page number on the board. When the bell rang, the researcher and the schoolteacher left the room to the coordination room where the interview was planned to be conducted.

b. Analysis of the rubric used while observing grade 4 mathematics class in Saturn school

The schoolteacher from Saturn school used traditional strategies even though she was aware that the students' points of view were windows into their reasoning. The schoolteacher showed several criteria that indicated non-traditional strategies. However, the schoolteacher did not have clear idea about constructivist teaching strategies. The schoolteacher allowed the students to find new ways to solve problems, and she also waited after posing questions in order to give time for students to answer. Yet this did not indicate her knowledge or openness to apply other strategies than the ones she used which shifted her from non-traditional schoolteacher to a traditional one considering the students as the center of the learning process (see appendix 13).

c. Results of the interview with the mathematics schoolteacher from Saturn
Analysis of the Interview with schoolteacher E from Saturn school

The first question was: "Can you please describe your classroom"? According to the respondent, while preparing lesson plans, the schoolteacher thought of the students and the objectives of the lesson. She tried to achieve the objectives of the lesson through engaging students in the learning process: "…When I prepare the lessons, I think of the student. In

addition to the students, I think of the objectives of the lesson and try to find the best way to let the students achieve it," she said. Moreover, she considered her classroom to be nontraditional; however, she made it clear though that the schoolteacher could not neglect the fact that lecturing the new concept was a must. The students should be taught first how to apply a new concept in order to be left alone for a while discovering ideas related to the new concept. She said, "My lessons are made up of both. I sometimes put the students to work collaboratively. Sometimes, I have to lecture to be able to teach them the new concept and then I ask them to apply it." The schoolteacher did not have a clear idea of the constructivist teaching strategy. She explained throughout the interview that she believed that constructivism might mean the students construct knowledge and learning but with the schoolteacher being the center and most important element in the classroom. She added,

> I am not sure what constructivist teaching strategy is, but I believe from its meaning it is based on constructing learning. So the first thing that comes to my mind is going step by step with the students while teaching them a new concept.

In addition to this, the schoolteacher made it clear that the administration and the coordinator/assigned mathematics teacher offered the assistance when the schoolteachers suggested a new strategy helping in promoting learning: "It depends on the materials needed for the strategy to be achieved. If it is within the budget, then why not? I can integrate technology into the classroom with no extra costs since there is data show in the classrooms," she said. From here, one can synthesize that the budget plays an important role for the teachers because with no proper equipment and facilities, they cannot implement a lot of new teaching skills. It was clear from the interview that the schoolteacher did not have knowledge of several teaching theories and that the schoolteacher was the main part of the learning process even though she believed in shifting from a traditional learning process to a nontraditional one (see appendix 13 for details for transcription).

6- **Mercury**

    a. **Results of the observation of the Grade 4 mathematics class**

Mercury, a private school located in Beirut, has a total of 351 students distributed among 18 English sections in the primary, the elementary, the intermediate, and the secondary divisions. The primary has a total of 66 students in 3 sections, the elementary 1 and 2 have 133 students in 6 sections, the intermediate division has 62 students in 3 sections, and the secondary division has 90 students distributed among 6 sections. The school has 1 full-time (ملاك) administrator and 6 part-time administrators. 31 schoolteachers teach in the school: 17 full-timers (ملاك) and 14 part-timers (متعاقد). Grade 4 class observed by the researcher had a total number of 21 students: 11 girls and 10 boys. On the 5th of June, 2015, the researcher visited the school in order to observe a grade 4 mathematics class and conducted an interview with the mathematics class schoolteacher and the mathematics coordinator/assigned teacher. On the day of the observation, 1 student was absent. The researcher met the mathematics schoolteachers in the class at 8:50 a.m. The schoolteacher started the lesson by having the students brainstorm what they had done previously in addition and subtraction lesson. Then, she drew on the board a triangle and added its angles degrees. At that point, she asked them to get four equations out of the three angles considering that the third was always missing. From the classroom discussion, she started writing on the board the students' suggestions. After the discussion, she started crossing out the incorrect suggestions [2+4 and 5+2] ending up with the four suggestion she was seeking to get [2+3, 3+2, 5+7, 7+5]. She wrote in huge handwriting the word FACT FAMILY, and she told the students that this was what we called a fact family. After 20 minutes, she gave them several angles and asked them to get the fact family of each group. Before leaving the class, she corrected the exercises by writing the solutions on the board, and she orally assigned homework for the upcoming class. When the bell rang, the researcher and the schoolteacher left the classroom to the coordination room where the interview was planned to be conducted.

b. **Analysis of the rubric used while observing grade 4 mathematics class in Mercury school**

The schoolteacher in Mercury school adopted a traditional strategy while teaching. She was lecturing almost all the time. The schoolteacher did not pose problems that allowed students to use prior knowledge to understand new ones. She was not aware that the students' points of view were windows into their reasoning. She did not adapt the curriculum to address the students' suppositions and development of new knowledge; however, she used different strategies to make sure students understood new concepts. For example, she drew a diagram on the board to explain again a concept taking into consideration that the student who asked the question might be visual (see appendix 13).

   c. **Results of the interview with the mathematics schoolteacher from Mercury**

Analysis of the Interview with schoolteacher F from Mercury school

The first question was: "Can you please describe your classroom?" According to the respondent, when preparing lesson plans, she took the students into consideration and tried to engage them in the learning process. "When I prepare the lessons, I think of the student and try to design a lesson where all the students get engaged. Of course I take into consideration also the objectives of the lesson taught," she said. The schoolteacher believed that her classroom was nontraditional. She allowed students to sit in groups almost all the time. The schoolteacher was not aware of several teaching theories. She had not heard of constructivist teaching theory and was not sure how it could be applied in the classrooms. However, she was aware of the behaviorist theory and that it encouraged reinforcement. She claimed, "…I know the behaviorist and the non-behaviorist. The behaviorists encourage reinforcement whereas the non-behaviorists don't encourage the reinforcement." When the researcher asked the schoolteacher whether the administration and the coordinator/assigned mathematics teacher were helpful and supported her new suggestions for new teaching strategy or not, she was clear that both were helpful. The coordinator/assigned mathematics teacher encouraged her to implement new ideas, but when it came to budget, she couldn't neglect the administration. She said, "The coordinator is very helpful. She tries her best to make our demands become true. However, sometime such things take time and need the

approval of the administration." Finally, the schoolteacher agreed that the students learned from their society and their friends; however, they couldn't build their own knowledge. The teacher's presence was very important and without the teacher, the students got lost and couldn't learn any new concept (see appendix 13 for details for transcription).

Analysis of the Interview with coordinator/assigned mathematics teacher F from Mercury school

The first question was: "Can you please describe your classroom? I want to think of the classroom in terms of students and lesson plans. I want to get an idea of how you design the lesson plans with the schoolteachers. Do you take the students into consideration while working on the lesson plan?" The coordinator/assigned mathematics teacher replied that the students and achieving the objectives of the lesson plan were vital. "The students are important; however, we cannot neglect the importance of other details in the lesson plan such as achieving the objective of the lesson," she said. Also, she believed that the classes she coordinated were mixture of both the traditional and the non-traditional strategies. It depended on the lesson's objectives. If application was required, then the schoolteacher used non-traditional strategies such as asking them to sit in groups. "The classes are mixtures of both. Sometimes the schoolteacher has to lecture in order to introduce a new equation for example and sometime she can ask the students to sit in groups in order to apply this particular equation," the coordinator/assigned mathematics teacher said. When asked about adapting the constructivist teaching strategy, the coordinator/assigned mathematics teacher indicated that the teachers asked the students to frequently sit in groups: "We do integrate a lot of group work into the learning process," the coordinator/assigned mathematics teacher believed, "it is important to learn new strategies, and it is important to apply non-traditional strategies; however, all of this requires training." She alleged that the schoolteacher was important as a facilitator and the main source of the new information introduced; however, she said, "the students also are important. This is why we cannot cancel the function of any of the two." The coordinator/assigned mathematics teacher wrapped up the interview by

welcoming any new request from the schoolteachers that would allow them to shift from traditional to non-traditional strategies (see appendix 13 for details for transcription).

4.3.   Extra participant (Star School)

After studying the findings of the dissertation, it became clear to the researcher that saturation did not occur and more investigation should be done in relation to the schoolteachers' perception to different teaching strategies. Thus, the researcher decided to conduct another field study and would stay in one school for a longer period of time where she could blend in the school's environment, gain the teacher's and administration's confidence, and study whether this would allow the schoolteacher to trust the researcher more and elaborate more during the interview. The researcher edited the research questions and added a fourth question to dissertation.

Since the actual study was conducted in Beirut and Mount Lebanon, the researcher decided to change the geographic location in order to study whether this might make the findings different from the obtained ones. The researcher called a semi-subsidized school located in the Bekaa plain and took permission to attend the school every Saturday for a period of 6 consecutive weeks. The researcher explained to the principal of the school the importance of the research she was conducting and the contribution to knowledge the research would add to the educational system in Lebanon. After getting the approval of the school's principal, the researcher spent 6 full days observing the grade 4 mathematics classes and trying to understand the system, the context, and the environment of the school. The same strategy used in the previous data collection was used to ensure reliability. The researcher filled a rubric in every class she attended and interviewed the schoolteacher after the last observation (week 6). The researcher wanted to gain the teacher's confidence in order for the schoolteacher to feel at ease and talk what she really believed without thinking of the consequences that might occur after the interview. The researcher made sure that neither the name of the school nor the name of the schoolteacher would be mentioned in the research and insisted on the issue of confidentiality as a protocol of the qualitative study.

4.3.1. School's context

The school where the extended study was conducted in was a semi-subsidized school where its student body came from a low economic status and were in dire need for financial and economic improvement. In fact, the school differed from the schools this dissertation was conducted. The students pay a quarter of the fees, which was around 300, 000 LL (around 200$), and the government paid the other 75% once a year, and this yearly payment was always paid to the school after 3 years. For example, in 2015, the government paid to the school the fees of 2012. It is also worth mentioning that some of the parents could not even pay the 25% fees. In other words, like all public schools, the school was funded by the government since it was a semi-subsidized school. As for the schoolteachers' qualification in the second cycle, 6 schoolteachers had a high school degree, and another 6 had a B.A. degree while the grade 4 mathematics schoolteacher had a B.A. degree in physics.

After discussing the schoolteachers' qualifications and situations with the principal, he explained that he schoolteachers in the school come from a traditional one since the students are taught in a very traditional way and that they needed a lot of training; however, due to budgeting reasons, nothing regarding this issue is being implemented.

The observation process was conducted every Saturday over a period of 6 weeks. After meeting with the principal of the school, the researcher spent every Saturday in the school trying to camouflage and blend in the school system in order to understand how the school system worked and how free the schoolteachers were when it came to decision making in the classrooms.

As for the classrooms' context, around 30 students studied in each section. The classes were not supported with rich material which helped the schoolteachers in developing lessons and allowed the students to have hands-on experiences. The schoolteachers relied mostly on the text books and workbooks. They did not use any materials which might enhance the learning process especially in the mathematics classes. Sometimes, posters that helped students link between concepts were hung on the classrooms' walls.

In the class the researcher was conducting the observations at, three students with learning difficulties were detected. However, the school did not have any specialist to work with such cases the schoolteachers were also not aware of such cases. Thus, the students were treated like other students and did not get any shadow schoolteacher or speech therapist to deal with their cases.

4.3.2. Method used to collect data in Star school

In Star school, similar steps were taken while collecting the data in order to keep the reliability of the dissertation. Only one further step was taken which was spending more time in the school in order to try to learn more about the school context and to gain the schoolteachers' confidence. Like the steps taken in the other six schools, the data collection was divided into three main steps. One extra step was conducted where the researcher spent more time in the school.

- Step 1: Observing the same grade 4 mathematics class every Saturday for a period of six weeks in a semi-subsidized school in Lebanon considered as a new a case study.

- Step 2: Spending valuable time in the school shadowing the schoolteachers to gain confidence and learn more about the school system.

- Step 3: Interviewing the schoolteacher teaching the observed class after the sixth observation.

- Step 4: Interviewing the mathematics coordinator of the grade 4 classes observed.

During the data analysis:

- Step 5: Triangulation method was adapted. The data from the seven classroom observations, schoolteacher interview, and coordinator were analyzed and common and uncommon data were also analyzed. This confirmed the research findings and reliability of the research.

While analyzing the data collected from Star school, the schoolteacher's way of teaching observed in each classroom was compared to her feedback during the

interview. Also, the schoolteachers' perceptions of constructivism learning theory were compared to those of the coordinators.

4.3.3. Summary of Methods used while collecting the data in Star school

Similar to the methods used while collecting the data in the six schools previously mentioned in this dissertation, the researcher adopted the observation and interview method in addition to being available in the school for a longer period of time.

The same observation procedure conducted earlier in the six schools was adopted in Star school (Referenced in chapter 3). As a summary, each observation was for around 50 minutes in which the mathematics schoolteacher explained a new concept or followed up a previous one. In the observed 6 classes, the researcher sat in a corner in the classroom where she could see the students and the schoolteachers, but without bothering them and being able to follow the interaction occurring between them. An observation rubric was filled out during each observation by the researcher (see appendix 6). The result was 6 observations rubrics. No additional data could be located from the previous observed six classes where satisfaction occurred, and the researcher thought that the data collection from observation should be stopped with the absence of any further useful data.

As for the interview method, like previously, before every interview, the researcher filled specific components which were the date, place, and name of interviewee to make sure she tackled every single record and explained for the interviewee that the interview would be recorded. In Star school, the principal did not mind recording the 20 minute interview without mentioning the name of the schoolteacher or school. The researcher referred to the questions from time to time to make sure the respondents covered all the intended objectives behind the interview. The researcher also posed after each question in order to give the interviewee a chance to answer, and she used a final "thank you" statement to acknowledge the time the interview was taken. As mentioned earlier, the researcher explained that confidentiality was secured.

The respondents had the chance to answer and express their ideas freely. As mentioned earlier under the ethics part, the researcher tried not to be biased and not to

interfere with the schoolteacher or coordinator/assigned mathematics teacher's opinion or interrupt them. However, she always had to guide the interview in order to stay on the right track, and after all, she had only 20 minutes to interview each of the coordinator/assigned mathematics teacher and the schoolteachers. Due to this tight time, the researcher had to jump sometimes to other issues trying to lead the interview to a different question. Of course, the schoolteachers and the coordinator/assigned mathematics teacher were always in a hurry, and each interview followed the observation directly on the first recess or in their free period. Since it was their free time, this made them feel tired and wanted to finish quickly. However, in two private schools, this was not the case. The researcher had the chance to interview the schoolteachers and the coordinator/assigned mathematics teacher during the coordinating hour they had on the last observation day which made the job done easier. Other than that, the interviews went smoothly and the objective behind them was accomplished. The schoolteachers freely elaborated and stressed on some issues they faced while designing their daily lesson plans. Some of these issues were the interference of the coordinator/assigned mathematics teacher or some facilities the school did not supply them with especially after the researcher gained the teacher's trust. The interview guide that the researcher used previously in other interviews was useful where she referred too more often (see appendix 16 for transcription of the interview).

The following section of this chapter will summarize the data collected from Star school.

4.3.4. Findings from Individual Cases in Star School (see appendix 15 for details)

The same procedure followed to collect the data for the 6 schools was followed in order to collect the data for Star school. Also, the researcher had a rubric (see appendix 6) that she used while observing which helped her identify what she wanted to observe in order not to be subjective and lose focus or forget details after six weeks. Also, another worth-mentioning reminder was that the purpose of the class observations was not the mathematics content being taught, but the way the schoolteacher taught it and how well the strategy went

with the given objectives. However, unlike in the previous schools, the researcher was given the grant to record the interview under one condition which was keeping both the school's and the teacher's identity anonymous.

4.3.4.1. Results of the six observations conducted in the Grade 4 mathematics class in Star school

a. Report on the observation of the grade 4 math class.

Star, a public school located in Bekaa, has a total of 309 students in the elementary cycle distributed among 10 sections. The elementary cycle has 2 full-time (مالك) administrators and 12 schoolteachers teaching in cycle 2: 8 full-timers (مالك) and 2 part-timers (متعاقد). Grade 4 class observed by the researcher has 30 students: 17 girls and 13 boys. The researcher accompanied the mathematics schoolteachers into each of the six classes every Saturday at 8:50 am. The researcher sat on a chair at the back of the classroom in a position that allowed her to see both the schoolteacher and the students easily without having to move around. The schoolteacher saluted the students every time she entered the class. The first day, the researcher had the chance to present herself to the students since she would be present every Saturday for six weeks. As a summary, the schoolteacher started the lessons by trying to let the students recall the previous lessons. She emphasized on classroom management and on the students' behavior especially the first couple of times the researcher was observing the class. The schoolteacher at first was aware of the researcher's presence in the school and that was why she was using a very 'elegant' language with the students such as "if you please…" and allowed them to participate. However, later on, the schoolteacher got used to the researcher's presence and started behaving differently with the students when she started shouting more often and more misbehavior cases were detected.

