Developing the chemistry teachers' preparation program at the Faculties of Education in the light of Nanotechnology Concepts and Applications

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Abstract

The current study aimed at developing chemistry teacher preparation program at Faculties of Education in light of Nanotechnology concepts and applications. To achieve such an aim achecklist of Nanotechnology concepts and applications ought to be incorporated in chemistry teacher preperation program in Faculities of Education, Two other standdard checklests ought to be considered in the objectives and content of chemistry teacher preparation program in faculties of Education in light of Nanotechnology concepts and applications were also prepared. Then, the objectives and content in chemistry teacher preparation programs at Banha, Ain shams and Alexandria universities were analyzed in light of the final version checklist of objectives and content standards. Based on the results of evaluating chemistry teacher preparation program in faculties of Education, aproposed ideation of chemistry teacher preparation program concepts and applications was prepared. The results revealed that the level of objectives and content of chemistry teacher praparation program at Banha, Ain shams and Alexandria universities concerning the objectivies and content standards in light of Nanotechnology and its applications is weak / poor.

Key words: Nanotechnology and its application – Chemistry teacher Preparation program.

Introduction:

Now adays, there are rapid and successire changes in the various spheres of life due to the scientific and

technological development. This necessarily affects curricula in general and science curricula in particular. One of the scientific revolutions that affected the various fields of life in Nanotechnology .

Nanotechnology is spreading rapidly. It is not only confined to a specific field of science, but also to the advent of some recent or modern sciences. These include Nanobiology, Nanophysics, Nanochemistry and Nanocomputers (Abdel Fattah,2013:240).

Nanotechnology is conserned with nanomatrrials, identifying their chemical, Physical and mechanical properties and studying the related phenomena emerging from minimizing their sizes. It is important to refer that minimizing the materials sizes and measures to the level of Nanometere is not an end in itself. It is an advanced scientific philosphy and a specific revolation against the classics the physical and chemical theories, This aims at producing a new category of materials known as Nano-materials whose characteristics/ properties are consistent with the requirements of advanced technology for the applied aim of Nanotechnology (Al-Eskandarany, 2010: 21).

That is why curricula should cope with modern technological and scientific progress and make use of Nanotechnology in the various spheres of life.

Integrating Nanotechnology into the various curricula is a must in 21st century. It helps in integrating the basic branches of science. It has become then necessary to make changes in the school curricula to cope with recent and modern developments (Xie and Pallan, 2012: 1807).

El-Mehy (2008:1101) confirmed that preservice teacher preparation programs should contribute to developing teaching science in the coming decades. This requires that the academic component in science teacher preparation programs should be reconsidered so that students become able to acquire knowledge and the skills that actually help them cope with the scientific and technological development.

Teacher preparation is one of the most issues educationists and experts in most countries of the world are concerned with. Its success depends on several factors include curricula, finance, social circumstances and most important is the teacher.

These are several studies that paid much interest to teaching Nanotechnology. These include Chin-Kuan(2006), Alford(2007), Jones et.al (2007), Jeremy (2009), Hany(2010), Gardener et.al (2010), Abdel-latif (2011), Lan(2012), Abdel-Fattah(2013), Hafez(2015), Ghattas(2015), Lin and Lin (2016), Habib (2017), Askar (2017), Darwish and Abu-Amra (2018), Inaddition, there are some other studies conducted in various fields such as Islamic studies (Al-Hoshany,2012), Economics (Mazid and Abbas,2011), Medicine (Kumar,2012), Chemistry (Nairat, 2013), Nutrition (Al-Sherif,2015), Law(Mesbeh, 2014), Mining and Petrolium (Al-Jabri, 2015).

Proplem and Questions of the study:

Out of scrutinizing chemistry teacher preparation programs at Benha, Ain-Shams and Alexandria universities and seviewing Literature and studies related to Nanotechnology, it becomes evident that chemistry pre-service teachers at the faculty of Education, Benha

university have lack in the acquisition of Nanotechnology concepts and applications.

To tackle such aproblem, the current study attempted to answer the following main question:

What is the proposed ideation of developing chemistry teacher preparation program at faculities of Education in light of Nanotechnology concepts and application?

