

Developing the Chemistry Curriculum in Light of Requirements of Comprehensive Development of Egyptian Society and its Effectiveness in Developing Secondary Stage Students' Achievement and Appreciation Aspects

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Abstract:

In the light of reviewing literature pertaining to the development of chemistry curriculum in line with the requirements of the comprehensive development of the Egyptian society, and report issued by Nuffield Foundation in 2014 entitled Science Education in Europe: Critical Reflections, confirmed that there was a little attention given in the secondary stage Chemistry curriculum to the relationship between Chemistry and everyday life. Moreover, recommendations of the International Conference on Chemistry Education in 2013; which stressed the need to show the role of the curriculum in general and Chemistry curriculum in particular in making progress and achieving development.

Therefore, the problem of the current research lies in the need to develop secondary school chemistry curriculum in light of the requirements of the comprehensive development of the Egyptian society. It also lies in the need to instill an appreciation of the role of science and technology in solving everyday life problems in learners' conceptions. So, the research is limited to Chemistry secondary stage textbooks, for analysis purposes, a group of first-year secondary stage students, at Al-Lozi secondary school for girls in Damietta, a group of chemistry teachers and supervisors at the secondary stage, as well as science professors of curriculum and instruction, for validating the lists of the comprehensive development requirements and aspects of appreciation, the Comprehensive Development Requirements List of the Egyptian society to that should be integrated into the secondary stage chemistry curriculum, and Aspects of Appreciation Scale for the aspects that should be developed at the secondary stage students through the chemistry curriculum.

The research tools included; an achievement test of the comprehensive development requirements in the Egyptian society

integrated into the proposed unit entitled "Chemistry in our life" of the first-grade secondary stage chemistry curriculum, and a scale for measuring optimal aspects of appreciation among first-year secondary stage students.

The results indicate that; there was a statistically significant difference between the mean scores of the research group students in the pre- and post-test application of the achievement test on the comprehensive development requirements in chemistry, for the post-test. Moreover, there was a statistically significant difference between the mean scores of the research group students (who study the selected unit of the developed curriculum) in the pre-application and post-application of the scale of appreciation aspects in chemistry, for the post-application.

Keywords: Requirements of Comprehensive Development of Egyptian Society – Chemistry curriculum – Secondary stage-Achievement- Appreciation.

Introduction

This age witnesses a scientific revolution in all facets of life, particularly at the cognitive, scientific and technological levels. This revolution has led to drastic changes in life styles and patterns, leading, in turn, to many problems that need further study for problem solving. These problems pertain to the individuals' environment, health, nutrition, and the society, at large. That being said, the future will witness major scientific and technological breakthroughs in fields such as scientific research, atom applications and nanotechnology.

These current changes were equally manifest in Chemistry curricula. School curricula witnessed serious reform initiatives at both the Arab and international levels. That is, specialized conferences and symposia in Science education have been conducted; development projects have been designed for identifying the current reality of Chemistry instruction and suggesting alternative solutions and prospects for future development. New advances in Science have resulted in new trends in Chemistry instruction that cope with these advances. Calls and recommendations for re-structuring Chemistry curricula to cope with the requirements for comprehensive social development have been echoed by: The National Science

Teacher Association (NSTA) and The American AAAS Association for the Advancement of Science.

Chemistry plays a pivotal role in advancing humanity. Therefore, secondary school Chemistry curricula should integrate requirements of comprehensive development of society and pertinent concepts, skills, values and attitudes that could possibly qualify students for playing active roles towards achieving this comprehensive development. This could be made possible through investment of natural and human resources. There is a need for special developmental Chemistry curricula that focus on the problems and issues of development. These curricula should also include activities through which students could possibly attain scientific facts and develop positive attitudes, values and behaviors towards their community.

In the process of development, Egyptian society faces many challenges. These challenges include safety, stability, supplying basic life needs, power, water, transport, fuel, unifying the goals of society, achieving democracy, freedom of disseminating information, transparency, boosting production, advancing agriculture, upholding the national Egyptian identity, solving poverty, slums and illiteracy problems, supplying bread, freedom and justice among other crises sectoral and partisan facing Egyptian society.

It has been such a challenge for curriculum designers to reconstruct school curricula to keep pace with the needs of the community. That is, optimal Science curricula are those whose objectives, content and methods are focused on productive learning and teaching. That is, they are focused on teaching students functional scientific knowledge, behavior, skills and attitudes, as well as developing scientific tendencies and humanitarian values and attitudes towards the use of science and its societal applications (Salama, 2004, 43).