The schoolteacher started every lesson by asking the students to recall information/knowledge gained from previous lessons and then she turned towards the board and wrote on it while telling the students the objectives of the lesson (every session had different specific objectives). She used terms such as "let us *discuss*.." and "what do you *know*.." She used the board almost all the time. During the six observed sessions, the

schoolteacher grouped the students and asked them to solve problems from the book, and then she gave them solutions on the board. She was code switching between English and Arabic almost all the time. Every time, after she finished explaining a new concept, she asked the students to copy on their copybooks the information written on the board, so they could review them at home. The given problems were an application of what was explained during the lesson where the students had to solve equations or problems based on what they previously learned. Every session, the schoolteacher asked the students to stop working and she assigned homework for the coming day.

b. Analysis of the rubrics used while observing grade 4 mathematics class in Star school

The schoolteacher from Star school showed more traditional teaching strategies than non-traditional ones. She only used the book and copybook in her teaching strategy. Her teaching skills did not show any adoption to the constructivist teaching strategy or any other teaching strategy. She focused more on transmitting new concept via lecture rather than trying to elicit from the students' background knowledge and build on them. All of the 6 filled rubrics indicated that the schoolteacher adapted very basic teaching skills. As a summary of the six rubrics, 7 teaching criteria adopted by the schoolteacher showed that the schoolteacher engaged the students with the learning process; whereas, 10 criteria showed that the schoolteacher followed a traditional strategy where she did not allow the students responses to drive the lessons, shift instructional strategies, and other content (see appendix 15).

c. Results of the interview with the mathematics schoolteacher and coordinator/assigned mathematics teacher from Star school

The researcher filled specific components to make sure not to waste time during the interview. The fact that the researcher was given the permission to record the interviews simplified the process and allowed the researcher to be engaged more in the discussion. The schoolteacher in Star school happened to be the mathematics coordinator/assigned mathematics teacher in cycle 2. The researcher started the interview by asking the question

"can you please describe your classroom?" As the interview proceeded, the researcher used the interview guide.

Analysis of the Interview with teacher/coordinator S from Star school

The first question was: "Can you please describe your classroom?" According to the respondent, her classroom was a mixture of students with different academic abilities. The students came from a culture that prohibited freedom of thought. Their parents were illiterate, which according to the schoolteacher affected the students' ability to study. The teacher said: "They come from a culture that prohibits freedom of thought. Their parents are illiterate. This is why it affects the students' ability to study." The schoolteacher explained that she tried to use different teaching strategies, but the school environment did not help her to that the background the students came from did not allow her to trust them and act freely in the class. The schoolteacher showed clearly that she knew that there were two ways of teaching: The traditional and the non-traditional: "A traditional classroom is when the schoolteachers only lecture. A non-traditional classroom is when the schoolteacher integrates computer or group work for instance…So if I ask my students to solve a problem for example then I will be teaching in a non-traditional way" the teacher said.

However, the schoolteacher did not believe that students had prior knowledge that they could build on. The only prior knowledge that they could have should be gained from a previous lesson taught by the teacher: "I am not aware of the word constructivism. I usually reinforce the students' good behavior and good learning. When I explain a new lesson, I expect from the students to solve the problems correctly." The schoolteacher wrapped up the interview by clarifying that students should always have a helping hand since they did not come with full knowledge. They might have some prior ones; however, they needed a helping hand to acquire all the new knowledge taught; especially in societies where the parents do not help or interfere in the learning process. Moreover, the schoolteacher clarified that schoolteacher needed teaching training in order to be updated with the learning strategies, especially that some of them have been teaching for long period of time.

159

The schoolteachers were not qualified to teach children of the age group. Some of them needed to be trained on how to deal with the children and how to use different strategies. "طرق التدريس بصصد التطور لازم نتدرب عليها You know that some schoolteachers have been here forever. Some of them have been teaching for 15 or 20 years" the teacher said. Basically, it was obvious from the conversation that the teacher's conception on different teaching strategies was limited to the class size and the group work on tasks and sharing answers (see appendix 15 for transcription of the interview).

4.3.5. Saturation

Since no relevant difference has been detected from the extra six observed sessions of a grade 4 mathematics class, the researcher, especially after getting to this conclusion and analyzing both the observation and interview conducted previously in Mercury school, concludes that saturation occurs. Flick (1998) said, "Saturation means that no additional data are being found whereby the sociologist can develop properties of the category" (p. 66).

4.4.   Analyzes of all the seven schools along with the variables chosen for this dissertation

As mentioned earlier, in a case study, the participants' size could not be large and this was why the researcher chose 6 schools to start with and if saturation did not occur, the researcher then proceeded with the study with an additional case study. In the case of this dissertation, after the interview with the last schoolteacher from the last school, the researcher was not learning any new information that might add any benefit tip to the data of the study. That was why the researcher had to stop collecting data after the 7th interview that was conducted with the schoolteacher and coordinator/assigned mathematics teacher of Star School. The result was 7 interviews with each of the 7 coordinator/assigned mathematics teacher and observed mathematics schoolteachers. In the first two observed classes and conducted interviews, the researcher observed a slight difference, but after the 3rd observation and interview in both sectors, no additional data could be located where saturation occurred and the researcher thought that the data collected from observation should be stopped with the absence of any further useful data. However, even though

saturation occurred, the researcher insisted on doing further research by following the same methods in a public school located in the Bekaa plain (Details in the previous chapter and analysis is available in the next section of this chapter).

To begin with cross-site analyses of the observations of the 7 grade 4 classes, all the schoolteachers in the observed classes indicated commitment to the classical/non-constructivist teaching strategy in one way or another. Even though some tried to put the students to work in pairs; however, they did not apply the cooperative work intending to construct on the students prior knowledge. They did not believe in the way they were communicating with the students that they could use prior knowledge on their own and build on them. They were in one way or another following the behaviorist teaching strategy where they used a lot of reinforcement phrases such as "very good! I will give a bonus grade for your correct answer." The 7 observed classes indicated that the 7 teaching strategies used by the schoolteacher were traditional. All the schoolteachers were lecturing almost all the time. Thus, going back to the role of the schoolteacher in the theory of the didactics situation, the used schoolteachers' strategies did not match a lot of characteristics. For example, in the TDS, the schoolteacher did not have to show the students from the beginning how to solve problems, but let them deal with these problem; however, from the cross analysis, we could synthesize that the schoolteacher was playing a very big role in providing the students with the answers. This step should occur only in the fundamental situation of the TDS. Nevertheless, in the case of the observed teacher's adopted strategies, the schoolteacher was not alert by what was said in the acting situations that were occurring in order to explicit topics from them for discussion. For example, when the schoolteachers gave the students an exercise to solve, the knowledge behind that exercise was already discussed with the students. The purpose of the exercise was only to apply what was taught by the schoolteacher rather than following the four situations of the TDS. The schoolteacher did not pose problems that allowed students to use prior knowledge to understand new ones. She was not aware that the students' points of view were windows into their reasoning. She did not adapt the curriculum to address the students' suppositions and development of new

knowledge. The schoolteachers did not have clear idea about constructivist teaching strategies which were reflected in their teaching and later on throughout the interview conducted with each of them.

4.5.   Cross sectional analysis of the 7 interviews conducted with the schoolteachers and the coordinator/assigned mathematics teachers.

The cross sectional analysis of the 7 interviews conducted with the schoolteachers and the coordinators/assigned mathematics teachers indicated that the schoolteachers elaborated freely and stressed on some issues they faced while designing their daily lesson plans. These issues were the interference of the coordinators/assigned mathematics teachers or some lack of facilities and supplies. Almost all of the schoolteachers agreed that they were not familiar with the constructivist teaching strategy. However, they agreed that they knew the difference between traditional and non-traditional teaching. Moreover, they agreed that the schoolteacher was very important in the learning process and was the center of the teaching process. However, they approved that the classrooms should be designed in a student-centered strategy. The schoolteachers decided that they had to build an environment that would help students learn a specific learning by the end of every activity; however, they couldn't do it on their own. The schoolteacher could control the situations and every change that might occur. The schoolteacher's role was to control all the learning process to comply with deadlines. They all agreed that the students learn from society and that they might get some of these previous learned things to the classrooms, but they could not build on them or expand them except with the help of the teacher.

As for the coordinators/assigned mathematics teachers, it is worth-mentioning that the coordinators' responses, in general, were short. They, unexpectedly, were not as supportive as the schoolteachers. The assigned mathematics teachers from the public schools were more conservative in their answers and were not open to integrate new ideas into their teaching strategies. They answered the questions very briefly. Therefore, the researcher needed to do extra effort to pull out some answers from them. Noteworthy, all the assigned mathematics teachers in the public schools almost agreed that their teaching strategies were

162

a mixture of non-traditional and traditional ones depending on the purpose of the taught lessons. Also, they all agreed that asking the students to work in groups was a non-traditional strategy while to others, it was considered a constructivist teaching strategy. Even though it was clear from the interviews with the coordinators/assigned mathematics teachers that they were unfamiliar with the constructivist teaching strategy, they welcomed the idea of training the schoolteachers to use different strategies in order to shift to the non-traditional teaching strategies. Moreover, it was clear that the coordinators/assigned mathematics teachers believed that the constructivist teaching strategy and the non-traditional strategies were linked with group work and technology. When the coordinators/assigned mathematics teachers were asked about their opinion about student-center strategy and the teacher-center strategy, they indicated that both are essential and that one could not be eliminated from the learning process. They agreed that without the teacher, learning does not occur. The schoolteacher should control the teaching situation and take the students into consideration as well. According to the coordinators/assigned mathematics teachers, the schoolteachers should also be open and welcome new strategies offered by the school to improve their teaching skills.

4.6. Findings

This section presents and analyzes the general findings in all the seven selected schools for the dissertation. Emerging themes and sightings made will be emphasized throughout the discussion.

4.6.1. Cross-case study analysis using the triangulation method

Thirteen participants were interviewed about their conception of different learning and teaching strategies especially the constructivist teaching one. Six grade 4 mathematics classes were observed once and 1 grade 4 mathematics class was observed 6 times. One rubric was filled out during every observation. Each of the rubrics and each question prepared in the interview guide studied the variables considered in this dissertation.

In this dissertation, multiple sources of evidence were used. As mentioned in the previous chapter, using several sources of evidence was a major strength for any case study

(Yin, 2003). Thus, in this dissertation, the researcher conducted the research in several schools in Lebanon where each grade 4 class was a case study by itself. The first source of evidence was the observation where the researcher observed the schoolteachers' teaching strategies. The second source of evidence was the interviews where the researcher interviewed the grade 4 class schoolteachers. The third source of evidence was the interviews with the grade 4 mathematics coordinators/assigned mathematics teachers. The triangulation method was adapted, and that helped the researcher answer the research questions of this dissertation.

The data collected from the interviews were manually coded and categorized. The researcher started analyzing the interviews from each schoolteacher and coordinator/assigned mathematics teacher. Transcriptions from the field notes in separate schools were thoroughly studied, and chunks of coded sections were grouped. Thus, the researcher coded all the common characteristics observed in the interview from each of the schoolteachers and coordinators/assigned mathematics teachers.

a- **Codes from the schoolteachers' interview data**

	Earth	Mars	Venus	Jupiter	Saturn	Mercury
*NFCTA	/	/	/		/	/
**DTNTT	/	/	/	/	/	/
***TC	/	/	/		/	/
****SCA	/	/		/	/	/
*****SLS		/	/	/		
******SPLI		/	/	/		

*Not familiar with the constructivist teaching strategy (NFCTS): 5 schoolteachers

**Know the difference between traditional and non-traditional teaching (DTNTT): 6 schoolteachers

***Teacher center (TC): 4 schoolteachers

****Student-centered strategy (SCS): 5 schoolteachers

*****Students learn from the society (SLS): 3 schoolteachers

******Students get previous learned information to the classrooms (SPLI): 3 schoolteachers

b- Codes from the coordinators/assigned mathematics teachers' interview data

	Earth	Mars	Venus	Jupiter	Saturn	Mercury
*NFCTA	/	/	/		/	/
**DTNTT	/	/	/	/	/	/
***TT	/	/	/	/	/	
****TC	/	/	/	/	/	/
*****SCA	/	/	/	/	/	/
******GW	/	/	/	/	/	
*******SDLS	/	/	/		/	/

*Not familiar with the constructivist teaching strategy (NFCTS) 5 coordinators

**Know the difference between traditional and non-traditional teaching (DTNTT) 6 coordinators

***Teacher training (TT) 5 coordinators

****Teacher center (TC) 6 coordinators

*****Student-centered strategy (SCS) 6 coordinators

******Group Work (GW) 6 coordinators

*******Students don't learn from the society (SDLS) 5 coordinators

The data collected from the three sources of evidence showed consistency. Data collected from each of the observation matched the data collected from each of the interviews with the schoolteachers who taught the class. Their responses to the questions asking about adapting a non-traditional strategy versus traditional strategy were reflected in the strategy they used while teaching. The results from the observations and interviews

165

showed that the schoolteachers and coordinators/assigned mathematics teachers knew the difference between traditional and non-traditional teaching. Even though the schoolteachers agreed in their responses to the question related to considering the student as the center of the learning process along with the schoolteacher during the interviews, they did not reflect that in their teaching. It was not observed that the schoolteacher gave a lot of importance for the students' background information. It was learned from the observations of the 7 grade 4 mathematics classes that the aim of the teaching was to deliver the content and to have students apply it in a passive way even though almost all of them agreed in the conducted interviews that the students learned from the society, and they might bring some of these previous learned things to the classrooms.

Moreover, the schoolteachers' perceptions of constructivist teaching theory were compared to those of the coordinators/assigned mathematics teachers. As a translator of the "schoolteachers' words and actions" (Corbin & Strauss, 2008, p. 48), the researcher's comprehension of the events related to the interview revealed harmony of responses. The coordinators/assigned mathematics teachers agreed with the schoolteachers' responses in relation to teaching strategies and that the classes they prepared were a mixture of non-traditional and traditional ones. Choosing the strategy depended on the purpose of the taught lesson. They also all agreed that asking the students to work in groups was a non-traditional strategy, and some classified it under constructivist teaching strategy. Even though it was clear from the interviews with both the coordinators/assigned mathematics teachers and the schoolteachers that they were not familiar with the constructivist teaching strategy, training the schoolteachers to use different strategies was beneficial in order to shift to the non-traditional teaching strategies. Moreover, both the schoolteachers from almost the seven schools and the coordinators/assigned mathematics teachers too agreed that the constructivist teaching strategy and the non-traditional strategies were linked with group works and technology. It was clear from the schoolteachers' and coordinators/assigned mathematics teachers' responses that both agreed that the schoolteachers and the students were important in the learning process and completed each other. They settled that the

schoolteacher's presence was very vital and that learning did not occur without the schoolteachers' presence. The schoolteacher should control the teaching situation and at the same time take the students into consideration.

4.7.   Summary

This chapter presented the findings of the data collected from this dissertation and the analysis of each. It was divided into two main parts. The first part presented and analyzed the findings in each school separately, and the second part presented and analyzed the 7 schools selected along the variables chosen for this dissertation: schoolteachers' and coordinators' perception of traditional versus non-traditional classrooms, schoolteachers' and coordinators' perception of different learning theories and their effect on enhancing teaching mathematics, and coordinators' views of problems that might lie under curriculum reforms.

Chapter 5

Discussion of Findings

5.1. Overview of Previous Chapters

The purpose of this dissertation was to identify the mathematics classroom environment as excerpted from fieldwork, to examine the schoolteachers' knowledge of different constructivist theories, and to suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study.

Chapter one reviewed the mathematics curriculum and the strategies used in teaching in some selected private and public schools in Lebanon upon which this dissertation was conducted. The information gathered for this dissertation came from several sources such as the TIMSS results, books, journal articles, legislative decrees, interviews, and other relevant documents. Chapter two presented the theoretical framework of the dissertation and reviewed pertinent literature on the constructivist teaching strategy particularly how it was related to mathematics curriculum, the ways it saw students in classrooms, and the ways the schoolteachers were expected to deal with this strategy. It also reviewed literature from Lebanese context. There was not much research concerning the purpose of this dissertation; however, there were some reports and studies concerning the development of the new curricula and its importance as a whole. The information for that chapter was basically taken from LAES (2006; 2010), Nahas (1999; 2005; 2010), Melhem (2010), and from an interview done with Nahas (2014). Chapter 3 discussed the design of the dissertation and its operational field measures. In addition, it described the procedures that were followed in order to analyze the data obtained from interviews and observations. Chapter 4 was dedicated to the findings of the dissertation. It was divided into two main parts: the first part presented and analyzed the findings in each school separately and the second part presented and analyzed the selected schools along with the variables chosen for this dissertation: Schoolteachers' and coordinators' perception of traditional versus non-

traditional classrooms, schoolteachers' and coordinators' perception of different learning theories, and their effect on enhancing teaching Mathematics, and coordinators' views of problems that might lie under the curriculum reforms.