Out of this main question, the following subquestions were derived:

1. What are the Nanotechnology concepts and applications ought to be incorporated in chemistry reacher preparation at faculties of Education?
2. What are the standards ought to be available in the objectives and content of faculties of Education?
3. To What extent does chemistry teacher prepartion program contain such standards?
4. What is the the proposed ideation of developing chemistry teacher preparation program at faculties of Education in light of Nanotechnology concepts and applications?

Significance of the study:

In light of findings of the current study, it might be significant to:

1. Preparing well-qualified chemistry teachers that can cope with the rapid and successive technological developments at the local and international levels.
2. Directing pre-service teachers' as well as in-service teachers' attention to the importance of coping with the tremendous and rapid progress in the field of Nanotechnology.

3. Providing teacher preparation program as well as curriculum developes with a checklist of Nanotechnology concepts and applications that might be of benefit to be incorporated in such programs and curricula.
4. Opening new avenues for nesearches in the field of Nanotechnology concepts and applications.

Delimitations of the study

The current study is delimted to:

1. Evaluting chemistry teacher preparation program in some faculties of Education including Benha, Ain-Shams And Alexandria.
2. Chemistry courses included in chemistry teacher preparation program at faculties of Education.
3. Only the objectives and content of the proposed ideation of developing chemistry teacher preparation program.

Terms of the study:

1. Developing chemistry teacher preparation program the term is used in the current study to refer to the quantitative or qualitative change in the educational experiences of chemistry courses in chemistry teacher preparation program in faculties of Education in which these are agroup of technological imovations such as Nanotechnology concepts and issues.
2. Nanotechnology The termis used here to refer to the very minute technology. It is a scientific application which produces things through grouping them from their basic constituents such as atom and molecule,

Its technological applications can be used in several scientific fields.

Theoretical Framework

Section One: Nanotechnology:

Concept of Nanotechnology:

The Term " Nanotechnology" consisted of two elements. The first element is " Nano" derived from Nanos which means the very minute or tiny unit of measurement.

Nanometer (NM) is aunit for measuring the length of very tiny things and helps to create new materials that have innovative characteristics and arrangements not available in nature (Abdallah, 2012:15).

The second element is technology, an old Greck word derived from "Techno" which means the technical skill, and "Logos" which means study. So the Word technology refers to how to apply knowledge to specific purposes. It is also aset of applied scientific knowledge and skills that aim to apply the findings of scientific research for the sake of finding mnique and innovative solutions to a certain problem (Al-Eskandarany .2010:24).

Mohamed(2010:18) defined Nanotechnology as " The advanced technology that is based on the study of Nano sciences and Humanities with the availability of technological abilities that help in creating Nano material, controling their inner structures and re-arranging the constituent atoms and molecules. This aims to have unique and innovative products".

On The other hand, Hingant and Albey (2010:121) defined it as " The attempt to understand the behavior the

mat the level of atoms and molecules measuring 1-100 Nanometer with the aim and tiny devices and system having new functions and characteristics".

To conclude, Nanotechnology is used in this study to refer to the very tiny technology and scientific application that produces things from their basic constituents (e.g. atoms and molecules) and whose technological applications are of benefit in several scientific fields.

Studies related to developing Nanotechnology concepts:

There are several studies that aimed to develop Nanotechnology concepts through designing some units. Examples include : El-sayeh and Hani (2009), Abdel-fattah(2013), El-Takbi(2016), Ayad(2017), Habib(2017), such study findings revealed that the proposed unit proved to be effective in developing Nanotechnology concepts.

There are also some studies that were concerned with designing programs through Nanotechnology concepts were developed, such studies include: Al-Deryosh (2011), Al-Shehri (2012), Ahmed(2015), Salah(2012), Salama et.al(2017). All such studies proved that the proposed programs were effective in developing Nanotechnology concepts.

Some other studies (Hani,2010; Noshi,2016; Sakhanini and Blonder,2016; and Melkawi,2017) nevealed the effectiveness of proposed courses in Nanotechnology in developing its concepts.

In addition there are some studies that revealed the low level of Nanotechnology concepts and recommended that the educational system in general and curricula in

particular be developed in light of Nanotechnology concepts.

Examples include Jeremy(2009), Fazarro et.al(2011) ,Hill et.al(2013) and Hafez(2015).