The study of chemistry is very important in everyday life due to the different ways in which it is used to interpret the

environment and its impact on the social behavior of the individual in relation to others. Therefore, experts in Chemistry reported aspects of appreciation the study of chemistry inculcates in learners as follows:

1. Clarifying the important and critical role played by Chemistry and its societal applications in daily lives
2. Clarifying the impact of scientific and technological development in the field of Chemistry on the welfare and advancement of society in the face of challenges
3. Clarifying the impact of scientific and technological development on human thought, beliefs, moral values and social responsibilities in relation to others
4. Illustrating the continuous efforts of scientists towards different scientific and practical achievements in the field of chemistry
5. Realizing the natural system and its underlying elements and laws
6. Recognizing aesthetic aspects in the universe (Thomas, 2015, 136)

Statement of the Problem

In light of literature review pertaining to the development of chemistry curricula in line with the requirements of comprehensive development of society, it was found that there was scarcity of research in this area in the Arab world. There was also a quantitative and qualitative shortage in foreign experience in this area. Examples of these studies include Chin, Ming and Hua's study (2013) that aimed at evaluating the content of Chemistry curriculum of eleventh grade secondary stage students in Taiwan in light of community development requirements. Examples also include Goodrum and Rennie's study (2014) that aimed at teaching Chemistry to tenth-grade secondary stage students at Illinois, USA, and explored the critical role of community development, and Norman's study (2014) which aimed at examining the role of secondary-stage Chemistry teachers in achieving community development.

A report issued by Nuffield Foundation in 2014 entitled "*Science Education in Europe: Critical Reflections*", confirmed that little attention was given in the secondary stage Chemistry curriculum to the relationship between Chemistry and everyday life. Conversely, scientific topics are presented as a series of steps advancing towards the scientific scene, the matter that lacks adequate examples illustrating chemistry applications in the contemporary world of secondary-stage students (Osborne & Dillon, 2014.21). Moreover, recommendations of several conferences such as the International Conference on chemistry education, 2013 stressed the need to highlight the role of the curriculum in general and Chemistry curriculum in particular in making change and achieving development. That is, through curriculum, it is possible to achieve economic diversity, address economic and social issues, transform information into an investment, improve the quality of life and achieve the security, stability and development necessary to cope with the 21st century challenges.

Curriculum is the cornerstone of positive and active participation in social, economic, political and cultural development. Thus, there is a need for Chemistry curriculum to promote students' national affiliation and belonging. It should prepare and enable students to engage actively in the development of their society.

Research Problem

The problem of this research lies in the need to develop high school chemistry curriculum in light of the requirements of comprehensive development. It also lies in the need to instill in learners an appreciation of the role of science and technology in solving everyday life problems. Thus, the present research attempts to overcome this problem by answering this main question: what is the proposed conception of the chemistry curriculum in light of the requirements of comprehensive development of Egyptian society and how effective is this proposed conception in developing achievement and aspects of

appreciation among secondary school students? This main question branches out into the following sub-questions:

1. What are the requirements of comprehensive development of the Egyptian society that can be integrated into the chemistry curriculum of secondary school students?.
2. To what extent are these comprehensive development requirements available in the chemistry curriculum of secondary school students?
3. What is the proposed conception of the secondary stage chemistry curriculum in light of the comprehensive development requirements of the Egyptian society?.
4. How effective is a unit of the proposed curriculum, integrating requirements of comprehensive development, in developing the secondary school students' achievement in chemistry?.
5. What are the major and minor aspects of appreciation that should be integrated in the secondary school chemistry curriculum in light of the comprehensive development requirements of the Egyptian society?.
6. How far are these aspects of appreciation developed among secondary stage students through the proposed chemistry curriculum based on comprehensive development requirements?.
7. How effective is a unit of the proposed curriculum, integrating requirements of comprehensive development, in developing the secondary school students' aspects of appreciation in chemistry?.

Terminology

Requirements of Comprehensive Development:

1. There are several definitions of 'Comprehensive development requirements'. For example, Williams (2007) defines it as a multi-faceted change process that aims at achieving social and economic growth, consolidating

concepts of patriotism, and strengthening individuals' capacities to improve their living standards.

2. Comprehensive development requirements can be operationally defined as an abstract description of a set of social, economic, environmental, cultural, scientific and technological needs and desires that enable members of the Egyptian society to improve ways to access all services and raise their living standards and conditions.