In this chapter, the findings from the schoolteachers' interviews, the findings from the coordinators/assigned mathematics teachers' interviews, and the findings from the conducted observations will be discussed with special focus on the theories overarching the conceptual framework of the current dissertation with occasional reference to the constructivist learning theories advocated by Piaget (1969-1975), Vygotsky (1978), and Brousseau (1997). The extent to which the findings congregated or departed from these theories and models will also be examined.

The chapter is outlined as follows:

- discussion of the findings;
- conclusion.

5.2. Discussion of the findings

The discussion of the findings will be presented according to the research questions of the dissertation presented in chapter 4.

Research question 1: How do grade 4 schoolteachers associate constructivism with their teaching of mathematics?

The observations and interviews showed that the schoolteachers and coordinators/assigned mathematics teachers knew the difference between traditional and non-traditional teaching. It was clear that the participants considered the schoolteacher the most important factor in the learning process and that he/she was the focal point in the teaching process. However, the researcher did not observe what the schoolteachers agreed upon. Schoolteachers believed that they were the center of the learning process. Schoolteachers did not give importance to the students' background information. The

analysis of the interviews indicated that both, the teachers and the students have prepared lessons that were a mixture of non-traditional and traditional ones depending on the purpose of the taught lesson. Moreover, the coordinators/assigned mathematics teachers and the schoolteachers were not familiar with the constructivist teaching strategy. The findings showed that some of them agreed on the benefits of training the schoolteachers on how to use different strategies in order to shift to the non-traditional teaching strategies.

Visiting the review of this dissertation, Grady et al. (n.d.) argued that theorists had not been able to come up with one particular teaching strategy that should be adapted in order to promote learning. As discussed in the findings of the dissertation, all the schoolteachers observed in the classes indicated commitment to the traditional learning strategy in one way or another. Even though some tried to put the students to work in pairs, they did not apply the cooperation work intending to construct on the students prior knowledge. This finding did not go in line with what was said by the teachers and coordinators/assigned mathematics teachers when asked about the strategies they used while teaching. They did not believe that the students could use prior knowledge on their own and build on them. They were in one way or another following the behaviorist teaching strategy. From the observations, it was detected that the schoolteachers almost did not pose problems that allowed students to use prior knowledge to understand new ones. The schoolteachers were not attentive that the students' prior knowledge leads them into reasoning. In general, the schoolteachers did not have clear ideas about constructivist teaching strategies which was reflected in their teaching strategy. In addition, based on the findings of the dissertation, almost all the schoolteachers agreed that they were not familiar with the constructivist teaching strategy. However, they agreed that they knew the difference between traditional and non-traditional teaching. As for the coordinators/assigned mathematics teachers, they agreed that their teaching strategies were a mixture of non-traditional and traditional ones. It depended on the purpose of the taught lesson. They also agreed that asking the students to work in groups was a non-traditional strategy, and some assigned it under constructivist teaching strategy.

Both, coordinators/assigned mathematics teachers and teachers, welcomed the idea that training the schoolteachers is effective in order to use different strategies and in order to shift to the non-traditional teaching strategies. The coordinators/assigned mathematics teachers believed that the constructivist teaching strategy and the non-traditional strategies were linked to group works and technology. According to the coordinators/assigned mathematics teachers, the schoolteachers should also be open to and welcome new strategies and suggestions offered by the school to improve their teaching skills. It was discussed in the theoretical framework of the dissertation that Piaget (1954, 1973) and Vygotsky (1978) helped us understand that learners came to school with ideas and previous knowledge that could be blended within the environment. Researchers (Franke & Grows, 1997; Enck, 2011) suggested that children should be told new information in order to understand new ideas and knowledge. They believed that children construct their own learning. Teachers only helped students develop a right way in order to achieve this. This was not obvious in the finding of the dissertation. As educators, we always argue and hear others assert that in order for children to learn, they should be engaged in the learning process. Theories of cognitive science point out the importance of having children undergo the thinking process in order to interact and gain new knowledge and be able to later on remember what they have learned and apply it in the correct context. However, from the observations and interviews conducted in this dissertation, schoolteachers and coordinators/assigned mathematics teachers did not show full awareness of this fact. The finding showed that the schoolteacher was the center of the teaching process. However, when interviewed, they agreed that the classrooms should be designed in a student-centered strategy.

Students learn from society, and they might get some of these previously learned concepts to the classrooms, but they won't be able to build on them or expand them except with the help of the teacher. Moreover, literature regarding the relationship between constructivism and the students' learning synthesis emphasizes that students use what they

know in order to learn new material. As students constructed their knowledge, the schoolteacher coached them in order to help them build on the previous knowledge by 'constructing mental scaffolding' in class to build new knowledge. However, this was not clearly noticed in the observed classes. They both believed that the teacher's presence in the classroom was very important. Learning did not occur without her presence. The schoolteacher should control the teaching process and at the same time take the students into consideration.

In addition to that, the literature regarding the relation between the constructivist strategies and the schoolteachers argued that the classrooms today have advanced and were no more a copy of the traditional classrooms where the learning was teacher-centered and where the schoolteacher was responsible to transmit information. On the contrary, classrooms today are more active and are student-centered where the student is involved in the process of understanding new information. According to researchers (Cobb, Yackel, & Wood, 1992; Novak & Gowin, 1984; Moore, 2009), learning in constructivist vision was active where the learning-teaching process was interactive in nature and needed negotiation of mathematics and other subject matter meaning. There were differences between the way knowledge was understood from both traditional and constructivist teaching strategies. It was essential to understand the teacher's constructivist role in education which is made up of creating, synthesizing, and interpreting information. It was also important to understand that the schoolteacher should act as a facilitator while using strategies other than the traditional one such as constructivist strategy. The constructivist strategy is a good way to engage students in reliable meaningful experiences and it encourages the participation of students having difficulties in studying. This was not clearly shown in the findings of the dissertation even though Oliva (2009) argued that a schoolteacher who facilitated learning and led class to a more student-centered, friendly, and relaxed environment followed a teaching skill that helped students build their knowledge. The schoolteachers and the coordinators/assigned mathematics teachers observed and interviewed in this dissertation agreed that the students were essential in the learning process. However, the teaching

Faculty of Educational Sciences

process could not be completed without the schoolteachers. The schoolteachers were the center of the teaching process, and both the students and the schoolteachers complemented each other in the learning process.

Research question 2: How can observation data yielded from fieldwork be used in identifying grade 4 mathematics teaching environment?

To answer research question 2, each criterion from the observation rubric was analyzed. The teaching strategies of each observed teacher were classified under either of tradition or constructivist. From the findings of the dissertation, several data yielded from the fieldwork helped in identifying grade 4 mathematics teaching environment.

The observed teachers' teaching strategies in the selected schools indicated that schoolteachers did not rely on the students' prior knowledge. They delivered passively new information to the students, and in order to practice the new explained knowledge, they relied on that strategy to make the students apply it individually without the help of their classmates. It was learned from the observations of the 7 grade 4 mathematics classes that the aim of the teaching was to deliver the content and let the students apply it in a passive way. Visiting the review of this dissertation detailed in chapter 2, the TDS emphasized on the idea that the teacher's role was to arrange situations to discover knowledge and then depersonalize it (Radford, 2008; Manno, 2005). The schoolteachers were only satisfied in giving the students the tools they needed and provided conditions that reproduce new knowledge as Brousseau argued, but they were in control of every knowledge the students were gaining since they were the only source of it. However, the role of the schoolteacher according to the TDS did not go in line with the findings of this dissertation. For example, as discussed by researchers, the theory of Brousseau (1997) argued that the role of the schoolteacher was not to show students how to solve problems, but to let them deal with these problems. The teacher's role was rather to find out the problems or situations that would be given to the students. However, this was not the case of the finding of the dissertation. In the observed classes, the schoolteacher was providing the students with

answers, and the purpose of the solved problems was to practice and not to elicit new words that might open new discussion that led to new knowledge. As mentioned in the review of this study (Radford, 2008; Manno, 2005), the role of the schoolteacher was to be responsible of the accomplished results, to provide students with all the necessary factors to learn and gain knowledge, and to build an environment that helps the students learn a specific learning outcome by the end of every activity. The schoolteacher role here was to make possible changes and connect them from knowledge that came from research to the 'knowledge taught' and to the knowledge that had been taught. The schoolteacher adopted re-conceptualization and a re-personalization of knowledge, and she looked for situations which could give meaning to the knowledge to be taught. The literature argues that schoolteachers and students are considered in the constructivist teaching strategy as active meaning-makers who continually gave contextually based meaning to each other's words and actions as they cooperated. Researchers explain that the schoolteachers use the curriculum to help the students build mathematical understanding. Different schoolteachers could use the same curricula and filter them differently depending on their way of constructivist thinking. In addition, the curricula could play a role in helping the schoolteachers decide on what the students needed, and another role could be in providing activities and problems that helped the students understand new mathematical concepts. However, this was not shown from the observations conducted in grade 4 classes. The literature on the relationship between the constructivism and the students' learning suggests that students use what they know in order to learn new material. The schoolteacher coaches the students as they construct their knowledge and helps them build on previous ones (Enck, 2011).

Research question 3: How would pedagogical models yielded from fieldwork inform mathematics teaching in the Lebanese elementary cycle?

To answer research question 3, several pedagogical models yielded from fieldwork were verified by observations and also by interviews. Research question 3 and the first objective of this research are related. Thus, a part will be answered in this section of chapter 5 and another one in chapter 6. The findings of this dissertation informed mathematics teaching in the Lebanese Elementary Cycle where no clear pedagogical models were excerpted from the observations and the interviews. Teachers followed the traditional teaching strategy and the applications to solve problems probably for examinations but not for constructivist learning purpose per se. From the rubrics used for the class observation, it became clear that teachers did not seem to have an overarching teaching philosophy that accented constructivism. As alluded to earlier, teachers did not show eagerness to integrate motivating tools that promoted the students learning such as technology use. The reason could be the lack of training, lack of motivation, lack of facilities such as LCD projectors and state-of-the- art technology, lack of proper qualification, and/or negative attitude towards the system. The findings of this research identified several needs the teachers demanded while being interviewed. Teachers and coordinators/assigned mathematics teachers agreed that their schools required facilities which deprived them from enhancing their teaching strategies, skills, and motivation. Several of these reasons helped in identifying the indicators to enhance the mathematics teaching in Lebanon which will be discussed later in chapter 6 of this dissertation. Although schoolteachers' interviews were cognizant of the potential benefits of technology in facilitating teaching and learning, yet their conception of technology as a panacea for the shortcomings of learning by rote attests to lack of breadth about the role of the teacher in directing technology, for according to Biggs (1993), the tail does not wag the dog.

Research question 4: How does the role of a researcher as a qualitative tool participate in identifying mathematics teaching in the elementary cycle?

Based on the findings of the dissertation discussed in chapter 4, it became clear to the researcher that saturation discussed in chapter 3 did not occur and more investigation was needed in order to further probe into the research questions in relation to research question 1 concerned with schoolteachers' associating constructivism with their teaching of mathematics. Thus, after the researcher conducted another field study in one school in the Bekaa plain (Star School) and stayed there for longer periods of time where she mingled and interacted with schoolteachers and administrators, interview and several observation results replicated those obtained from other schools. In other words, the idea of spending more time in schools for data gathering had not resulted in generating different results. The schoolteacher from Star school showed more traditional teaching strategies than non-traditional ones. She only used the book and copybook in her teaching strategies. Her teaching skills did not show any adoption to the constructivist teaching strategy or any other teaching strategy. She focused more on transmitting the new concept via lecture rather than trying to elicit from the students' background knowledge and build on them. All of the filled 7 rubrics indicated that the schoolteacher adapted very basic teaching skills. Every time the researcher started a new observation, she expected that the schoolteacher felt more comfortable and would start cooperating more with the students. It was expected that the role of schoolteacher became more as a facilitator; however, the same results as the 7 previously observed schools were obtained. 7 teaching criteria adopted by the schoolteacher showed that the schoolteacher engaged the students with the learning process whereas 10 teaching criteria showed that the schoolteacher followed a traditional strategy where she did not allow the students' responses to drive the lessons, shift instructional strategies, and other content, and this does not go in line with the review of this dissertation and does not reproduce the theory of Brousseau. From the conducted interviews, the findings showed that the schoolteacher believed that the students had no prior knowledge to build new ones. She/he is the only source of new knowledge and the only prior knowledge that they could have should be gained from a previous lesson. The teacher's conception on different teaching strategies was limited to the class size and putting the students in groups to work

Faculty of Educational Sciences

on one task and share answers. This did not go in line with Franke and Grows (1997); Novak and Gowin (1984); Moore (2009); and Oliva (2009) who discussed that classrooms today stepped forward and were no more just a copy of the traditional classrooms where the learning was teacher-centered and where the schoolteacher was responsible to transform the information. On the contrary, classrooms were now more active and student-centered where the student was involved in the process of understanding new information.

As a summary, the following points related to this research question are discussed in the findings chapter of this dissertation:

- The researcher observed the same grade 4 mathematics class every Saturday for a period of six weeks for 30 minutes.
- The researcher spent valuable time in the school shadowing the schoolteachers to gain confidence and learn more about the school system
- The researcher interviewed the schoolteacher after the sixth observation.
- The researcher interviewed the mathematics coordinators/assigned mathematics teachers.
- Triangulation method was adapted.
- The schoolteachers' perceptions of constructivism learning theory were compared to those of the coordinators/assigned mathematics teachers.

To wrap it up, the researcher was more of an observer rather than an actor in the previous schools but assumed a more engaging role in the last one, Star, to further gain more rapport from schoolteachers. The observer/actor shift approach has not resulted in gathering new observations and data, and saturation was maintained.

5.3. Patterns detected from the findings of the dissertations in relation to each theory of the theoretical framework

5.3.1. Constructivist teaching theory

While answering the research questions of this dissertation, several patterns got detected from the interviews conducted with the schoolteachers and the coordinators/assigned mathematics teachers and from the classroom observations which

deficit the Theory of Constructivism Teaching discussed in chapter 2 of this dissertation. To explain, the constructivism teaching theory stresses on several variables that informed this dissertation. In order to be able to relate them to the findings of the research questions, it is worth going over how both variables and the objectives behind each research question are related. The variables are related to the first two objectives of this dissertation which are to identify the mathematics classroom environment as excerpted from fieldwork and to examine the schoolteachers' knowledge of different constructivist theories. As a summary, the patterns that got identified while answering the research questions are:

- Learning is based on teacher-centered strategy;
- Students build on previous background to construct new ones;
- Knowledge is perceived only if the person is ready to acquire it.
- The observed learning was more passive than active and practical;
- Schoolteachers helped the learners by providing them with suitable background in order for the conceptual change to occur;
- Schoolteachers believed that they were the center of the learning process.
- Schoolteachers did not give a lot of importance to the students' background information;
- Schoolteachers did not believe that the students could use prior knowledge on their own and build on them;
- Schoolteachers almost did not pose problems that allowed students to use prior knowledge to understand new ones;
- They were not aware that the students' points of view were windows into their reasoning. In general, the schoolteachers did not have a clear idea about constructivist teaching strategies, and that was reflected in their teaching strategy.

As a summary, the identified patterns deficit the variables of the theory of constructivism teaching. The new constructivist teaching strategies have shifted the understanding of the learning process to radical conception where learners use the fresh

ideas they get with them to the classroom and share them with their classmates. The learners, in the constructivism education theories, do not only receive information passively, but they are also engaged in the learning process and create their new knowledge based on prior ones in relation with new experiences. In constructivist teaching, knowledge shouldn't be inserted in the learners' mind, but constructed through experiences and activities. Here, the schoolteachers should encourage higher – level thinking where learners are encouraged to summarize concepts by analyzing, predicting, justifying, and defending their ideas. In order for teaching to be classified under constructivist theory, it should follow several characteristics according to McGregor (2007) which were not reflected in the case of this dissertation. Schoolteachers should expect particular types of cognitive activity within schemas, expect learners to create meaning from the activity, present tasks and learning that require active participation, expect students to develop abstract models or explanations for observable phenomena, expect learners to show initiative, assess current learner understanding of concept to be taught, and ask demanding questions, particularly those of a reflective nature. However, the findings of this dissertation did not reflect the above characteristics. The following quotations are taken from the interviews with the teachers which deficit the characteristics of a constructivist schoolteacher. The following are said by some teachers and coordinators/assigned mathematics teachers:

"Children cannot build on knowledge without having a pre-taught one. Without the help of an elder, the students will lose focus."