Besides, there are some studies that dealt with developing Nanotechnology concepts in the various branches of science for example in Physics (Abdel-fattah,2013 and Noshi,2016). Also there are three studies in Biology (Hany,2010; Hafez,2015; Salma et.al,2017. In Chemistry (Khalifa,2017 and Askar,2017).

2.Nanotechnology Application:

The applications of nanotechnology have no longer become afiction; they have become areality and may lead to anew industrial, such applications are expected to penetrate the various spheres of life including medicine, agriculture, nutrition, invironment, psychology, electronics and computers, in addition to the military and exploratory field in the near and far space.

The applications of Nanotechnology are various. They pervade the productive, industrial, medical, electronic and military. According to Salama(2009), Hussein(2016) and Noshi(2016), the following are some of Nanotechnology application:

1. Medical field, where Nanotechnology aims to develop Nanodrugs and the equipments used for medical purposes.
2. Energy where research in Nanotechnology aims to provide safe, clean and alternative energy. It also aims to convert solar energy into an inexpensive electric one using Nanosilicone.

3. Food where Nanotechnology applications include food industries with the aim of increasing production, improving its quality and developing its packaging.
4. Agriculture where Nanotechnology researc aims to overcome pesticides and store fruit and vegetables as well as plant and animal medicine.
5. Idustry where Nanotechnology include tissues industry, auto-cleaning clothes, electronic circuits, tiny layers for painting surfaces and cameras (for illustrating chemical interaction in femtoseconds's time) industries.
6. Environment where Nanoapplications include Nanopurifiers or filters to purify air and water, solving the problems of Nano-wastes and removing dangerous elements from industrial wastes.

In Addition to the above mentioned, there are some other application in fields of aerospace, building and construction and media.

Section Two: Local and International Efforts concerned with Nanotechnology.

With the advent of the term Nanotechnology in the beginning of 21st century, several advanced countries made professional strategies and plans for developing Nanotechnology sciences and techniques. The number of world companies increased in the field of Nanotechnology sciences, according to the most important international site www.statnano.com ,amounting to 1921 companies of which 296 work in the field of raw materials, and 276 work in the field of Biology and Medical Biotechnology. In addition, there are 1193 companies work in the field of

products and electronic devices and applications and 190 work in the field of services and mediation. It also reached to various fields including electrical or electronic devices, cars manifacturing, cosmetics, construction, spinning, weaving, energy, medicine and agriculture etc…..

There is rapid race among all world countries in Nanotechnlogy research, applications, investment and conferences entitled "Keeping pace with" or "Retreating". This is also realized by arab countries which attempted to keep pace with the advanced countries in Nanotechnology (Salama,2009:209).

-Efforts Exerted by Egypt in Nanotechnology:

According to Egypt's plan for Mpgrading science and technology system, the first Nanotechnology center in Egypt was set up, IT has three functions:

1. Setting up ascientific database in Nanotechnology for researches.
2. Making participatory programs in researc, development and creativity.
3. Cooperation with industrial companies and to produce research and development products for the local and world markets.

There are several centers that are with Nanotechnologym These centers include:

1. Egypt Nanotechnology center.
2. Kafr El-sheikh Nanotechnology center.
3. Advanced technology research indstitute at scientific research and technological applicaton city.
4. CNT-Zewail.
5. CNT-Nile University.

6. Setting-Up Nanotechnology sciences faculity, Cairo University, Egypt (Under Construction).

Section Three : Developing Chemistry teacher preparation programs:

Xie and Pallon (2012:1807) pointed out that teaching Nanotechnology is an urgent need in 21st century as it is the field through which basic branches of science can be integrated. This helps make the integration of Nanotechnology concepts and applications in the various curricula possible.

There have been several local and world attempts to integrate Nanotechnology in the educational system. That is why it has become necessary to focus on developing preparation such as expected transition. This can take place through changing university programs and developing the relationship with educational and research institutions (Carolyn and Hutchinsem,2010).

Steven and Krajcik (2007) stated that the structure of science subjects taught nowadayes at the faculties of science and Education is not ready for such integration, in addition to the ineffective methods of teaching delivery. So, new strategies for science teaching must be introduced. This helps preoare students who are capable of applying knowledge to their lives in an integrative frame work for physics, chemistry and biology topics, there by, integrating Nanotechnology concepts and applications in all specialities.

Demensions of teacher preparation at Faculties of Education.