Appreciation in Teaching Chemistry:

Aspects of appreciation in teaching Chemistry can be defined in this research as "student's behavior based on his/her level of knowledge and awareness of chemical phenomena and their importance, his/her evaluation of these phenomena and, his/her response to certain stimuli, preference of certain behaviors and estimation and commitment to them through certain contexts such as:

1. The magnificence of God's creation
2. The role of scientists in general in the revival and development of Science and serving humanity
3. The role of science and technology in human welfare and solving life problems
4. Environment and its investment and maintenance

Research Significance

This research may hold significance in the following respects:

1. It sheds light on the current secondary school chemistry curriculum and how far comprehensive development requirements of Egyptian society are manifested.
2. It concerns with integrating the requirements of comprehensive development of Egyptian society into the secondary school chemistry curriculum as a trend that could possibly serve the community and contribute to its stability and development.
3. The list of comprehensive development requirements and the results of this research may be a useful addition to the

field of planning and development of curriculum, instructional materials and textbooks. It might also be beneficial to planners and developers of Science teacher preparation programs.

Research Objectives

This research aims at developing the secondary school chemistry curriculum in light of the requirements of comprehensive development of Egyptian society. It aims at investigating the effectiveness of this proposed curriculum in developing secondary stage students' optimal aspects of appreciation and achievement.

Research Delimitations

This research is limited to the following:

1. Chemistry textbooks of all three grades at the secondary stage, for purposes of analysis.
2. A group of first-grade secondary stage students, at Al-Lozi secondary school for Girls, Damietta.
3. A group of chemistry teachers and supervisors at the secondary stage, as well as professors of curriculum and instruction of science, for validating the lists of comprehensive development requirements and aspects of appreciation.
4. Comprehensive development requirements of the Egyptian society to be integrated into the secondary stage chemistry curriculum.
5. Measuring the effectiveness of the developed curriculum is confined to administering one unit of the curriculum to a group of first-grade secondary stage students.
6. Aspects of appreciation developed in the secondary stage students through the chemistry curriculum.

Research Tools and Materials

To test the research hypotheses and answer its questions, the following tools and materials were prepared:

1. A list of comprehensive development requirements that should be integrated into the secondary-stage chemistry curriculum.
2. A questionnaire for investigating students' opinions about comprehensive development requirements that should be integrated into the secondary-stage chemistry curriculum.
3. A list of optimal aspects of appreciation that should be promoted through the developed secondary-stage curriculum.
4. A proposed unit entitled "Chemistry in our life" in the developed first-grade secondary stage chemistry curriculum.
5. Teacher's guide to the proposed unit entitled "Chemistry in our life".
6. An achievement test of the comprehensive development requirements in Egyptian society integrated into the proposed unit entitled "Chemistry in our life" of the first-grade secondary stage chemistry curriculum.
7. A scale for measuring optimal aspects of appreciation among first-grade secondary stage students.

Method and Procedures

The quasi-experimental method was used for the purposes of this study. The experimental design was attempted through administering the tools of this research to a group of first-grade secondary stage students according to the following procedures:

1. Preparing the initial version of the list of comprehensive development requirements of the Egyptian society to be integrated into the secondary stage chemistry curriculum, submitting the list to a group of specialized jurors, making adjustments based on their opinions, and preparing the final version accordingly.
2. Analyzing the content of the secondary stage chemistry curriculum in light of the requirements of comprehensive development of Egyptian society.

3. Preparing the initial version of the list of optimal aspects of appreciation that should be promoted through the secondary stage chemistry curriculum ,submitting the list to a group of specialized jurors, making adjustments based on their opinions, and preparing the final version accordingly.
4. Preparing the the initial version of the proposed conception of the secondary school chemistry curriculum in the light of the comprehensive development requirements of the Egyptian society, including objectives, content, activities and methods of teaching and evaluation, submitting the proposed conception to a group of specialized jurors, making adjustments based on their opinions, and preparing the final version accordingly.
5. Preparing an achievement teston one of the units of the developed curriculum in light of the comprehensive development requirements of the Egyptian society, submitting it to a group of specialized jurors, making adjustments based on their opinions and checking test validity.
6. Preparing the scale of optimal aspects of appreciation in Chemistry for secondary stage students, submitting it to a group of specialized jurors, making adjustments based on their opinions and checking the scale validity.
7. Administering thepre-test of achievement andthe pre-scale measuring aspects of appreciation in chemistry to the research group.
8. Teaching the selected unit from the developed curriculum, using the teacher's guide,to the research group.
9. Administering the post-test of achievement and the post-scale measuring aspects of appreciation in chemistry to the research group.
10. Treating the results statistically and providing interpretations.

11. Providing recommendations and suggestions for further research.

Review of literature and related studies

Comprehensive development of society is one of the important issues that catch the interest of developing countries, including Egypt. It is considered a national issue for which all efforts of the community members must mobilize to benefit from science and technology in achieving a high standard of living and improve the quality of life.