"I believe that students learn for a purpose. They study to achieve their exams. One of the rewards is the grade they earn."

"When the teachers prepare lessons individually, they are expected to think of the students. However, the more main thing is for them to think how to deliver the information to the students and achieve the objectives of the lesson."

"The teacher's presence is essential. Learning does not occur without her presence. She should always be around for the learning process to occur."

"I see from the yearly plan the objectives behind the lesson and I design it according to it and gets approval from the mathematics coordinator."

"The teacher presence is very important. Learning does not occur without her presence. However, I am not saying that the students should be the center too. I believe a bit of each does not harm. The schoolteacher should control the teaching situation and at the same time take the students into consideration."

All of the above facts shed lights on several pedagogical issues which helped in coming up with recommendations of this dissertation for better mathematics teaching. Even though the results deficit the theories discussed earlier, such results can not prohibit the researchers to come up with several recommendations and contributions to knowledge, which will be discussed in chapter 6 of this dissertation.

5.3.2. Social Constructivism Teaching Theory

While answering the research questions of this dissertation, several patterns were detected from the interviews conducted with the schoolteachers and with the coordinators/assigned mathematics teachers and the classroom observations which deficit the theory of social constructivism discussed in chapter 2 of this dissertation. The social constructivism teaching theory stresses on several variables that informed this dissertation. In order to be able to relate them to the findings of the research questions, it is worth going over how both variables and the objectives behind each research question are related. The variables are related to the first two objectives of this dissertation which are to identify the mathematics classroom environment as excerpted from fieldwork and to examine the

schoolteachers' knowledge of different constructivist theories. As a summary, the patterns that got detected while answering the research questions are:

- Knowledge is not shaped by cultural influences;
- Children do not learn throughout social activities;
- Language is very important tool for children to learn new concept;
- Schoolteachers believed that putting students in groups is fun and motivates the learning process;
- Group work is not a methodology used for peers to learn from each other.

As a synthesis, the patterns detected deficit the variables of the theory of social constructivism teaching. Opposite to the cognitive constructivism, the social constructivism views knowledge as a result of culture. Knowledge is shaped by cultural influences, and students learn throughout social activities. Higher mental functioning is related to culture. Social constructivism viewed knowledge as shaped by cultural influence, and it focused on the context of the new knowledge. In order for teaching to be classified under social constructivist theory, it should follow several characteristics according to McGregor (2007), which were not reflected in the case of this dissertation. School teachers expect learners to internalize meaning from the activity through interaction with others, encourage learners to seek elaboration, to rationalize ideas, prioritize propositions and deliberate on direction of learning, expect learners to mediate each other's ZPD, ask more open questions of the collective, provide scaffolds or meditations to support learning of the task on hand, encourage learners to discuss ideas and share understandings, expect students to collaboratively develop strategies and solutions collaboratively, encourage a mutually supportive learning environment, and present tasks and learning that require active participation. However, the findings of this dissertation did not reflect the above characteristics. The following quotations are taken from the interviews with the teachers which deficit the characteristics of a constructivist schoolteacher. The following are said by some teachers and coordinators/assigned mathematics teachers:

"Student do [Sic] learn from the society; however, this is not enough. The teacher is a main part of the learning process."

"We do integrate a lot of group work into the learning process."

"I have to work parallel with the coordinator. We sometimes try to implement some new activities."

5.3.3. Theory of Didactic Situation

Several patterns were detected from the interviews conducted with the schoolteachers and with the coordinators/assigned mathematics teachers and the classroom observations which deficit the Theory of Didactic Situation discussed in chapter 2 of this dissertation. In order to be able to relate the variables of the TDS to the findings of the research questions, it is worth going over how both variables and the objectives behind each research question are related. These variables are related to the third objective of the dissertation which is to suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study.

As a summary, the patterns that got detected while answering the research questions showed that the teachers:

- Did not show the students how to solve problems, and were not allowed with these problems individually;
- found out the problems or situations that will be given to the students.
- did not play positive roles in building the knowledge;
- taught knowledge directly when it was not possible to find a fundamental situation that fits the students' intellectual possibility;.
- did not built an environment helping the students learn a specific learning by the end of every activity;
- was in control of the situation and every change.

As a synthesis, the perceived patterns shortage the variables of the Theory of Didactics Situation. Brousseau (1997) explained that the theory of didactic situations was a

Faculty of Educational Sciences

model that studied the problems related to teaching mathematics. The schoolteachers had to make sure that the learning was taking place and if they found that the students failed to learn, they should provide them with more details. However, the findings of this dissertation did not reflect the above characteristics.

Beside all of the above findings related to the theories discussed in chapter 2, a new finding was detected which might help in facilitating the learning process if taken into consideration by policymakers in the education sector. From the interviews conducted with both the schoolteachers and the coordinators/assigned mathematics teachers, the factor of the lack of facilities was raised up by almost all the participants of this dissertation. They focused on the idea that the schools they taught at didn't support them with facilities which might help them boost their teaching skills. According to the teachers and coordinators/assigned mathematics teachers, if facilities such as LCD projector, cardboards, and much more were available, this would have helped them introduce new methodologies into their classrooms. Below are some teachers' quotations:

"The school does not support us with what we need easily and it takes forever to order new material… This is why no my classes are neither pure traditional nor nontraditional. They are combination of the two."

"Whenever I can I try to put the students in groups. I don't have a lot of facilities which can allow me to teach in a pure nontraditional way."

"The public schools lack facilities such as LCD projectors and internet connections. How can a schoolteacher get rid of the lecture method if the minimum requirement of the nontraditional methods is not available?"

All of the above facts shed light on several pedagogical issues, which helped in coming up with the recommendations of this dissertation for a better mathematics teachings. Even though the results deficit the theories discussed earlier, such results can not prohibit the researchers to come up with several recommendations and contribution to knowledge which will be discussed in chapter 6 of this dissertation.

5.4. Conclusion

As a schoolteacher trainer, a university teacher, and mother, the researcher believes that the main lesson she has learned from this dissertation endeavor is that one must always seek to learn new teaching and learning strategies in order to enrich the background of children. Whether in pedagogy or andragogy, children have a lot of capacities and abilities. We, as educators, should help them develop higher order thinking by exposing them to strategies which allow them to evaluate, synthesize, analyze, apply, and comprehend.

As a summary of the finding, all the schoolteachers observed in the classes showed commitment to the traditional teaching strategy in one way or another. They did not believe in the way they were communicating that students could use prior knowledge on their own and build on them. They were in one way or another following the behaviorist teaching strategy (Thorndike, 1911; Skinner, 1968). Even though the results from the observations and interviews showed that the schoolteachers and coordinators/assigned mathematics teachers knew the difference between traditional and non-traditional teaching, yet more traditional teaching was applied in the classrooms. Several factors were not observed by the researcher such as giving a lot of importance to the students' background information. Both, the teachers and coordinators/assigned mathematics teachers, believed that the teacher's presence in the classroom was very important and that learning did not occur without her presence. Only the schoolteacher can control the teaching process. The researcher observed that answers were provided to the students, and this prohibited the students to elicit new words that might open new discussion that leads to new knowledge. As for the idea of spending more time in schools for data gathering has not resulted in generating different results, the schoolteacher from Star school still showed more traditional teaching strategies than non-traditional ones. Her teaching skills did not show any adoption to the constructivist teaching strategy. She focused more on transmitting the new concept via lecture rather than trying to elicit from the students' background knowledge and build on them.

184

Chapter 6

Conclusion and Recommendations

6.1 Introduction

This dissertation dealt with the schoolteachers' knowledge of different constructivist strategies. In addition to that, it suggested a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study. In this chapter, recommendations for research in mathematics teaching in schools in Lebanon will be discussed. This chapter is divided into two basic parts: the conclusion of the dissertation and some recommendations for improving and for future research.

The chapter is outlined as follows:

- brief review of the dissertation;
- conclusion of the dissertation;
- recommendations of the dissertation;
    - implications for improvement;
    - implications for future research.

6.1. Brief review of the purpose of the dissertation

In her stay at Ball State University in summer 2015, after observing that higher education at this university stressed and aimed on switching from the traditional school to the non-traditional one, the researcher expanded the research of the dissertation and met many researchers in the field of education, especially those who were specialized with constructivist teaching strategies. The researcher wanted to learn more on how educational pedagogy could be improved and how schoolteachers could be motivated to integrate more teaching strategies into their teaching routine. Ball State University's aim was to integrate the students in the learning system where they were given the responsibility to search for

information based on student-centered strategy, project based learning, and problem based learning.

The researcher would like to start this chapter with a brief summary about one of the meetings she has conducted with a higher administrator who is responsible for restructuring the curriculum. The interview was held with Blackmer, Associate Provost for Entrepreneurial Learning and the VP of Academic Affairs/Provost.

According to Blackmer (Interview, 2015), it was expected that students build on their knowledge based on their needs. In other words, the schoolteachers showed the students the right way to Blackmer gave an example regarding this issue. She said that the schoolteachers in such teaching strategies gave the students the freedom to construct as if they got a box filled with sand and they were given the freedom to play with it within specific perimeter which was the students' learning outcome. Educators needed to change the education from inside out. The schoolteacher was a mentor or a facilitator. The students were given the responsibility to build on their knowledge throughout their educational experiences following the students' learning outcome. The teacher's job was to address the students with some questions to lead the students' needs and ask them to solve them out based on their own needs. Some of the students got the work back with them and others missed some of the requirements and were way off because they wanted someone to tell them what to do. In this case, the schoolteacher should redirect the question. They were used to that type of learning where the schoolteacher was the provider of information. The educators should change this gradually and shift the old school of education to a new exciting one. Students never forget the knowledge they construct on their own. The schoolteachers' comments on the students' work is very important. The schoolteacher gives the students a project in which they have to work on based on project or problem-based teaching strategies. The schoolteacher in this case is a facilitator who tries to let students apply what they have learned in their community. The schoolteacher should teach the students how to think of a conflict and find ways to solve it by teaching higher order thinking. They should tap on ideas they have not thought of. The schoolteacher should

186

provide the students with more innovative ways to take roles in the education process. The easy way to do this is to design the aim, go back to it, and decide on what kind of learning to do. In such cases, each time the schoolteacher teaches the course, the syllabus will be different. Students shouldn't use books nowadays as they used to do before. According to Blackmer (Interview, 2015), based on a survey about using their text books in the universities, 49% of the students claimed that they did not use books anymore. Books help the students if they need them. As a teacher, one has the choice either to make the students read all the time or meet you in the middle. The schoolteachers should have clear student learning outcomes and help the students achieve them in different ways by providing them with some readings that are considered as tools. If the students are engaged in the learning process and are motivated, they might be learning more. Sometimes, students feel at ease if they receive the information rather than search for it, but when they grow up and start to contribute and pull out knowledge into the world, they will definitely perform better if they knew how to search for information themselves. This is why group thinking and project examinations are required. The philosophies of education are exciting, but we are operating in the old structure. Organization should have a system that is flexible and open to change. In academia, there is always the conflict between the old school and the new school. The new school should be built in the curriculum, so the staff and the students get used to it.

6.2. Implications for a Better School Environment

In order to improve quality of education in Lebanon, both public and private schools' pedagogy should be enhanced. Although public schools constitute 45.9% of the total number of schools in Lebanon, they account 34.3% of the total student population. In order to overcome the gap of the findings of this dissertation and in order to enhance the schoolteachers' perception of several teaching strategies which help them shift to student-centeredness, a concerted effort and coordination between MEHE and CERD, education makers in the education field, school administrators and schoolteachers, and students and their parents are highly beneficial and important.

Surely, such a challenge needs a lot of strategical plans and needs to be comprehensive. Guidelines should be developed in order to work on the liaison between all the parties mentioned especially between the MEHE and the CERD since each governmental institution plays a certain role in the development of the pedagogy process. For example, both, the responsible at CERD for developing the curriculum and the responsible monitors/facilitators from DOPS should sit together in order to restructure the curriculum based on the school needs suggested by the DOPS monitors who are in the field and are aware of what is needed. The conclusion in this chapter is a blend of results from classroom observations, interviews, field observations, CERD publications, LAES publication, published and unpublished reports from MEHE, and discussion with educators from both the public and the private setting.

6.3. Conclusion of the Dissertation

One of the most important issues concerning education in schools is how to improve students' comprehension of the subject taught and their learning process. Whatever the subject matter is, it is worth finding ways to improve the students' learning. In order for the students to acquire higher-order thinking and be able to think independently, the schoolteacher should be prepared and ready to facilitate this process and introduce students to different teaching strategies.

One of the most important purposes of this dissertation was investigating the schoolteachers' knowledge of different teaching strategies, especially the constructivist teaching strategies, which help the students promote their level of thinking into higher ones and help them be independent. Mathematics is a very important subject-matter to most of the parents, especially in the early elementary cycles, because it is considered as a preparatory stage that allows their children to achieve better. Whatever the subject-matter is, it is essential to find the best way to improve the students' learning, and this way may be eye opener to schoolteachers regarding different teaching strategies such as the constructivist teaching strategy. Mathematics and other subject matters are of great importance because they are crucial for the development of better technological and

scientific societies. It is concluded from the findings and discussion of this dissertation that the schoolteachers and coordinators/assigned mathematics teachers knew the difference between traditional and non-traditional teaching. They understood that the schoolteacher was very important in the learning process and that he/she was the center of the teaching process. However, this was not applied by the teachers in the classrooms. The teaching strategies observed underlie the traditional ones. In addition, several data yielded from the fieldwork helped in identifying grade 4 mathematics teaching environment where mathematics teaching in the Lebanese elementary cycle was informed, and no clear pedagogical models were excerpted from the observations and the interviews. Teachers did not seem to have an overarching teaching philosophy that accents constructivism. As such, it is worth to reconsider the way these subject-matters are being taught by the schoolteachers. The responsibility here does not lie only on the schoolteacher since she/he is one partner from several ones responsible in the education sector. Since CERD is responsible for developing the curriculum and training the schoolteachers on the teaching strategies that should be adapted in the classrooms, more awareness should be given to the new teaching methods, and more teacher trainings should be considered. Of course, this means that while working on the curriculum reform, which MEHE along with CERD started with this in 2017, the new teaching strategies should be taken into consideration. Moreover, the DOPS monitors also should take part in reforming the curriculum since they are the ones who visit the field and monitor the schoolteachers' teaching strategies.

One of the factors to take into consideration for improving students' mathematical learning and comprehension is using teaching strategies that stress on the participation of the students in the learning process where they construct knowledge and not only receive it. Schoolteachers should adapt the deductive strategy rather than the inductive one. Moreover, in case the learner finds difficulty deducing new knowledge, then the schoolteacher 'holds his hand' and shows him the right way. Most reasons for students not being able to learn are the curriculum and the problem of teaching rather than the problem of students. Problems are related to the curriculum and teaching strategies and are not related to the fact that the

students cannot learn. In traditional learning, the student is asked to memorize, conduct experiments, and 'perform' mathematical calculations, whereas constructivist teaching requires more challenging methods.

Accordingly, in constructivism, the students are more motivated and perform better when they are allowed to participate in the learning process, and the new knowledge stays with them on the long run. Because the constructivist teaching strategy involves all students to construct their knowledge, students construct new knowledge by participating actively rather than just being passive and receiving the information from the teacher. Thus, the researcher believes that the education in Lebanon should shift from these teaching strategies and integrate more strategies that allow students to develop what they learn and not what should be learned. Constructing knowledge is very important; it allows the students to remember what they have acquired from the learning process rather than what they have memories of for example. However, it is obvious from the findings of this dissertation that schoolteachers are not motivated to introduce new teaching strategies, yet the administration should provide the schoolteachers with tools that encourage them to do so.

More elaboration on this issue will be discussed in the following part of this chapter.

6.4. Meeting the objectives of the dissertation

In order to fulfil the objectives of this dissertation mentioned in chapter 1, several actions were done. The second and third objectives were met while conducting the research. However, the first objective related to constructing a list of indicators for identifying the mathematics classroom environment as excerpted from fieldwork will be met in this section of the dissertation.

The objectives of this dissertation could not be achieved unless through careful research. Indicators of the best teaching practice quality were detected in order to be able to provide important implications, such as being able to identify the knowledge and skills required for teachers to become successful classroom teachers, being effective teachers, and designing and implementing teacher professional development programs.

A key primacy within the evaluation teaching strategies applied for better mathematics teaching in Lebanon is to develop indicators that permit a good understanding of how well schooling is being delivered. Using these indicators, policymakers can analyze performance and identify priority areas for better teaching strategies in all subject matters in general and in mathematics in particular. Table 7 characterizes a list of indicators for identifying the mathematics classroom environment as excerpted from fieldwork conducted for the sake of this research.