Preparing teachers at Faculties of Education in Egypt relies on three main dimenions, namely: the cultural, academic and professional (Mohammed, 2017: 122-126).

The academic dimension refers to the subject matter he/she is going to teach and how he/she should be competent in. While the professional preparation is related to the pedagogic competence and founndations, the cultural dimension is related to general literacy required for becoming an effective teacher.

Teacher preparation programs are designed in away that the academic dimension should have 75% of the total hours of the program. The remaning hours should be distributed to 20% to professional preparation and 5% to the cultural dimension (National Document for Evaluating and Accreditating Faculties of Education in Egypt, 2010:7).

Teachers' mastery of Nanotechnology concepts and their understanding of the moral and social dimensions affects their teaching. Also, what teachers leason during their preparation programs certainly affects their perceptions of what they feel important while teaching. That is why teacher preparation programs should be continously mp-dated.

There are several studies concerned with teaching Nanotechnology either in teacher preparation programs or for inservice teavhers. The former include Hani(2010), Salama, Habashi and Al-Sadek(2017), Saleh(2013), Darwish and Abu-Amra(2018), Abdel-Latif(2011), Lan(2012), Cox(2013), Ghattas (2015) and Sakhanini and Blonder(2016).

However, there are few studies that integrated Nanotechnology concepts in Chemistry, Biology, Science and Agricultural science teacher preparation programs. Also, to the researchers' knowledge, there are no studies

conducted in the field of developing chemistry teacher preparation program at Faculties of Education in light Nanotechnology concepts and applications.

Hypothesis of the study:

In light of literature review and related studies, the following hypothesis was formulated:

The level of integrating Nanotechnology concepts and applications into chemistry teacher preparation program is not sufficient (not less than 30%).

Procedures of the study:

First: Preparing achecklist on Nanotechnology concepts and applications ought to be incorporated into chemistry teacher preparation program at Faculties of Education.

Aim of the checklist:

The checklist aimed to identify the most important Nanotechnology concepts and applications necessary for pre-service chemisrty teachers in terms of importance and appropriteness to chemistry teacher preparation program according to educationists' and academics' viewpounts.

Sources of the checklist:

The sources of the checklist include:

1. Books and literature related to Nanotechnology, its concepts and applications.
2. Research and studies related to Nanotechnology.
3. Local and world directives concerned with integrating Nanotechnology into various courses.
4. Some Internet sites that are related to Nanotechnology.

5. Projects concerned with integrating into chemistry teacher preparation program at Faculties of Education.

Construction and validity of the checklist:

The checklist was prepared in the form of main topics and concepts bearing on such topics. Each item had three responses including important, of little importance and unimportant, as well as the appropriateness of each item to chemistry teacher preparation program (Appropriate – Not appropriate).

The first version of the checklist was submitted to apanel of Jury members (n=22) from the faculties of science and Education. The jury members had their remarks and viewpoint which the researches modified the first version according see Appendix (5) for the final version of the checklist.

Second: Preparing the standard chechlists (Objectives-content) of chemistry teacher preparation program at Faculties of Education in light of Nanotechnology concepts and application.

Objectives standard checklist:

Aim of the checklist:

It aimed at identifying the standards of each of cognitive, affective and psychomotor objectives ought to be incorporated in the objectives of chemistry teacher preparation program at faculties of Education. This was done as apreliminary step towards measuring whether Nanotechnology concepts and applications are contained in the current chemistry teacher preparation program.

Sources of the checklist:

The sources of the checklist include:

1. The results of validating the checklist in its final version.
2. Some previous studies including Jermy(2009), Hani(2010), Saleh(2013), Taha(2014), Mutambuki(2014), Ahmed, Abdel-Karim and Mohamed(2017), Salama, Al-Habashi and Al-Sadek(2017), Darwish and Amra(2018).
3. National researches of Faculty of Education evaluation and accreditation standards, Egypt (2010).
4. World projects concerned with incorporating Nanotechnology into chemistry teacher preparation program, see Appendix (6) for the final version of the checklist.

Third: Analyzing the objectives and content of chemistry teacher preparation program at Faculties of Education in light of the checklist of objectives and content standards:

Such analysis went through the following steps:

1. The objectives of chemistry teacher preparation program were analyzed to see whether the objectives determined in the objective standards checklist are contained in chemistry teacher preparation program.
2. The analysis instrument was represented in the objectives standard checklist (Final version) of Nanotachnology and its applications.
3. Analysis categeries were represented in the objectives standard checklist (Final version) of Nanotachnology and its applications.