There are various requirements for comprehensive development of Egyptian society, most among which are the following:

1. Technological requirements:

This age witnesses scientific and technological revolutions in various spheres of life that brought about change and development in the lives of individuals and communities. Change/development has become a key feature of this age, the age of technology, satellite and information.

2. Economic requirements:

They are manifest in increasing production, reliance on domestic savings as a source of investment, development of local capacity, and fair distribution of income and wealth in society to eliminate poverty.

3. Social Requirements:

They are manifest in improving education, health levels and well-being of all citizens, raising interest in the middle and working class, deepening values such as love of knowledge and hard work, and developing a national culture of patriotism.

4. Cultural Requirements:

They are manifest in raising awareness of societal thought and culture issues, consolidating values of reasoning versus rote-learning, emphasizing objectivity.

5. Environmental requirements:

They are manifest in promoting the efficiency of natural resources and effective governance of these resources.(Al-Sorougi, et al., 2001, 220)

In light of rapid developments in the field of chemistry, there is an urgent need to develop chemistry curricula in ways that help develop learners' abilities to solve societal problems, make appropriate decisions, and think in a scientific way.

There is a worldwide interest in developing Chemistry curricula towards optimal outcomes for individuals and society. However, chemistry still lags far beyond societal issues. Therefore, much criticism has been addressed to chemistry curricula in the United States and Britain for their incapacity to attract as many students as possible who could be potential scientists in the field.

In response to these critical views, chemistry curriculum-development initiatives grew active worldwide. Among these initiatives was the Australian Council for Educational Research report in 2010. This report echoed on the need to review secondary stage chemistry curricula in light of the outcomes and policies of the Societal Development Plan (see figure 1).

Figure 1 shows the importance of integrating life activities in the secondary stage chemistry curriculum to help students apply and use information and to instill in them behaviors of community participation, volunteering, rationalized production and consumption, optimization of resources, resource conservation and adherence to community culture and authentic, genuine values of society.

The following are methods used in some developed countries, such as USA and England, to teach requirements of comprehensive community development in the secondary stage chemistry curriculum (Clark, 2012):

1. Problem analysis method

Analysis of the problem directs learners' attention to processes that can be used to analyze any issue as a series of general procedures that can be applied on a large scale, addressing environmental, social and economic problems.