Table 7 List of indicators for identifying the mathematics classroom environment as excerpted from fieldwork

Indicators	Characteristics
Physical and technological resources	Availability and use of : -equipment -materials -technology -Facilities
Non cognitive indicators	Motivation of teachers Attitude of teachers Students' number in each classroom
Cognitive indicators	Skills Knowledge of the theory Competencies
Teaching indicators	Assessment Evaluation Teaching strategies Professionalism capacity building Strong commitment to training

6.5. Limitation of the Dissertation

The dissertation embraces many limitations presented as follows:

- First, schools from Beirut and Mount-Lebanon made the scope of data collection limited.

- Second, this dissertation was concerned with only one outcome of the learning and teaching process, which was the schoolteachers' knowledge of the importance of adopting a constructivist teaching strategy.

- Third, the fact that the public schools in Beirut and Mount-Lebanon teaching grade 4 mathematics in English were few limited the choice of the schools.

- Another limitation related to the schools was that the study did not include male schoolteachers. It was a coincidence that all the teachers were females. It would have been interesting to compare different gender's point of view towards different teaching strategies, and especially towards the school context and facilities available in order to check for any change in the findings.

- The presence of the researcher in the classroom did not allow the schoolteachers to feel free in their way of teaching. Observation might influence some schoolteachers' examinations because they might worry about their way of teaching and how much they know about the taught subject and not only the strategy used even though it was clearly explained to them that the strategy was only going to be observed and not evaluated.

- The timing the researcher chose to conduct her research at was annoying and a negative aspect since May and June fell at the end of the academic year where both the students and the schoolteachers were already exhausted and where the hot weather made the classroom environment quite uncomfortable.

- A likely inadequacy in this dissertation involved bias introduced by the subjectivity of the researcher. In this multiple-case study, the researcher was the primary source of data collection and analysis. This might lead to the fact that some of the incidents might have been overlooked while others were overemphasized.

- Teaching effectiveness and schoolteachers' job performance and schoolteachers' qualifications could certainly be assessed against many other variables such as the age and gender.

- The rubrics were used several times in each observed class in order to ensure reliability, but it gave the researcher replication while going from one school to another as it was identified while describing the data procedure, analyzing the data, and findings of the dissertation.

- Moreover, not being given the permission to record the interviews and the observation made it harder for the researcher since she had to directly take notes and be fully attentive and be part of the conversation between her and the teacher/ coordinators/assigned mathematics teachers.

- In addition, the researcher realized that her short presence in the school might have in a way or another affected the schoolteachers' and coordinators' honesty in the interviews conducted. They did not feel at ease elaborating on the asked questions even though the researcher insisted on the fact that the schools' names and that of the interviewees would stay anonymous.

- The above limitation suggests that perhaps one classroom observation in each school was not enough since the researcher was considered probably an intruder who wanted to 'judge' on every single detail she inquired about.

6.5.1. Overcoming Limitations

During the analysis of the data, the researcher looked for contrast, comparisons, and examples from the mixture of data collected from the classroom observations, schoolteachers' interviews, and coordinators' interviews. A significant amount of time was spent in order to assure the reliability and validity discussed at the beginning of this chapter (Yin, 2003).

The previous section discussed the limitations of the dissertation; some of the limitations were minimized, some others could have been avoided while the rest were

beyond the researcher's control. The second section discusses the researcher's implications for improving and implementations for future research.

6.6. Recommendations of the Dissertation

Several steps could be taken in the future in order to overcome the limitations of this dissertation and to have more reliable findings which could lead to more reliable study. It is not easy for the students also to adapt to the constructivist teaching strategy. They should be trained to do so. As for the schoolteachers, if they are not trained to guide the students to be independent and to search for the new knowledge, then they cannot do the job in an outstanding way. It was deduced from the findings of the dissertation. As educators, introducing the constructivist teaching strategies more into the lower cycles such as the preschool would help the students become more independent. If we look back at the researcher's personal experience that has led her to start this dissertation in chapter 1, the researcher described the way her two sons were playing with their toys and building their own prior knowledge to figure out solutions and build on new ones. Now, after 4 years, both sons have acquired their own knowledge independently.

6.6.1. Implications for Improving

A new culture is suggested to be built in where teaching professional programs such as seminars should be introduced to both educational sectors in Lebanon taking into consideration that not all schools in Lebanon are subject to follow up on such trainings and seminars. Such seminars can train the schoolteachers to help learners be independent and help them practice the innovative strategies recommended in the literature. In other words, schoolteachers should learn new teaching strategies and should be introduced to the constructivist teaching strategies which will help them shift from the teacher-centered strategy to the student-centered teacher training. Schoolteachers should be motivated to be effective schoolteachers and leaders in that they empower the learners and encourage them to reflect on their new learning which they have built themselves.

To close the gap between theory and practice, it is recommended that the capacity building programs be introduced to all schools where the schoolteachers' knowledge of new

strategies is always updated. More workshops or seminars should be done with more concentration on constructivist learning activities including student-centeredness, authentic problem-solving tasks, learning practices, and much more. All of the held workshops should be based on student-centered strategies and should be based on case studies from real pedagogical situations. Schoolteachers should be aware that learners differ from each other. They should know that even though constructivist teaching strategies promote higher order thinking, they should be aware that not all students achieve higher-order thinking at the same time and that this may be in conflict with the learning environments the students constructed. Seminars and professional development workshops could be implemented to reinforce and enhance the teaching skills and motivation of the schoolteachers and boost their motivation. This solution was suggested by several schoolteachers and coordinators/assigned mathematics teachers while conducting the interview. One said: "it is important to learn new strategies and it is important to apply non-traditional strategies; however, all of this requires training"; "Not all the teachers are trained to use several teaching strategies. We prefer to stick to the strategies we are familiar with".

Whatever the strategy the schoolteacher is adopting, it is suggested that the classroom environment be safe in a way where the students are motivated to learn and engage in activities.

It is suggested that the administration supports their staff with more tools that motivate them to introduce new strategies into their lesson plans. It is also suggested that the coordinators/assigned mathematics teachers be more flexible and aware of the different constructivist teaching strategies in order to facilitate the job for the schoolteacher.

Finally, it is suggested that the schoolteachers and coordinators/assigned mathematics teachers understand the nature of knowledge required both to seek a long-life professional improvement in order to build an understanding of student-centered education based on constructivist teaching strategies, and to be role models for their students. This is why it is suggested to enroll in continuing educational programs that introduce them to new strategies.

195

6.6.1.1. What to do?

Undoubtedly, the challenge is big and falls on the schoolteachers because they are the ones who are in direct contact with the student. Of course, other parties play a big role too in filling the gap; however, they are not in the front line. This is an opportunity for the schools to do a change and improve their teaching effectiveness and skills. If the schoolteachers did not seek change, then who would? At least, the teacher can start from her/his own classroom where she/he is the leader, and then other parties of the education system will eventually get involved and seek to improve. During some of the interviews, even though fear of losing their job was obvious from the conversation, schoolteachers aimed to improve and to be given the chance and the facilities required for better teaching effectiveness: "I would like to give the teachers workshops regarding this issue and draw their attention to several ways to apply it." Schoolteachers need training in order to enhance their knowledge and practice constructivist teaching strategies. It is very important for the organizations that are responsible for the training to work hand in hand with the schoolteachers in order to promote more effective teaching strategies and skills.

Initiatives are being taken from several NGO's especially with the invasion of the Syrian crisis. High budgets are being spent on improving the educational system in public and some private schools in Lebanon. For example, World Learning (International NGO) introduced two major projects for child education and teacher qualifications. The first project is called Developing Improvement Rehabilitation Assistance to Schools and Teacher (D-RASATI) and the second one is called Quality Instruction towards Access and Basic Education Improvement (QITABI). D-RASATI is a project that aims at enhancing student learning in Lebanese public schools by training schoolteachers, developing extra-curricular activities, providing schools with ICT equipment and training, developing school leadership and building the capacity and tools necessary to support school improvement planning. QITABI aims to expand equitable access and improve learning outcomes for vulnerable students in Lebanese public schools. QITABI project includes partners such as Ana Aqra', AMIDEAST, and Management Systems International, CERD and MEHE. These partners

will provide technical assistance and capacity building within the context of three project components focused on three components.

- Component 1: Improving reading outcomes for primary level public school students;
- Component 2: Expanding access to safe and relevant education for vulnerable public school students;
- Component 3: Strengthening management (resilience) in the education system to better direct and monitor education.

Another example of an organization that aims at enhancing the teaching process is the proposal the World Bank submitted to MEHE, which is being studied before implementations. The proposal included several professional growth programs. Education Professionals will train the schoolteachers and others will give them workshops upon the schoolteachers' requests under recommendations while writing their yearly evaluation reports.

6.6.2. Implications for Future Research

In Lebanon, there is still little research on examining the schoolteachers' knowledge of different constructivist theories. This is why it is suggested that more qualitative research in different school cycles and in higher education be conducted in order to examine the extent of schoolteachers' knowledge of different constructivist theories. The results of this dissertation should not be viewed as an end in themselves. More in-depth research should be conducted to examine the schoolteachers' knowledge of different constructivist theories and to suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study.

After synthesizing from the review of the dissertation and after interviewing researchers of the constructivist theories, the importance of the constructivist theories and other learning theories and their impact on enhancing the schoolteachers' and the students' learning and motivation became clear.

It is also suggested that in order to apply the constructivist teaching strategies from a more interdisciplinary viewpoint, research should not be limited to only one classroom from

one cycle of the school. It should be studied throughout different classes from different cycles.

Also, it is worth taking into consideration that the schoolteachers come from different educational background and experience. This is why, it is suggested that research can be constructed and examined based on the teaching-orientations of schoolteachers at the beginning of similar studies in the future to be able to collect more data to build on.

A final note in this section is that the findings in this research are not intended to be generalized to all private and public schools across Lebanon. Also, it should be taken into consideration that this dissertation followed the protocol of case study research design which provided little generalization (Yin, 2003). The findings of this study shed light on the schoolteachers' knowledge of different constructivist theories and offered researchers a first step towards expanding the research in Lebanon.

6.8. Conclusion

Despite the 1997 curriculum reform which Lebanon is using until 2017, several models of reforms were detected and countries adapted different ones based on their educational vision. From the findings of this dissertation, it became clear that Lebanon education system may not have a clear vision since the schools do not all abide by the same one. The three models of reforms adapted by several countries are the Market-based model, the State-Led Approach, and the Professional-Oriented Approach. The market-based model of reform is associated with open market economies including the United States, England, New Zealand and parts of Australia and increasingly influential in South Asia, Africa and Eastern Europe. The model focuses on the standardized teaching and learning, literacy and numeracy, teaching a prescribed curriculum, devolution of budgetary and managerial responsibility to school level, and test-based accountability and control. The state-led approach to reform is associated with market or marketing economies including South Korea, Taiwan, Hong Kong, Singapore and, in recent times, China. The model focuses on harnessing high levels of social and parental support for education, testing as a basis for student assessment rather than for accountability, adapting didactic teaching methodologies, focusing on role of

education in promoting social cohesion and normative behaviors, and having high expectations of all learners. The third model of reform is a more professional-oriented approach to reform, which is associated with the Nordic countries, includes high-performing: Finland. The model focuses on teaching as a high-status profession that attracts able graduates. It stresses on the fact that teachers can independently drive forward improvements to practice and their own professional learning. In addition, it believes in relatively high levels of professional trust with low stakes accountability. Moreover, it believes that curriculum can be devolved within a broad framework of agreed goals. It also strongly emphasizes on links between education and other social services and on a sympathetic adaption to local geography, demography, and economy culture which are significant to school improvement.

Thus as a synthesis, even though the findings of this dissertation are not intended to be generalized to all private and public schools across Lebanon, it can be deduced that Lebanon can be placed under the market-based approach since the findings of this dissertation showed that the teachers and coordinators/assigned mathematics teachers focused more on the importance of the standardized teaching and learning, literacy and numeracy, teaching a prescribed curriculum, devolution of budgetary and managerial responsibility to school level, and test-based accountability and control. The Lebanese private and public schoolteachers and coordinators/assigned mathematics teachers participating in this dissertation did not focus on testing as a basis for student assessment rather than for accountability, adapting didactic teaching methodologies, focusing on role of education in promoting social cohesion and normative behaviors, and having high expectations of all learners. However, they tested for accountability as mentioned earlier and did not use a didactic strategy to help the students construct knowledge.

While this dissertation represents a starting premise for establishing a line of research in this area, it is only considered a springboard for future research in all sectors in Lebanon. This dissertation represented a starting point for establishing a line in this area and is considered a preliminarily study for future research in all the areas in Lebanon. There is still

Faculty of Educational Sciences

little research on examining the schoolteachers' knowledge of different constructivist theories. This is why it is suggested that more qualitative research in different school cycles and in higher education be conducted in order to examine the extent of schoolteachers' knowledge of different constructivist theories. The researcher have learned many facts besides the mentioned ones earlier about the school system in Lebanon whether in private or public schools. Her presence for an 11 months period in MEHE, especially at DOPS, has helped her studying and analyzing the school systems as well as the different long term projects several organizations are implementing in the schools in order to enhance the teaching qualifications. What is really happening behind the walls of the schools has actually started to become clearer to the researcher because of her permanent presence at MEHE and because of her one-to-one work with some members of the CERD. The research from these sites answered many of my initial questions, and for sure, many remain unanswered due to the discussed limitations of the study.

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Faculty of Educational Sciences

Appendices

List of Appendices

Appendix 1: Correspondence Table

Appendix 2: The Interview Conducted with Prof. George Nahas on January 17, 2014.

Appendix 3: Questions which were prepared to guide the interview that was done with Prof. George Nahas on January 17, 2014.

Appendix 4: Rubric used for observation in grade 4 mathematics classes

Appendix 5: Interview questions prepared to guide the interviews with the responsible people, coordinators, and grade 4 mathematics schoolteachers.

Appendix 6: The edited Rubric used for observation in grade 4 mathematics classes

Appendix 7: The interview conducted with the math coordinator and the teacher for the pilot study

Appendix 8: The Observation conducted in grade 4 math class for the pilot study.

Appendix 9: Questions which were prepared to guide the interview that was done with Prof. Iman Osta on December 22, 2014.

Appendix 10: The Interview Conducted with Prof. Iman Osta on December 22, 2014.

Appendix 11: Approval letters sent to the schools

Appendix 12: Emails sent for member checking

Appendix 13: Transcriptions of the interviews conducted with the participants

Appendix 14: Copies of the e-mails replied by some of the participants

Appendix 15: Transcription of interview with Teacher S from Star school conducted on April 2, 2016

Appendix 1: Correspondence Table

Objectives	Research questions	Significance of the study	Statement of the problem
1-To examine the teachers' knowledge of different constructivst theories.	1- How do grade 4 schoolteachers associate constructivism with their teaching of mathematics?	-There is little information in the published literature. -Early piloting of the research instruments and the crystallization process to identify the significance of the study and its need in Lebanon suggest that, through the dissemination of its results, this study will: Provide a systematic approach for understanding and a more proactive approach for addressing problems and explore opportunities for informing the public and the academic community.	-Mathematics and Sciences are considered very important subject matters to enable future scientific brains to improve the technological word we are living in. Most of the parents give a lot of importance on the mathematics subject matter and insist on their children to perform very well in it especially in the early elementary cycles because they consider it as a preparatory stage that allows their children to achieve better. Grade 4 class of cycle 2 is considered a preparatory stage that allows students to transfer the bridge between one cycle and another and prepares them to have more challenging objectives in the advanced classes. Whatever the subject matter was, it is important to find the best way to improve the students' learning and comprehension of the content.