4. The phrase was used as the analysis unit.
5. A sample of chemistry course descriptions for the four years of study at Benha, Ain-Shams and Alexandria Universities were analyzed.

The results of analysis were shown in the following table:

Table(1) Universities and course Descriptions

University		Chemistry course Descriptions in Bylow	Edition
1	Benha	26 Courses	2017/2018
2	Ain-Shams	24 Courses	2017/2018
3	Alexandria	24 Courses	2017/2018

6. Analysis Reliability: Analysis was conducted twice with a 2-week interval. The reliability coefficient was 0.979 reffecting that the analysis of objectives was reliable.

The findings revealed that:

1. The objectives of the current program in the three faculties were limited and do not cope with the changes and development occurding in light of the scientific and technological revolution where one of its foundations is Nanotechnology and its applications.
2. They also lack the skills and the behaviours students need in everyday life to deal with the recent scientific and technological applications in the field of Nanotechnology.
3. Furthenmore, they donot focous on the affective aspects related to attitudes, tendencies and

appreciation of scientific and technological innovations.

These findings require the comprehensive revision of the objectives of the current chemistry teacher preparation program in the three Faculities of Education.

Procedures of analyzing the content of chemistry teacher preparation program at Faculties of Education:

The content of the program was analyzed in light of Nanotechnology concepts and applications. The following steps were taken:

1. The aim of analyzing the content to see whether the content descriptions determined in the content standards checklist are available in the current content of the program.
2. The analysis instrument was represented in the content standard checklist (Final version) in light of Nanotechnology and applications.
3. Analysis categories were represented in the content standard checklist of Nanotechnology and its applications.
4. Analysis unit was the paragraph.
5. A sample of chemistry course content for the fours of study at Benha, Ain-Shams and Alexandria universities were analyzed.

The findings revealed that the level of manipulating the concepts of Nanotechnology and applications in chemistry courses in the academic year 2017/2018 was poor/weak. It is not sufficient enough.

So, the study hypothesis is supported and retained.

The proposed ideation of chemistry teacher preparation program in light of Nanotechnology concepts and applications:

The rationale of the proposed ideation relied on the results of evaluating the objectives and content of chemistry teacher preparation program. The results revealed that there is lack of Nanotechnology and its applications in both the objectives and contents of the current program. That is why it is necessary to help student teachers have ascientific foundation on recent scientific innovations (Nanotechnology) to be able to teach them in the future.

The proposed ideation included:

1. General objectives.
2. Preparing the structure of the proposed ideation.
3. Identifying the ways of incorporating Nanotechnology concepts and applications into chemistry teacher preparation program
4. Providing course descriptions of chemistry courses in the program.

Recommendations:

In light of the study findings, there are some recommendations that include the following:

1. The necessity of continuous evaluation for chemistry teacher preparation programs to incorporate scientific innovations.
2. Holding training programs for chemistry teachers to cope with the recent innovations, e.g. Nanotechnology and its applications.
3. Providing various learning resources that help faculty of Education students benefit from Nanotechnology and its applications.

4. Measuring the cognitive, affective and psychomotor skill aspects in teacher preparation programs.
5. Continuous acquaintance of teacher preparation course descriptions at the local and world levels to cope with changes and development of Nanotechnology sciences etc…..
6. Holding symposia and training programs for Faculity of Education students, scientific sections to acquaint them with the importance and daggers of Nanotechnology.

Suggestions for Future Research:

1. Developing physics teacher preparation program at Faculties of Education in light of Nanotechnology concepts and applications.
2. Developing Biology teacher preparation program at Faculties of Education in light of Nanotechnology concepts and applications.
3. A comparative study of the differences among chemistry teacher preparation programs at some Faculties of Education in Egypt.
4. Developing preparatory stage science curricula in light of Nanotechnology.
5. Preparing a proposed training program for in-service chemistry teachers in light of Nanotechnology and its impact on their students' achievement of Nanotechnology concepts and applications in 1st secondary grade.
6. Preparing proposed units for secondary stage students in light of Nanotechnology and applications and their impact on their decision taking.

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