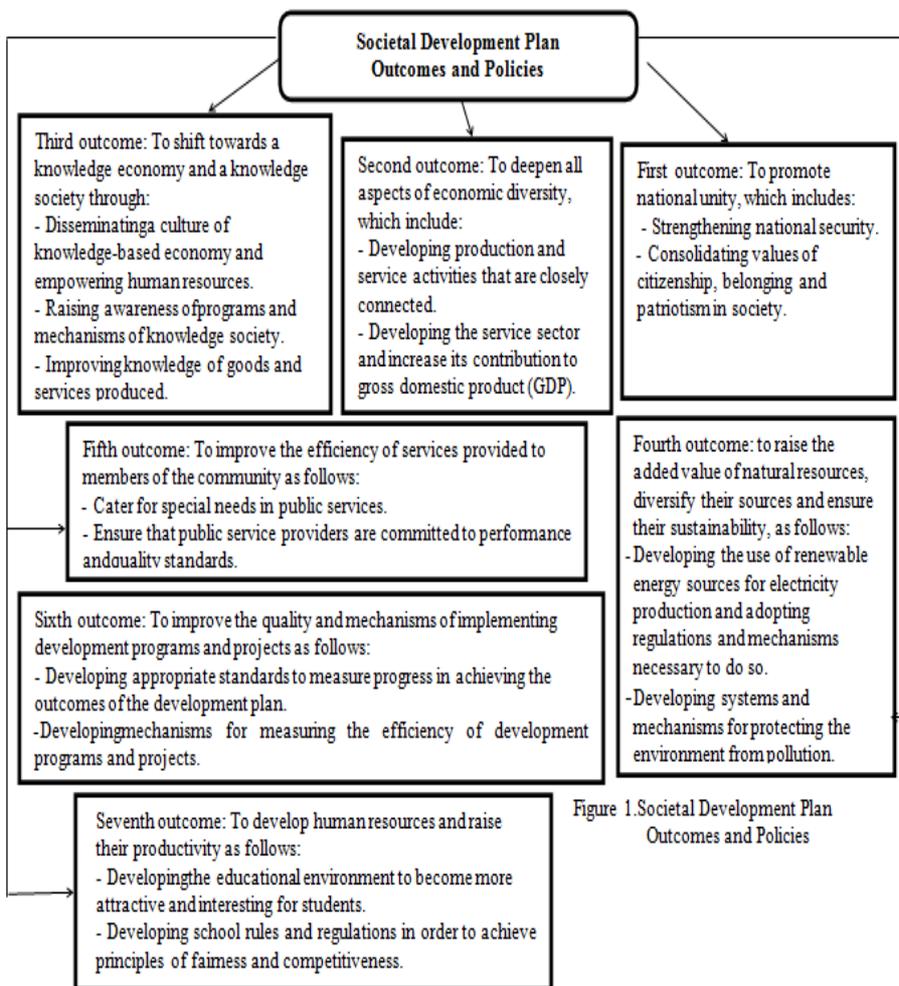


Figure 1. Societal Development Plan Outcomes and Policies

Figure 1. Societal Development Plan Outcomes and Policies

2. Storytelling

Storytelling is considered an effective educational tool to support community development, such as values derived from traditional stories and the wisdom of the elderly or inspired by stories of creatures, the matter that gives respect to the cultural heritage and environment.

3. Simulation

This is done by addressing the real-life problems faced by local communities, and strengthening the link between them and the curriculum. That is, problems are integrated into the curriculum and learners are engaged audio-visually, emotionally and physically in educational models designed to develop their problem-solving and high order thinking skills.

The following are some research attempts that focused on integrating community development requirements into the secondary stage chemistry curriculum:

Kulig, Kulig, Krupa and Nowatzki's Study (2008) aimed at using concept mapping as a tool to assist in teaching community development requirements to eleventh grade students as part of the concepts of the chemistry curriculum in Taiwan.

The results of Burman and Jakubowski's study (2010) consist with those of Kulig, Kulig, Krupa and Nowatzki's (2008) in that there was a statistically significant difference between the mean scores of the research group students in the pre-test and post-test of achievement of community development requirements in chemistry, in favor of the post-test. Burman and Jakubowski's study aimed at investigating the impact of using problem-based learning via the internet in Alaska, USA on eleventh-grade students' achievement of the requirements of community development in chemistry and their attitude towards it. The researcher benefited from those two previous studies in instrumental design, formulating hypotheses, adjusting variables during experimentation and selecting the statistical treatment.

Aspects of appreciation targeted in the chemistry curriculum:

Aspects of appreciation are considered one of the most important aspects of learning Science in today's world. Coping with situations faced in modern life does not depend only on the application of facts, but on feeling and emotion as well.

Eilks and Hofstein (2013, 76) identified aspects of appreciation targeted by chemistry instruction as follows:

1. To appreciate the magnificence of all creation in the universe.
2. The role of scientists in general in the revival and development of science and the provision of services to humanity.
3. The role of science and technology in achieving welfare and solving problems.
4. Environmental investment and maintenance.

Within the limits of the researcher's knowledge, there is a paucity of research dealing with developing aspects of appreciation in Science generally and Chemistry in particular. For example, Tantawi's study (1995) investigated the effectiveness of the science curriculum in middle schools in Saudi Arabia in developing students' aspects of appreciation. Moreover, Hedihiid's study (1998) aimed to highlight the role of science education in developing some aspects of appreciation among students at the second cycle of basic education. Glazar & Sasa's study (2012) also aimed to highlight the impact of chemistry on developing students' positive perceptions about the benefits of studying chemistry on the one hand and about scientists and Science on the other hand.

Research Hypotheses

In light of the previous review of pertinent literature and research, the following hypotheses were formulated:

1. Comprehensive development Requirements of Egyptian society are poorly integrated in the secondary stage chemistry curriculum.
2. There is a set of aspects and sub-aspects of appreciation pertaining to chemistry instruction that should be integrated into the content of the secondary school chemistry curriculum.
3. There is a statistically significant difference between the mean score of the research group students (who study the selected unit of the developed curriculum) in pre-test and that of the post-test of achievement regarding the development requirements of Egyptian society in chemistry, in favor of the post-test.
4. There is a statistically significant difference between the mean score of the research group students (who study the selected unit of the developed curriculum) in pre-measurement and that of the post-measurement of aspects of appreciation in chemistry, in favor of the post-measurement.
5. The selected unit of the developed chemistry curriculum achieves a suitable level of effectiveness in developing the research group students' achievement of the comprehensive development requirements as measured by Black's modified gain ratio.
6. The selected unit achieves a suitable level of effectiveness in developing the research group students' aspects of appreciation in chemistry as measured by Black's modified gain ratio.