Faculty of Educational Sciences

			-No single study conducted thus far in Lebanon has sought to examine Lebanese students' mathematics learning and teaching mathematical concepts and reasoning for grade 4 students, an important gestation period for their cognitive development. In other words, how Lebanese private and public schools teach mathematical concepts and reasoning for grade 4 students in relation to their constructivist teaching approach is marooned from burgeoning research in Lebanon's educational landscape.
2- To construct a list of indicators for identifying the mathematics classroom environment as excerpted from fieldwork.	2- How can observation data yielded from fieldwork be used in identifying grade 4 mathematics teaching environment?	-To anticipate in helping teachers use different teaching strategies such as the constructivist strategy in order to develop more active classrooms which might improve students' learning in mathematics. -To analyze the private and public school situations especially the small ones that might be located in villages which include the highest percentages of students with low Math scores.	-The quality of learning in the classrooms should be analyzed. For example, in the elementary cycle, Skaff (2012) explains that Lebanon didn't do well based on the students' scores, and this shows that they haven't received a good education in both Math and Science education. -Second, it is also worth mentioning that even though Lebanon was one of the few countries which improved its scores in mathematics whereas other countries improved their scores in Science; yet, it still scored less than the required average 500 (Skaff, 2012). -The new cognitive approaches are not being accepted in general by some educators, but in where it should be part of the curriculum especially in some public schools (Nahas, Communication, January 17, 2014). -One of the main problems that some of the Lebanese schools are facing is that even though the general objectives of

Faculty of Educational Sciences

			the mathematics curriculum are based on the constructivist theory, yet not all the Lebanese schools adapt this kind of strategy in their classrooms.
3. To suggest a model for identifying mathematics teaching in elementary cycles taking grade 4 as a case study.	3- How would pedagogical models yielded from fieldwork inform mathematics teaching in the Lebanese elementary cycle?	To anticipates in helping teachers use different teaching strategies such as the constructivist strategy in order to develop more active classrooms which might improve students' learning in mathematics.	-Another problem is that 50% of the private schools in Lebanon who participated in the TIMSS scored more than 500; however, the students that participated from public schools scored low (Skaff, 2012). -This leads us to question the teaching strategies and teaching quality in the public sector and search for the several problems that might encounter the students' learning and prohibit their improvement.
4- To provide recommendations for future research in mathematics teaching in schools in Lebanon.	4- How does the role of a researcher as a qualitative tool participate in identifying mathematics teaching in the elementary cycle?	-To find several educational solutions to overcome the other factors that might encounter some schools and students such as the students' economic and social status: the gap that might exist between poor students where the economic and social conditions affect students' learning and contributes in limiting their competencies, the schools' facilities, and the class size. -It proposes an understanding of the existing educational gap that is occurring between some of the Lebanese public and	-Mathematics whereas other countries improved their scores in Science; yet, it still scored less than the required average 500 (Skaff, 2012). -Another problem the Lebanese mathematics curriculum faces is that the objectives, which are essential in the curriculum, missed some of the most important active verbs that lead to a constructivist classroom. Nahas (1999) and Melhem (2010) state that the objectives missed some of the most important active verbs such as observe, interpret, question, expect, classify and they were replaced by verbs such as know, understand, learn, prove ect. -The more advanced the level is, the more complex the required analyses are from the students. This higher-order thinking cannot be acquired by the students alone, but with the help of the teacher. Thus, some of the issues that

212

		private sectors and helps responsible people such as teachers and coordinators tweak in the existing mathematics curriculum and integrate more active verbs to the objectives that might help develop better constructivist classrooms. -To provide a plan in order to enhance the teachers awareness of different teaching strategies while implementing the curriculum. -To review the Lebanese mathematics constructivist curriculum and its different teaching strategies. -To anticipates in helping teachers use different teaching strategies such as the constructivist strategy in order to develop more active classrooms which might improve students' learning in mathematics.	should be taken into consideration are the curriculum, teaching methods used, the students, availability of facilities, and the teachers.

Appendix 2: The Interview Conducted with Prof. George Nahas on January 17, 2014.

Location: Balamand University

Date: January 17th, 2014

Name of Participant: Dr. George Nahas

Name of Transcriber: Pascale Hajal-Chibani

Number of Tapes: 1

On the 17th of January 2014, I met Dr. George Nahas in his office at Balamand University at 11:00 a.m. I prepared ahead of time a set of questions (refer to appendix 3), in order to guide my interview.
I got approval of Dr. Nahas, offline, if I can reference the interview while writing the dissertation.
The interview started at 11:00 a.m. sharp.

I[7]:   OK, before we begin the interview itself, I'd like to confirm that you have no problem to record our conversation which will help me while transcribing the interview and will give me the chance to participate more in our conversation and not be taking notes all the time (*background music for Bach*).

P[8]:   No, I do not mind and I understand its importance.

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[7] **"I" refers to the interviewer which is me in this study.**

[8] **"P" refers to the participants (the interviewee)**

I: First, let me introduce myself. As I have written in the email I sent you, my name is Pascale Hajal. I am a PhD candidate studying Science Education at USJ. My Advisor is Dr. Kamal Abouchedid, and my Co advisor is Dr. Antoine Dagher.

P: Yes sure I know Dr. Kamal since long time and we a have a good relationship.

I: Good. My study is about constructivist teaching approach and its effect on the students' achievement in Mathematics. While I was doing my research about this topic in Lebanon and especially when I visited the LAES website, I have learnt that you have written several articles and books related to this topic. In addition, I have learnt that you were a member in the panel, along with Dr. Milhim and Dr. Jurdak, which was responsible to write the general objectives for mathematics for the new curriculum. So, I searched for your website[9] and started reading all the r articles related to my study that you have written that will cover a huge part of the Lebanese review of my study. As you know we live in Lebanon, and I want to learn about problems that face Lebanon and not only what international reviews say.

P: Aha!!! Your topic is very interesting and new. I encourage you to work on it thoroughly; maybe we can change anything of the current situation that is facing the public schools here in Lebanon (*telephone call*). *(Hmmmm)* I have written several articles related to constructivism. Some are in English and Arabic, but the majority is in French. According to me, constructivism is very important when we speak about education. However, not everyone knows about this concept or applies it in his class. Teachers think that they are applying the constructivist teaching approach, but if you look deep, you find that they don't. For example (*ehemehem*), if you tell a student to consider that they have 5 marbles and then you ask them to consider that they have got 4 extra marbles. The student in this case will do an addition equation. He will add 5 to 4 and will say that now he has 9 marbles. This is not

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[9] http://www.georgesnahas.com/gnn/

constructivism. Constructivism is when you ask the student to use his previous knowledge and build on it new ones which lead to a new concept. Thus you ask the student to go down the playground and you divide the class to two groups you give each group 5 marbles and you ask one of the groups to give the other group half the number of marbles they have for example. Then, in this case, the students won't only do an addition equation but they are going to compare too. In here, you are asking them to think of their daily life activities and integrate with mathematics to learn a new concept *(drinking water).* We should teach the children how to use their previous knowledge and background information to build a new one. Each individual has different capabilities. Subject matters come as cones. These cones are integrated. We can not consider each subject matter separate from the others. Knowledge starts somewhere and students continue on building them. We can not deny the importance of language. Language is very important and goes along with every other subject matter. In my PhD dissertation, I have fought for this idea and my entire study was about the importance of language in order to acquire any other concept in any subject matter.

I: Yes I agree with you. While I was reading your book " *الجديد والممكن في تعليم الرياضيات:* *حالة"لبنان"* ", I understood the importance of language in Math and the importance of considering the different cognitive strategies while teaching Math.

P: While working on the objectives at Vision document of LAES, year 1996, we stopped our work and the report that we have issued was not published.

I: Yes, this is true. I couldn't find information on neither website related to the report you have written.

P: Exactly! This is because they did not publish it because we did not agree on the fact that the government issued the Math specific objectives before we finished working on the general objectives. They did not wait for us to finish the general objectives. They published

216

the specific ones before. They did not wait.

I: Can I have a copy of this report?

P: Yes I will ask my secretary to photocopy a part of it. Read it but don't publish it.

I: Yes sure. Thank you.

P: (*Dr. Nahas calls his secretary*). Photocopy from page 17 to 35.
I: Thank you.

P: Listen Pascale. Your study is very interesting, but there are a lot of obstacles that will face you. Decide on what you want to study. For example, (*EhemEhem*), say I want to study constructivism in mathematics subject matter and to which extent is it being applied in schools in Lebanon especially the public ones since they use the Lebanese books. If you do this, then I believe you will become a hero. I advise you to investigate to which extent do teachers and coordinators know the cognitive learning theory and to what extent do they apply it in their classrooms. I want to offer you my new book which will be published next month but it is in French.

I: Thank you so much. No problem, I can read French.

P: (*Dr. Nahas calls his secretary*). Get one copy of my new book.

I: I would like to really thank you and I appreciate what you are doing.

P: (*Secretary goes in)*. Here you go.

I: I kindly ask you to sign it.

P: Yes sure.

I: Dr. Nahas! I would like to share with you my thoughts out loud since you are giving me advices concerning my study.

P: (*Nodding head*).

I: Dr. Kamal advised me to do a challenging study which everyone benefits from and not put it on the shelf like other studies. He is encouraging me to do a research which the country needs and which improves the conditions of the Math in Lebanon.

P: Oh sure! I agree with Dr. Kamal. In Lebanon, you will find the majority doing research just to do one and finish their PhD. I advise you to do a study related to teachers and not students. Study what the teachers consider constructivism to be. Check what their concept behind learning is. Is it to add the students' knowledge or to build on it?

I: Thank you so much. I will, for sure, take your advises into consideration and I will keep you posted with any news related to my study.

P: You are welcome. Please do not hesitate to call me or email me if you have any question. Send regards to Dr. Kamal.

I: Sure I will. Thank you again. (*Shaking hands*).

Appendix 3: Questions which were prepared to guide the interview that was done with Prof. George Nahas on January 17, 2014.

1- What is your opinion in the new curricula in Lebanon?

2- Does the curriculum adapt a cognitive approach and what is the important of adapting a cognitive approach in Mathematics?

3- What is the importance of integrating constructivism approach in the Mathematics curriculum?

4- Does the Math curriculum face some problems in Lebanon?

5- Is there difference between public schools curriculum and the curriculum in private schools? Does the book help the teacher in using variety of strategies?

6- Is the new active (student centered) approach being applied in public schools?

7- Can the diagram presented in 'enhancing productivity in higher education' be adopted to schools?

8- What is the year the book *الجديد والممكن في تعليم الرياضيات: حالة لبنان* published on?

Appendix 4: Pilot Rubric used for observation in grade 4 mathematics classes

Constructivist observation Checklist

School: _____

Grade level: _____

Lesson Taught: _____

Date: _____

Duration: _____

Number of Observation: _____

The teacher:	Yes	No	Comments
1. Pose problems that are or will be relevant to the students.			
2. The problem the teacher poses is or will be relevant to the students, and they will strategy it sensing its relevance to their lives.			
3. Structures learning around essential concepts.			
4. Encourages students to make meaning by breaking wholes into parts. Avoid starting with the parts to			

	build a "whole."			
5.	Is aware that students' points of view are windows into their reasoning.			
6.	Adapts curriculum to address students' suppositions and development			
7.	Assess student learning in the context of teaching.			
8.	Shifts from measuring how well or poorly a student performs to assessing how much and what kind of help a student needs to be successful.			
9.	Encourages and accepts student autonomy and initiative.			
10.	Uses raw data and primary sources, along with manipulative, interactive, and physical materials.			
11.	When framing tasks, uses cognitive terminology such as "classify," "analyze," "predict," and "create."			

12.	Allows student responses to drive lessons, shift instructional strategies, and alter content.			
13.	Inquires about students' understanding of concepts before sharing your own understandings of those concepts.			
14.	Encourages students to engage in dialogue, both with you and with one another.			
15.	Prompts student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other.			
16.	Seeks elaboration of students' initial responses.			
17.	Engages students in experiences that might engender contradictions to their initial hypotheses, and then encourage discussion.			
18.	Allows "wait time" after posing questions.			

19.	**Provides time for students to construct relationships and create metaphors.**		

Faculty of Educational Sciences

Appendix 5: Interview questions prepared to guide the interviews with the responsible people, coordinators, and grade 4 mathematics schoolteachers.

1- Can you compare a traditional classroom to a nontraditional one?

2- Can you describe a class that you think you have taught in a nontraditional way?

3- There are different learning theories. With which theory are you familiar with the most?

4- Do you believe that children get prior knowledge to their classrooms?

5- Do they build on their prior knowledge or just use them to understand a new concept?

6- What is the role of the teacher in the class?

7- Between behaviorism (Reinforcing good behavior) and constructivism (building on prior knowledge), which strategy do you prefer to adapt in your class?

8- What do you understand by students "construct understandings"?

9- Do you believe that all teachers are familiar with the constructivist learning theory?

10- Where does the problem lie in your opinion? Should the government add it to the teacher qualifications?

11- Do you believe that the school plays a role in helping the teachers fulfill the constructivist teaching strategy? How?

12- How does constructivist teaching differ from the traditional strategy?

13- Does the curriculum you are adopting to teach the lessons help you move from a traditional strategy to a non-traditional one?

14- Would you like to add anything?

Appendix 6: The edited Rubric used for observation in grade 4 mathematics classes

Constructivist observation Rubric

School: _____

Grade level: _____

Lesson Taught: _____

Date: _____

Duration: _____

Number of Observation: _____

The teacher:	Yes	No	Comments
1. **The teacher uses traditional classroom teaching strategies.**			
2. **The teacher uses non-traditional classroom teaching strategies.**			
3. **The teacher pose problem that allow students to use prior knowledge to understand new ones.**			
4. **Is aware that students' points of view are windows into their reasoning.**			

Faculty of Educational Sciences

5.	**Adapts curriculum to address students' suppositions and development of new knowledge.**			
6.	**Uses different strategies to make sure students understood new concepts.**			
7.	**Encourages and accepts student autonomy and initiative.**			
8.	**Uses raw data and primary sources, along with manipulative, interactive, and physical materials.**			
9.	**When framing tasks, uses cognitive terminology such as "classify," "analyze," "predict," and "create."**			
10.	**Allows student responses to drive lessons, shift instructional strategies, and alter content.**			
11.	**Inquires about students' understanding of concepts before sharing your own understandings of those concepts.**			
12.	**Allows students to find new ways to solve problems.**			
13.	**Students are given the way to solve problems.**			
14.	**Students apply what they have learned.**			
15.	**Engages students in experiences that might allow them to construct their new knowledge based on prior ones.**			
16.	**Allows "wait time" after posing questions.**			
17.	**Provides time for students to construct relationships and create metaphors.**			

Appendix 7: The interview conducted with the math coordinator and the teacher for the pilot study

After the class observation, on the 4th of November 2014, I was accompanied to the coordination room where teachers and coordinators meet. I met a math coordinator and a math teacher from a school located in the Shouf area in Lebanon. I prepared ahead of time a set of questions in order to guide my interview since I have planned to conduct a guided interview. The interview started at 9:00 a.m. sharp. I re-explained to the teacher that I am not in a position to evaluate her teaching skills. However, one of my study's purpose is to see to which extent do the teachers in Lebanese schools know about different teaching strategies. I started the interview by explaining to both the teacher and the coordinator that I need their approval in order to record the conversation which will help me while transcribing the interview and will give me more chance to participate more in the conversation and not be taking notes all the time even though I will be taking some notes just in case something happens wrong with the recorder. I decided to make the interview informal, conversational, exploratory, flexible, and open-ended. I used the interview guide I had prepared that helped me focus and make sure all the questions I had in mind were answered.

I started the interview by asking the teacher and the coordinator to describe a classroom each had taught the day before. I asked each "Can you please describe your classroom"? My aim was to start the interview with a preliminary idea of how usually the teacher designs her classroom. The way the teacher and the coordinator described their classroom and the way they were explaining how they use different strategies while teaching showed me that they were familiar with different teaching methods which they might be integrating in her daily classroom lesson plans. However, I did not hear a clear explanation or understanding of what constructivism or socio-constructivism might be. They did not clearly mention that they depend on the student's background knowledge to build on them new ones. They kept on repeating that they use nontraditional techniques such as integrating computer, hand on

227

activities, pair work, and cooperative work. They thought that these might be what is meant by constructivism, but unfortunately they are not. The teacher's accounts mainly were that she thought that she had an idea of what constructivism learning theory was, but actually, she did not. She thought that using non-traditional classroom was a constructivism strategy. She was clear that she uses activities in the classrooms and allows students to use hands-on activities, but from what I have understood, she uses non-traditional strategies such as using cooperative learning, integrating technology, and using hands-on activities, but she does not rely on eliciting what the students already know in order to build on it. From here, I was convinced that the questions I have prepared to guide my interview where reliable. Both the variables from the observations and the questions had the same result.

I was convinced more after the pilot study that the purpose of this study was very important. There is a dire need to study the teachers' knowledge of constructivism learning theory and their effect on students' learning especially in mathematics.

Appendix 8: The Observation conducted in grade 4 math class for the pilot study.

On the 4th of November, 2014, I observed a mathematics class at 8:00 a.m. The classroom was located at the end of a long corridor. While being accompanied to the classroom, I explained to the teacher of the classroom I observed that I am going to observe the teaching strategies used in the lesson plan and try to understand how they promote the students' learning. I stressed on the idea that I am not going to observe her teaching skills and knowledge of the content taught. Thus, I sat in the back of the classroom in a corner where I was able to see the entire classroom and not disturb anyone at the same time. I filled out the items in the rubric (see appendix 4) I had previously prepared silently.

The teacher started her class by welcoming the students and summarizing the lesson of the day before. While observing the lesson, I focused on the teachers' strategies more than anything else. The teacher explained a new lesson based on the previous one she taught a day before, and then she asked the students to sit in groups and apply what they have been taught.