Research Procedures

To answer the research questions and test its hypotheses, the following steps were conducted:

1. Preparing a list of Egyptian society that should be integrated into the secondary stage chemistry curriculum.(appendix 1)¹.
2. Determining the relevance of the proposed list of comprehensive development requirements of Egyptian society to be integrated into these secondary stage chemistry curriculum:
 1. The items of the list of comprehensive development requirements were identified in light of opinions of a group of specialized jurors. Before each requirement three options were assigned on a likert scale to judge how fareach requirement was appropriate for the grade level (Extremely suitable –fairly suitable - not suitable). The jurors were asked to express their point of view, marking (√) before each requirement and in the likert-scale column representing suitability of requirements for grade level.
 2. The relative weight of each item was calculated in order to be classified in three categories by limiting the frequencies of responses to each of the alternatives.
 3. The range of each of the three ranks was calculated as follows: (Appendix 2)².
3. Content analysis of the secondary stage chemistry curriculum in light of comprehensive development requirements of Egyptian society:

The content of the secondary stage chemistry curriculum was analyzed in light of comprehensive development requirements of the Egyptian society through the following steps: (Objective of content analysis - content analysis unit -

¹Appendix 1. The list of comprehensive development requirements to be integrated into the secondary stage chemistry curriculum

²Results of the survey on comprehensive development requirements of Egyptian society to be integrated into the secondary stage chemistry curriculum.

content analysis steps – Checking reliability of content-analysis tool – determining content-analysis space). (see table 1)

Table 1 shows few recurrences of comprehensive development requirements of Egyptian society in the content of the chemistry curriculum across the three grades of the secondary stage.

Table 1. Content Analysis results of the secondary stage chemistry curriculum in light of comprehensive development requirements of Egyptian society

Comprehensive development requirements of Egyptian society	First-grade secondary		Second-grade secondary		Third-grade secondary	
	Number of paragraphs	Percentage	Number of paragraphs	Percentage	Number of paragraphs	Percentage
Socio-economic requirements	15	2.4%	49	9.9%	12	2.6%
Environmental requirements	21	3.4%	---	---	25	5.4%
Technological requirements	---	---	---	---	---	---
Total	36	5.8%	49	9.9%	37	8%

4. Preparing a list of the optimal main and sub-aspects of appreciation to be integrated in the secondary stage chemistry curriculum.

1. The main and sub-aspects of appreciation to be integrated in the secondary stage chemistry curriculum were determined in light of pertinent research (e.g. Glazar&Sasa, 2012; Hedihid, 1998; Tantawi, 1995) and writings of specialized experts in emotional aspects and aspects of appreciation in particular (e.g. Eilks&Hofstein, 2013,76).
2. The list was prepared in its initial version including five main aspects of appreciation and underlying dimensions to be integrated in the secondary stage chemistry curriculum. The main aspects of appreciation include: (appreciation of the creator and His magnificent creation of the universe,

appreciation of the role of scientists in general and Arab and Muslim scientists in particular in the development of Chemistry, and appreciation of the role of scientists in effectively investing environmental resources).

3. The list was submitted to a panel of jurors (10 jurors) specialized in curriculum and instruction of Science for checking its appropriateness to secondary stage students' characteristics and proficiency level. The jurors confirmed its validity and suggested adding some Qur'anic verses in the first aspect "appreciation of the creator and His creation" which was verse 4 of Surah At-Tin (The Fig) to the sub-aspect of "God, creator of mankind". The list was then prepared in its final version in light of jurors' opinions and suggestions (appendix 3)³.
5. The proposed conception of the secondary stage chemistry curriculum in light of comprehensive development requirements of Egyptian society.

The proposed conception of the secondary stage chemistry curriculum was prepared in light of comprehensive development requirements of Egyptian society, which included the following:

1. Goals of the secondary stage chemistry curriculum;
2. The proposed conception for developing the content of the chemistry curriculum in light of comprehensive development requirements (in the form of concepts);
3. The proposed conception for integrating comprehensive development requirements into the chemistry curriculum;
4. Teaching methods and approaches used;
5. Instructional activities and learning resources used; and
6. Evaluation methods used.

³Appendix 3. A list of main and sub-aspects of appreciation to be integrated in the secondary stage chemistry curriculum.

6. Preparing the proposed unit entitled "chemistry in our lives" in the first-grade secondary stage chemistry curriculum.

Before presenting the procedures of re-structuring the unit, the researcher will illustrate the rationale for selecting this particular unit and the steps of preparing the unit.

1. Reasons for selecting this unit:
2. Low recurrence level of comprehensive development requirements in the content of the three grades of the secondary stage chemistry curriculum.
3. Possibility of integrating the largest number of comprehensive development requirements in this unit, which was evident in jurors' opinions about the proposed conception of the curriculum (see table 2).

Table 2. Number of comprehensive development requirements to be integrated into the first-grade secondary stage chemistry curriculum

Grade	Current textbook units	Comprehensive development requirements to be integrated
First Grade	Unit 1. Chemistry in our lives	25 requirements
	Unit 2. Quantum Chemistry	1 requirement
	Unit 3. Solutions - acids and bases	7 requirements
	Unit 4. Thermal chemistry	4 requirements
	Unit 5. Nuclear Chemistry	4 requirements
	Unit 6. Chemistry and the environment	11 requirements
	Total	52 requirements

4. Preparing the content of the unit.
5. Evaluating the proposed unit.
7. Preparing the teacher guide to the unit entitled "Chemistry in our lives" in the first-grade secondary stage chemistry curriculum.

The present researcher prepared a teacher guide to the unit, including the following:

1. Introduction

2. General teacher guidelines
3. Timeline of teaching the unit (see table 3).
4. Aspects of learning included in the unit
5. Goals of the unit
6. Teaching strategy used
7. Teaching/learning techniques used

Table 3. Timeline of teaching the unit

Unit	Topics	Number of Periods
Chemistry in our lives	The nature of chemistry	3
	Measurement systems and units	3
	Nanotechnology and chemistry	4
Total		10 periods

The teacher guide to the unit also included three topics; each topic consisted of the following: (Title of the topic - behavioral objectives - instructional activities and facilities - Lesson plan - evaluation).

After preparing the teacher guide, it was submitted to a group of jurors specialized in curriculum and instruction of Science. Jurors confirmed that the guide was valid, pertinent to the operational objectives and scientific content and informative, including clear instructions and guidelines (see appendix 7)4.

8. Achievement test on the unit entitled "Chemistry in our lives" for first-grade secondary stage students.

The researcher prepared an achievement test on the unit "Chemistry in our lives" for first-grade secondary stage students according to the following procedures:

1. Determining the objective of the test.
2. Determining the dimensions of the test.
3. Preparing a table of specifications.
4. Designing the test items.
5. Conducting the test piloting.

⁴Appendix 7. Teacher's guide to the unit "Chemistry in our lives" for first-grade secondary stage students

To calculate the validity, reliability and discrimination coefficients and to determine the timing of the test questions and the clarity of instructions, the researcher went through following procedures:

- a. Checking validity through the following methods:
 1. Juror validity: The test was submitted to a group of jurors and changes were made based on their opinions. The number of test questions was 30 items⁵. A scoring rubric was also prepared⁶. Correct answer was given 1 point whereas wrong answer was given zero.
 2. Internal consistency: The coefficient of correlation between each item of the test and the total score was calculated after administering the test to a number of 46 first-grade secondary stage female students at Fareskour secondary school for girls in Damietta as shown in table 4 below.

It is clear from table 4 that all test items are significantly correlated at the 0.01 level of significance, which confirms that the test has a high degree of internal consistency.

3. Intrinsic Validity: It was calculated by finding the root square of the reliability coefficient that was 0.865, indicating high validity of the achievement test.

Table 4. Coefficient of correlation between each item of the test and the total score

Item	Correlation coefficient	Significance level	Item	Correlation coefficient	Significance level
1	0.742	0.01	16	0.842	0.01
2	0.631	0.01	17	0.746	0.01
3	0.853	0.01	18	0.758	0.01
4	0.624	0.01	19	0.742	0.01
5	0.549	0.01	20	0.843	0.01
6	0.634	0.01	21	0.827	0.01
7	0.672	0.01	22	0.684	0.01

⁵Achievement test on comprehensive development requirements in Egyptian society

⁶Scoring rubric of the achievement test on comprehensive development requirements

8	0.658	0.01	23	0.689	0.01
9	0.687	0.01	24	0.786	0.01
10	0.746	0.01	25	0.746	0.01
11	0.749	0.01	26	0.742	0.01
12	0.784	0.01	27	0.657	0.01
13	0.745	0.01	28	0.687	0.01
14	0.687	0.01	29	0.856	0.01
15	0.843	0.01	30	0.672	0.01

b. Calculating the reliability coefficient (see Table 5).