From my observation, I learned that the teacher does involve her students with different techniques such as integrating the power point presentation and hand on activities. I did not see any tendency to let the students come up with answers and new knowledge. However, she does not seem to have clear idea of how to implement the constructivist teaching strategy. She did not rely on the students to elicit was they know from previous information in order to build on them new ones. On the contrary, she explained to them the new method the first 10 minutes, and asked them to apply it. The answers or actually the way to solve a problem was explained to them ahead of time, and they were simply asked to apply the procedure of solving this problem. While filling out the observation rubric, I felt that some

229

items were repeated in several observation variable. This made me not focus a lot on the process that was taking place in the classroom. I had to read each item and search for answers. Thus, I decided to restructure the observation rubric and make it easier to read and follow while the observation process was taking place. Thus, I had to join some items, delete others, and add new ones (see appendix 6).

Appendix 9: Questions which were prepared to guide the interview that was done with Prof. Iman Osta on December 22, 2014.

1- What is your opinion regarding the new curricula in Lebanon?

2- Does the curriculum adapt a cognitive strategy and what is the important of adapting a cognitive strategy in Mathematics?

3- What is the importance of integrating constructivism strategy in the mathematics curriculum?

4- Does the Math curriculum face some problems in Lebanon?

5- Is there a difference between public schools curriculum and the curriculum in private schools? Does the book help the teacher in using variety of strategies?

6- Is the new active (student centered) strategy being applied in public schools?

7- What problems does the math curriculum face in general?

Appendix 10: The Interview Conducted with Prof. Iman Osta on December 22, 2014.

Location: Lebanese American University

Date: January 8th , 2015

Name of Participant: Dr. Iman Osta

Name of Transcriber: Pascale Hajal-Chibani

Number of Tapes: 1

On the 8th of January 2015, I met Dr. Iman Osta in her office at Lebanese American University at 11:30 p.m. I prepared ahead of time a set of question (refer to appendix 9), in order to guide my interview since I planned to conduct a guided interview.
The interview started at 1:00 p.m. sharp.
I started the interview by introducing the purpose of the study. I have introduced her to the objectives and research questions of the study. I asked Dr. Osta's approval to record the conversation in order not to lose track and be writing notes all the time. As a summary, Dr. Osta believes that the topic is very interesting and beneficial and up to the new research demands. It will contribute a lot to the pedagogical knowledge of the teachers since it deals with the awareness of the teachers to different teaching strategies, especially the constructivist one. However, Dr. Osta advised the researcher to edit in the research questions such as changing the word 'assess' from research question # 2 to the word 'identify' since my purpose is to do a fieldwork observation to check what is happening around in the Lebanese context in the mathematics classes. She believes that the research questions I am planning to study are wide. She believes that the researcher should specify the variables in order not to lose control later on while trying to collect data. Moreover, she

232

advised the researcher to add details regarding the sample that was going to be used. She advised the researcher to specify the reason behind choosing specific schools and the number of observations that is going to be conducted in each. She also suggested that the researcher explains in details about the rubric used while observing and make sure that all the items observed are related to the research questions. Finally, she suggested that the researcher decides on how she is going to use the data collected in order not to face any problems later on while advancing in the study. The meeting finished at 12:10 p.m. where Dr. Osta repeated her admiration to the purpose of the study, especially that it deals with pedagogical knowledge of teachers which is one of the very important topics nowadays.

Appendix 11: Approval letters sent to the schools

الجمهوريـــة اللبنائيـــة
وزارة التربية والتعليم العالي
المديرية العامة للتربية

رقم الصادر: ٣/٣٠٦٠
بيروت في ٢٧/٤/ ٢٠١٥

جانب جامعة القديس يوسف في بيروت
كلية العلوم التربوية

الموضوع: تسهيل مهمة الطالبة بسكال سمير الحجل.
المرجـــع: كتابكم تاريخ ٢٠١٥/٣/١٧.

إشارة إلى الموضوع والمرجع المبينين أعلاه،

نحيطكم علماً بموافقة المديرية العامة للتربية على طلبكم السماح للطالبة بسكال سمير الحجل بدخول المدارس الرسمية التالية خلال العام الدراسي ٢٠١٤/٢٠١٥؛ مدرسة الأشرفية الثالثة المتوسطة الرسمية المختلطة، مدرسة رأس النبع الثانية الرسمية للبنات ومدرسة الشوير المتوسطة الرسمية، من أجل إنجاز بحث ميداني لإعداد شهادة دكتوراه، يشمل حضور حصص مادة الرياضيات في الصف الرابع الأساسي وإجراء مقابلات مع مدرسي ومنسقي هذه المادة، على أن يصار إلى التنسيق مع إدارة هذه المدرسة بغية تنفيذ المطلوب وتأمين حسن سير العمل فيها./

المدير العام للتربية

فادي يرق

FACULTÉ DES SCIENCES DE L'ÉDUCATION

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في بيروت

كليّة العلوم التربويّة

Référence : 15/USJ/FSEDU/2819

Beyrouth, 17th of March 2015

To whom it may concern

Mrs Pascale Hajal-Chihani is a doctorate at the faculty of Educational Sciences at Saint Joseph University in Beyrouth since September 2014. Her theses is about « Towards a Conceptual Framework for Advancing Mathematics Achievement in Lebanon: A Multiple Case Study».

It would be very helpful if you allow her to have full access to observe a Mathematics classroom in grade 4 and to interview the teacher and the coordinator of the classroom.

The results will be confidential.

Thank for your cooperation.

Best regards,

Yvette Gharib PhD
Coordinator of Research
Faculty of Educational Sciences,
Saint-Joseph University (USJ)
Tel: +961-1-421000 ext.5712

Pour accord

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Appendix 12: Emails sent for member checking

To whom it may concern,

I would like first to remind you of who I am. My name is Pascale Hajal. I have conducted an observation and an interview last spring in your school. First, I would like to thank you for your valuable time, cooperation, and for the remarkable information and feedback you supported me with during the interview. Second, as a protocol of the qualitative study, I visited the finding (results) of the interview and observation and I thought of sharing them with you for several reasons. The first reason is that it is a must due to variations of design and protocol in qualitative inquiry to verify information acquired such as the data retrieved from the participants. Also, it is important in order to increase the credibility of the study especially that I was not given the permission to record the interviews to take approval from the participants that my analysis for the data reflect what the participants meant in order not to be bias. Thus, I kindly ask you to find attached a summary of the findings and to reflect briefly on them by giving your opinion whether the information provided reflect your words.

I ask you to reply to all in order to keep track all the conversation that occurs.

Thank you for your cooperation.

Regards,

Pascale Hajal

Appendix 13: Transcriptions of the interviews conducted with the participants

Transcription of the Interview with teacher A from Earth school

Researcher: Good morning again. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to know about your understanding of teaching and discuss about your teaching experience till now. I won't be recording, and this is why I would like to apologize for taking notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Teacher A: No problem. Go ahead.

Researcher: Can you please describe your classroom?"

Teacher A: My classroom is a combination of students from different backgrounds. The majority have illiterate parents or parents with little education. The parents don't have time to spend with their children. If a student's parent does not have time to spend beside his child teaching him his homework, then for sure, the student won't care a lot to achieve his best".

Researcher: So let me remind you of the purpose of the interview. I want you to describe your classroom in terms of taught lessons. Do you consider it to be traditional or traditional?

Teacher A: I believe that my classes are combination of both. Sometimes I do ask students to sit in groups, and I assign to them exercises to solve them together. I even assign roles to each member of the group. I even use power point in some of the lessons while explaining.

Researcher: So let me see if I got it. You do integrate in your classroom instruction power Point Presentations and do ask your students to sit in groups in order to be following the nontraditional method of teaching. Isn't it?

Teacher A: Yes. No one nowadays teaches in the traditional way. Classes are shifting from the teacher-centered strategy to the student-centered strategy.

Researcher: Do you believe that children get prior knowledge to their classrooms?

Teacher A: Yes if they were taught from before. Someone should have taught it to them or else why do we have teachers? Children can not build on knowledge without having a pre-taught one. Without the help of an elder, the students will lose focus.

Researcher: Between behaviorism (Reinforcing good behavior) and constructivism (building on prior knowledge), which strategy do you prefer to adapt in your class?

Teacher A: I believe that students learn for a purpose. They study to achieve their exams. One of the rewards is the grade they earn. This is why I am with the reinforcement. It's as if a child receives a stamp every time he does something correct. The child will be tempted to do the good thing in order to get another stamp and so on.

Researcher: So you don't favor the constructivist teaching strategy which is based on the idea of students building their new knowledge based on older ones that they have built on their own?

Teacher A: I am not that familiar with this strategy, but I believe that all students should be taught by someone. Yes we can be helpers sometimes and not give them answers directly. However, they need someone to direct them.

Researcher: Would you like to add anything?

Teacher A: No thank you and good luck with your research.

Researcher: Thanks

Transcription of the Interview with Coordinator A from Earth school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to understand your understanding of teaching and discuss your point of view towards several teaching strategies. I won't be recording, and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Coordinator A: Ok.

Researcher: Can you please describe a classroom you coordinate?

Coordinator A: What do you mean?

Researcher: I want you to think of the classroom in terms of students and lesson plans. I want to get an idea of how you design the lesson plans with the teachers. Do you take the students into consideration while working on the lesson plan?

Coordinator A: Yes sure. When the teachers prepare lessons, they are expected to think of the student as the center of the classroom. They shouldn't prepare the lesson in a way where they are the only providers of information.

Researcher: So do you consider the lessons you coordinate to be traditional or nontraditional?

Coordinator A: The taught lessons vary. If a lesson requires some nontraditional teaching, then yes, I do ask the teachers to integrate some group work.

Researcher: Do you support the teachers when they request some extra materials in order to integrate some new strategies into the classroom?

Coordinator A: It depends on the budget. We work in a public institution funded by the state. So it is not easy to ask for a lot of facilities. It requires a lot of process.

Researcher: So do you adapt or ask your teachers to adapt a specific teaching strategy such as the constructivist teaching strategy?

Coordinator A: No I don't adapt a particular teaching strategy, and I don't ask the teachers to adapt any. Anyway, not all the teachers are trained to use several teaching strategies. They come from the old school.

Researcher: So, do you believe that students come from their societies with some pre-gained knowledge, and they build on them without the interference of the teacher?

Coordinator A: Oh yes. Student do [Sic] learn from the society; however, this is not enough. The teacher is a main part of the learning process.

Researcher: So, in your opinion, the presence of the teacher is very important. She is not only a facilitator but the center of the teaching process?

Coordinator A: Yes. The teacher is a main part of the teaching process. She should always be around for the learning process to occur.

Researcher: Would you like to add anything?

Coordinator A: No thank you it was a pleasure talking to you.

Researcher: My pleasure too. Have a nice day.

Transcription of the Interview with teacher B from Mars school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to understand your understanding of teaching and discuss a little bit your teaching experience till now. I won't be recording and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Teacher B: No problem.

Researcher: Can you please describe your classroom?

Teacher B: Do you mean in terms of activities?

Researcher: Yes. I want to get an idea of how you design your lesson plans. Based on what? Do you follow a specific theory? Do you consider it to be traditional or nontraditional?

Teacher B: In my case, I cannot be that much creative. I don't have a lot of facilities which can allow me to teach in a pure nontraditional way. Even though i know how to apply methods that are student centered; yet, the school does not help in this area.

Researcher: Is this because you teach in the public sector?

Teacher B: Yes. The public schools lack facilities such as LCD projectors and internet connections. How can a teacher get rid of the lecture method if the minimum requirement of the nontraditional methods are not available?

Researcher: Is adapting a nontraditional strategy limited to internet and LCD projectors?

Teacher B: No of course. I put them in groups sometimes. Believe me when you see that the school administration does not appreciate a lot such work, and when you see other teachers lecture all the time, you feel demotivated.

Researcher: What are the learning theories that you are familiar with and which one you feel you adapt if you were given the chance to do a change in the school such as constructivism?

Teacher B: I am not familiar with names, but I know that there is the student-centered strategy which stresses on the student being the center of the learning process. I don't like to be traditional all the time. I feel bored and so do the students. This is why I implement group work and hands-on activities as much as I can to be creative.

Researcher: Would you like to add anything?

Teacher B: No thank you.

Researcher: Thank you and have a nice day.

Transcription of the Interview with Coordinator B from Mars school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to understand your understanding of teaching and discuss your point of view towards several teaching strategies. I won't be recording, and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Coordinator B: Ok.

Researcher: Can you please describe a classroom you coordinate? I want to think of the classroom in terms of students and lesson plans. I want to get an idea of how you design the lesson plans with the teachers. Do you take the students into consideration while working on the lesson plan?

Coordinator B: When the teachers prepare lessons individually, they are expected to think of the students. However, the more important thing is for them to think how to deliver the information to the students and achieve the objectives of the lesson.

Researcher: So do you consider the lessons you coordinate to be traditional or nontraditional?

Coordinator B: Neither one. As I said before, it depends on the purpose of the lesson. If the lesson requires group work for example, then the teacher is expected to put the students in groups.

Researcher: Do you support the teachers when they request some extra materials in order to integrate some new strategies into the classroom?

Coordinator B: It depends on the budget. Usually it is not easy to require new materials except at the beginning of the academic year since we work in a public institution.

Researcher: I understand. Do you adapt or ask your teachers to adapt to a specific teaching strategy such as the constructivist teaching strategy?

Coordinator B: No I don't. What do you mean by constructivist teaching strategy?

Researcher: It is an strategy where the students are encouraged to use their prior knowledge in order to build on them new ones.

Coordinator B: Not all the teachers are trained to use several teaching strategies. We prefer to stick to the strategies we are familiar with.

Researcher: So, in your opinion, the presence of the teacher is very important. She is not only a facilitator but the center of the teaching process?

Coordinator B: Yes. The teacher presence is essential. Learning does not occur without her presence. She should always be around for the learning process to occur.

Researcher: Would you like to add anything?

Coordinator B: No thank you.

Researcher: Thank you.

Transcription of the Interview with teacher C from Venus school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to your understanding of teaching and discuss a your teaching experience till now. I won't be

recording, and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Teacher C: Ok.

Researcher: Can you please describe your classroom?

Teacher C: My classroom is a normal one. It contains students, a board, bulletin boards with some themed decoration and a teacher.

Researcher: Yes sure. I want to get an idea of how you design your lesson plans.

Teacher C: I see from the yearly plan the objectives behind the lesson and I design it according to it and gets approval from the mathematics coordinator.

Researcher: Do you follow a specific theory? Do you consider your lessons to be traditional or nontraditional?

Teacher C: I cannot adjust in the curriculum design. I have to work parallel with the coordinator. We sometimes try to implement some new activities. The school does not support us with what we need easily and it takes forever to order new material. Sometimes I get from my own budget, but for how long should I do this? This is why none my classes are neither pure traditional nor nontraditional. They are combination of the two. Whenever I can I try to put the students in groups. I don't have a lot of facilities which can allow me to teach in a pure nontraditional way.

Researcher: Is this because you teach in the public sector?

Teacher C: Yes. The public schools don't supply their staff with advanced materials. We still have the overhead transparency. We don't have any LCD projector so how am I going to make the kids for example watch a documentary or simply share with them a power point presentation?

Researcher: If you hear the phrase 'constructivist teaching strategy', what is the first thing that comes to your mind?

Teacher C: I don't know. Maybe…it is related to students constructing things! From its meaning, I can tell that it is not traditional, but I am not familiar with the strategy itself.

Researcher: What are the learning theories that you are familiar with and which one you feel you adapt if you were given the chance to do a change in the school?

Teacher C: I don't know. Does student-centered strategy count?

Researcher: yes sure. Student-centered strategy is a type of constructivist teaching strategy.

Teacher C: So yes I would like to apply it in all the classrooms. I would like to give the teachers workshops regarding this issue and draw their attention to several ways to apply it.

Researcher: Would you like to add anything?

Teacher C: No thank you for drawing my attention to different techniques. I will try my best to read about them.

Researcher: You are welcome. Have a nice day.

Transcription of the Interview with Coordinator C from Venus school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to know your understanding of teaching and discuss your point of view towards several teaching strategies. I won't be recording and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Coordinator C: Ok no problem.

Researcher: Can you please describe a classroom you coordinate? I want you to think of the classroom in terms of students and lesson plans. I want to get an idea of how you design the lesson plans with the teachers. Do you take the students into consideration while working on the lesson plan?

Coordinator C: Yes. When the teachers prepare lessons they are expected to integrate different strategies such as cooperative work. Then, I add my comments and approve the work.

Researcher: So do you consider the lessons you coordinate to be traditional or nontraditional?

Coordinator C: They are mixture of both. Some lessons require traditional strategies where the teacher needs to lecture in order to introduce new concepts; however, when the students are applying concepts, the class then can be held in a non-traditional way.

Researcher: Do you support the teachers when they request some extra materials in order to integrate some new strategies into the classroom?

Coordinator C: We work in a public school, so requests should be done at a specific time and are not easily acquired.

Researcher: Do you adapt or ask your teachers to adapt a specific teaching strategy such as the constructivist teaching strategy?

Coordinator C: No. it is not easy to do such work in a public school.

Researcher: Ok. If you hear the word 'constructivism', what is the first thing that comes to your mind?

Coordinator C: I believe constructivism should be constructing 'something'. Maybe the students construct what they learn and develop them in models. Let me tell you something: not all the teachers are trained to use strategies that are far away from the traditional ones. However, if they were trained, it would make the learning process easier.

Researcher: So what do you have to say regarding the student center strategies versus the teacher center strategies?

Coordinator C: The teacher presence is very important. Learning does not occur without her presence. However, I am not saying that the students should be the center too. I believe a bit of each does not harm. The teacher should control the teaching situation and at the same time take the students into consideration.

Researcher: Would you like to add anything?

Coordinator C: No.

Researcher: Thank you.

Transcription of the Interview with teacher D from Jupiter school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to know your understanding of teaching and discuss a little bit your teaching experience till now. I won't be recording and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Teacher D: Ok. No problem.

Researcher: Can you please describe your classroom?

Teacher D: My classroom?

Researcher: Yes.

Teacher D: What do you mean?

Researcher: I want to think of your classroom in terms of students and lesson plans. I want to get an idea of how you design your lesson plans. Do you take the students into consideration while working on the lesson plan?

Teacher D: Yes sure. When we prepare lessons, we always think of the student as the center of the classroom. At least this is what I do, and I try to share with my coordinator. This is what I learned while working on my teaching diploma.

Researcher: So do you consider your lessons to be traditional or nontraditional?

Teacher D: My lessons vary. I cannot all the time make the students work in groups. Sometimes I have to lecture in a way where I introduce the lesson and the new concepts. But when it comes to applications, I tend to put the students to work collaboratively.

Researcher: Do you get support from the administration? Does the school support you with facilitates that makes your job easier?

Teacher D: Yes sometimes. It depends on the budget. We don't get all of what we ask for. But at least, now we have data shows. We can at least integrate technology into the classroom.

Researcher: So do you adapt a specific teaching strategy? In other words, what are the teaching strategies that you are familiar with?

Faculty of Educational Sciences

Teacher D: No I don't adapt a particular teaching strategy. I try to prepare nontraditional classroom instructions. I try to put them in groups and make them get the solutions on their own.

Researcher: If you hear the phrase 'constructivist teaching strategy', what is the first thing that comes to your mind?

Teacher D: I have no idea, but from the words 'teaching strategy' I suppose it is a strategy the teacher can use.

Researcher: yes it is. It is a big umbrella for tiny strategies, but it is based on building on the students' prior knowledge. Tell me, do you believe that students come with some pre-gained knowledge, and they build on them without the interference of the teacher?

Teacher D: Oh yes. Students do learn from the society but not mathematics. They might see for example some geometrical shapes around them, but they can not link theories and calculate their perimeters, for example, if the teacher did not teach them how to do it.

Researcher: So, in your opinion, the presence of the teacher is very important. She is not only a facilitator but the center of the teaching process?

Teacher D: Yes. The teacher is a main part of the teaching process. She should always be around for the learning process to occur.

Researcher: Would you like to add anything?

Teacher D: No thank you it was a pleasure talking to you.

Researcher: My pleasure too. Have a nice day.

Transcription of the Interview with Coordinator D from Jupiter school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to recognize your understanding of teaching and discuss your point of views towards several teaching strategies. I won't be recording, and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Coordinator D: Ok.

Researcher: Can you please describe a classroom you coordinate? I want to think of the classroom in terms of students and lesson plans. I want to get an idea of how you design with the teachers the lesson plans. Do you take the students into consideration while working on the lesson plan?

Coordinator D: Yes. Yes. The students are very important when it comes to the lesson plan along with the objective.

Researcher: So do you consider the lessons you coordinate to be traditional or nontraditional?

Coordinator D: They are more non-traditional. We try to integrate more group work these days.

Researcher: Do you adapt or ask your teachers to adapt a specific teaching strategy such as the constructivist teaching strategy?

Coordinator D: If you consider group work and introducing power point presentations as constructivist leaning strategy, then yes.

Researcher: So what do you have to say regarding the student center strategies versus the teacher center strategies?

Coordinator D: The teacher presence is very important. Learning does not occur without her presence. However, I am not saying that the students should be the center too. I believe a bit of each does not harm. The teacher should control the teaching situation and at the same time take the students into consideration. However, the teachers should also be open and welcome new strategies and offers offered by the school to improve their teaching skills.

Researcher: Do you support the teachers when they request some extra materials in order to integrate some new strategies into the classroom?

Coordinator D: Yes, we do ask the teachers to fill out a paper where they can order any new reasonable material before the academic year starts.

Researcher: Would you like to add anything?

Coordinator D: No thank you.

Faculty of Educational Sciences

Researcher: Thank you.

Transcription of the Interview with teacher E from Saturn school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to cognize your understanding of teaching and discuss your teaching experience a little bit till now. I won't be recording, and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Teacher E: Ok. Go ahead.

Researcher: Can you please describe your classroom?

Teacher E: My classroom is dynamic.

Researcher: Aha! What do you mean by dynamic?

Teacher E: It means that I always let the students sit in groups.

Researcher: I want you to think of your classroom in terms of students and lesson plans. I want to get an idea of how you design your lesson plans. Do you take the students into consideration while working on the lesson plan?

Teacher E: Yes. When I prepare the lessons, I think of the student. In addition to the students, I think of the objectives of the lesson and try to find the best way to let the students achieve it.

Researcher: So do you consider your lessons to be traditional or nontraditional?

Teacher E: My lessons are made up of both. I sometimes put the students to work collaboratively. Sometimes I have to lecture to be able to teach them the new concept and then I ask them to apply it.

Researcher: So if you hear the word constructivism or the phrase constructivist teaching strategy, what come to your mind in terms of lesson plans?

Teacher E: I am not sure what constructivist teaching strategy is, but I believe from its meaning it is based on constructing learning. So the first thing that comes to my mind is going step by step with the students while teaching them a new concept.

Researcher: When you plan to introduce a new teaching strategy into your lesson plans, do you get support from the administration? Does the school support you with facilities to make your job easier? Does the coordinator help you?

Teacher E: Yes sometimes. It depends on the materials needed for the strategy to be achieved. If it is within the budget, then why not. I can integrate technology into the classroom with no extra costs since there is LCD projector in the classrooms.

Researcher: So do you adapt a specific teaching strategy? In other words, what are the teaching strategies that you are familiar with?

Teacher E: No I don't adopt a particular teaching strategy. I try not to be boring by allowing the students to move around from time to time.

Researcher: Do you think that students learn from the society and come to class with some knowledge?

Teacher E: Oh yes. Students do learn from the society. However, scientific subject matters need to be facilitated by the teacher. The student can not learn how to apply a formula from the society. The teacher should teach him how to do it.

Researcher: So, in your opinion, the presence of the teacher is very important. She is not there only to help the student but the center of the teaching process?

Teacher E: Yes. The teacher is a main part of the teaching process. Her presence is essential.

Researcher: Would you like to add anything?

Teacher E: No thank you it was a pleasure talking to you.

Researcher: My pleasure too. Have a nice day.

Transcription of the Interview with teacher F from Mercury school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to know your understanding of teaching and discuss your teaching experience a little bit till now. I won't

be recording and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Teacher F: Ok.

Researcher: Can you please describe your classroom?

Teacher F: My classroom is a classroom like all other classrooms.

Researcher: Yes sure. If you want to describe your classroom in terms of students and lesson plans, what can you say about it? In other words, I want to get an idea of how you design your lesson plans. Do you consider the students as the center of the learning process while working on the lesson plan?

Teacher F: When I prepare the lessons, I think of the student and try to design a lesson where all the students get engaged. Of course, I take into consideration also the objectives of the lesson taught.

Researcher: So do you consider your lessons to be traditional or nontraditional?

Teacher F: No I believe my lessons are nontraditional.

Researcher: What do you mean by nontraditional?

Teacher F: I mean that I don't lecture all the time. I ask the students to work in groups almost all the time.

Researcher: So if you hear the word constructivism or the phrase constructivist teaching strategy, what come to you mind in terms of lesson plans.

Teacher F: Constructivism? I am not sure? What do you mean?

Researcher: It is a learning theory. Let me rephrase my question. Are you familiar with different learning theories?

Teacher F: Yes, I know the behaviorist and the non-behaviorist. The behaviorist encourage reinforcement whereas the non-behaviorists don't encourage the reinforcement.

Researcher: When you plan to introduce new teaching strategy into your lesson plans, do you get support from the administration? Does the school support you with facilities that makes your job easier? Does the coordinator help you?

Teacher F: Yes sometimes. The coordinator is very helpful. She tries her best to make our demands become true. However, sometimes such things take time and need the approval of the administration.

Researcher: Do you think that students learn from the society and come to class with some knowledge?

Teacher F: Yes. Everyone learns from society. Student do [Sic] learn from the society.

Researcher: So, in your opinion, is the presence of the teacher important? Can the students learn on their own?

Teacher F: No they cannot. The teacher is a main part of the teaching process like the students. Her presence is very important and students cannot learn without her help.

Researcher: Would you like to add anything?

Teacher F: No thank you.

Transcription of the Interview with Coordinator F from Mercury school

Researcher: Good morning. I would like to remind you of the purpose behind the interview. We are going to have a short discussion and not a formal interview. I just want to cognize your understanding of teaching and discuss your point of views towards several teaching strategies. I won't be recording, and this is why I would like to apologize for having to take notes all the time. This is for the sake of the reliability of the data analysis later on in my study.

Coordinator F: Ok. Go ahead.

Researcher: Can you please describe a classroom you coordinate? I want to think of the classroom in terms of students and lesson plans. I want to get an idea of how you design with the teachers the lesson plans. Do you take the students into consideration while working on the lesson plan?

Coordinator F: The students are important; however, we can not neglect the importance of other details in the lesson plan such as achieving the objective of the lesson.

Researcher: So do you consider the lessons you coordinate to be traditional or nontraditional?

Coordinator F: The classes are mixtures of both. Sometimes the teacher has to lecture in order to introduce a new equation for example and sometime she can ask the students to sit in groups in order to apply this particular equation.

Researcher: Do you adapt or ask your teachers to adapt a specific teaching strategy such as the constructivist teaching strategy?

Coordinator F: We do integrate a lot of group work into the learning process.

Researcher: So what do you have to say regarding the student center strategies versus the teacher center strategies? When you hear the word 'constructivism', what comes to your mind?

Coordinator F: I believe it is important to learn new strategies, and it is important to apply non-traditional strategies; however, all of this requires training.

Researcher: Do you think that the teacher is the center of the learning process or are the students the center of the learning process?

Coordinator F: The teacher is important, and she is a facilitator and is the main source of the new information introduced; however, the students also are important. This is why we can not cancel the function of any of the two.

Researcher: Do you support the teachers when they request some extra materials in order to integrate some new strategies into the classroom?

Coordinator F: Yes why not. It is important always to have new ideas and the teachers are encouraged to search for new methods to be able to integrate the students with new strategies in order to enrich their learning.

Researcher: Would you like to add anything?

Coordinator F: No thank you.

Researcher: Thank you.

Appendix 14: Copies of the e-mails replied by some of the participants

███████████████████████████

Thu 25/02/2016 08:58
To:
Pascale Chibani;

Cc:
Kamal Abouchedid;
antoine.dagher@usj.edu.lb;

i don't mind to include the information you provided. please you promised not to include my name. good luck

███████████████████████████████

Wed 24/02/2016 12:19
To:
Pascale Chibani;

Cc:
Kamal Abouchedid;
antoine.dagher@usj.edu.lb;

You replied on 24/02/2016 12:21.

Action Items

ok Pascale. But your description show that I am not a good teacher since the class was working on classwork all the time. please i ask you nt to write my name or school as you promised me.

████████████████████████████████

Wed 24/02/2016 08:01
To:
Pascale Chibani;

Cc:
Kamal Abouchedid;
antoine.dagher@usj.edu.lb;

You replied on 24/02/2016 12:22.
thank you pascale. I would like to stress that if i had more facilities it would be more easier for me to use nontraditional teaching. i agree with ur analysis. good luck

Wed 24/02/2016 08:00
To:
Pascale Chibani;

Cc:
Kamal Abouchedid;
antoine.dagher@usj.edu.lb;

You replied on 24/02/2016 12:20.
Dear pascale. It was pleasure to meet you. I read the papers you attached and I like the way you summaries exactly what happened. i apologize again for not recording but as you know we should be allowed to allow you.

Tue 23/02/2016 12:19
To:
Pascale Chibani;

Cc:
Kamal Abouchedid;
antoine.dagher@usj.edu.lb;

You replied on 23/02/2016 12:27.

عزيزتي باسكال

لا مانع لدي الا ربما تتحسن طرق التدريس على يدك
الى الامام

Tue 23/02/2016 12:00
To:

Pascale Chibani;

Cc:
Kamal Abouchedid;
antoine.dagher@usj.edu.lb;

You replied on 23/02/2016 12:08.
Hi pascal

I have looked all the files and i agree with ur analysis. I wish you the best. i only ask you not to say my name since i work in public school.

Appendix 15: Transcription of interview with Teacher S from Star school conducted on April 2, 2016

Location: Semi-Subsidized School in Bekaa (Star)

Date: April 2, 2016

Name of Participant: Teacher S

Name of Transcriber: Pascale Hajal-Chibani

On the 2nd of April 2016, the researcher met Teacher S in a room in Star school at 9:30 a.m.
The researcher prepared ahead of time a set of questions in order to guide the interview
since she planned to conduct a guided interview.
The interview started at 9:30 a.m. sharp.

I[10]: Before we begin the interview itself, I'd like to confirm that you have no problem to record our conversation which will help me while transcribing the interview and will give me the chance to participate more in our conversation and not be taking notes all the time.

S[11]: Yes no problem.

I: Can you please describe your classroom?

S: My classroom is a mixture of students with different academic abilities.

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[10] **"I" refers to the interviewer which is the researcher in this study.**

[11] **"S" refers to the participants (Teacher S from Star school)**

I: Can you explain more? What do you mean by different academic abilities?

S: What I mean is that they come from a culture that prohibits freedom of thoughts. Their parents are illiterate. This is why it affects the students' ability to study. For example… let me phrase the sentence in this way. I try to use different teaching strategies but the school environment does not help me and that the background the students come from does not allow me to be free in the class and trust them.

I: Can you compare a traditional classroom to a nontraditional one? And can describe a class that you think you have taught in a nontraditional way?

S: A traditional classroom is when the teachers only lecture. A non-traditional classroom is when the teacher integrates computer or group work for instance. *(Knocking on the door).*
        Yes! Please come in. *(A teachers goes in and takes a pile of papers).* I apologize for this. So if I ask my students to solve a problem for example then I will be teaching in a non-traditional way.

I: So what is the role of the teacher in the class?

S: She helps the students to learn. She explains new concepts and helps students apply them

I: Excellent. So if I tell you the word "prior knowledge". How can you relate it to students? Do you believe that children get prior knowledge to their classrooms? Do they build on their prior knowledge or just use them to understand a new concept?

S: The students gain knowledge from previous lesson explained by the teacher and then they they they بيستعملوهن.

I: So you don't believe that they build on their prior knowledge. Students just use the prior knowledge to understand a new concept.

S: Yes

I: Between behaviorism (Reinforcing good behavior) and constructivism (building on prior knowledge), which strategy do you prefer to adapt in your class?

S: Actually I am not aware of the word constructivism. I usually reinforce the students' good behavior and good learning. When I explain a new lesson, I expect from the students to solve the problems correctly.

I: What do you understand by students "construct understandings"?

S: I think it means like I said before that the students understand a concept and then they learn a new one and link both to apply later on.

I: You said that you are not aware of the term "constructivism"; however you kow that there are several teaching strategies.

S: *Ehemm*

I: So, do you believe that the school plays a role in helping the teachers fulfill the constructivist teaching strategy or any other strategy? And how?

S: Yes for sure. The teachers are not are qualified to tach small kids and early grades. Some of them need to be trained on how to deal with kids and how to use different strategies. طرق التدريس بصضد التطور لازم نتدرب عليها. You know that some teachers have been here forever. Some of them have been teaching for 15 or 20 years.

I: Does the curriculum you are adopting to teach the lessons help you move from a traditional strategy to a non-traditional one?

S: Sometimes. I do not put the curriculum. I try to change in the lessons I prepare. As you have seen from the classes you observed, I have 30 students squeezed in one room. There is no way to differ the strategies of teaching.

I: Would you like to add anything?

S: No thank you.

I: Thank you so much for your valuable time.