Table 5. Reliability coefficient of the achievement test items on the unit "Chemistry in our lives" taught to first-grade secondary stage students

Number of items	Odd items		Even Items		Spilt-half correlation	Cronbach's alpha formula
	mean	SD	mean	SD		
30	8.67	3.57	8.28	2.46	0.763	0.749

Table 5 shows that the test reliability coefficient using split-half method was 0.763, which shows high reliability. Moreover, the reliability coefficient using Cronbach's alpha formula was 0.749, which equally shows high reliability of the test.

c. Calculating the facility, difficulty and discrimination coefficients

The table shows that the facility coefficient of the test items ranged between 0.6 and 0.86 whereas the discrimination coefficient ranged between 0.217 and 0.282 (appendix 9)7.

d. Test Timing

Table 6. Calculating the right time for the test

Average of students who took the least time	Average of students who took the most time	Time average
45	55	50

Table 6 shows that the right time for the test is 50 minutes

9. Scale of aspects of appreciation to be integrated in the first-grade secondary stage chemistry curriculum.

⁷facility, difficulty and discrimination coefficients of the achievement test items

the researcher prepared the scale of appreciation aspects according to the following steps:

1. Determined the objective of the scale.
2. Determined the dimensions of the scale.
3. Distributed the scale items on the major aspects of appreciation.
4. Rephrased the scale items (appendix 10)⁸.
5. Scoring of the scale.
6. A piloting of the scale .

The following are the results of the scale piloting:

- Validity of the scale was calculated through the following methods:

1. Experts' validity: it was checked through submitting the scale to a group of experts in the field of curriculum and instruction of science and making adjustments and modifications based on their views. Consequently, the final version of the scale included 30 situations.
2. Internal consistency: (see table 7).

Table 7. Coefficient of correlation between each scale situation and the total score

Situation Number	Correlation coefficient	Significance level	Situation Number	Correlation coefficient	Significance level
1	0.451	0.05	16	0.641	0.05
2	0.628	0.05	17	0.504	0.05
3	0.711	0.05	18	0.713	0.05
4	0.543	0.05	19	0.452	0.05
5	0.541	0.05	20	0.534	0.05
6	0.467	0.05	21	0.435	0.05
7	0.654	0.05	22	0.534	0.05
8	0.753	0.05	23	0.437	0.05
9	0.614	0.05	24	0.734	0.05
10	0.543	0.05	25	0.674	0.05
11	0.469	0.05	26	0.436	0.05
12	0.435	0.05	27	0.513	0.05
13	0.547	0.05	28	0.623	0.05
14	0.632	0.05	29	0.546	0.05
15	0.541	0.05	30	0.436	0.05
16	0.641	0.05			

⁸ Scale of appreciation aspects to be integrated into the secondary stage chemistry curriculum

Table 7 shows that all situations of the scale are significantly correlated at the 0.05 level, which confirms a high level of internal consistency.

-Checking Scale Reliability: (see table 8).

Table 8. Reliability coefficient of the aspects of appreciation scale

	Number of situations	Spilt-half correlation	Cronbach's alpha formula
Scale	30	0.727	0.639

3. Checking discrimination coefficient

Discrimination coefficients of the items of the scale ranged between 0.43 and 0.789. Therefore, the discrimination coefficients of the items of the scale were suitable.

-Clarity of the scale instructions and items

10. Experimental research procedures

1. The research group was selected at random from Al-Lozi Secondary School for Girls in Damietta and it consisted of 52 first-grade female students.
2. The experimental design was determined
3. First: Pre-application of the study instruments (achievement test - scale of aspects of appreciation).
4. Second: Teaching the experimental unit to the research group, which consisted of 52 first-grade female students from Al-Lozi secondary school for girls in Damietta. Teaching the unit took 10 periods over five weeks, two periods a week. Each period took 40 minutes, besides the hours allocated to pre-test and post-test application.
5. Instruments of the study were administered after experimentation and statistical treatments were conducted.

⁹Appendix 13. Discrimination coefficient of the appreciation aspects scale

Interpretation of Results

Testing the second hypothesis: Table 9 shows results of testing the second hypothesis.

Table 9. Correlated-samples t-test results showing significant differences between the mean scores of the research group on the pretest and posttest of achievement

Number of research group students	Difference between mean scores	Standard Deviation (SD)	t-value	Degrees of freedom (df)	Significance level
52	15.038	6.802	15.94	51	0.001

Table 9 shows that the t-value equals 15.94 at a degree of freedom 51 and significance level 0.001. Since the significance level is less than 0.05, the t-value is significant. Therefore, the research hypothesis stating: "There is a statistically significant difference between the mean score of the research group students (who study the selected unit of the developed curriculum) in pre-test and that of the post-test of achievement regarding the development requirements of Egyptian society in chemistry, in favor of the post-test" was verified. That is, the selected unit had an effective impact on developing the research group students' achievement of comprehensive development requirements in chemistry.

Testing the third hypothesis: Table 10 shows results of testing the third hypothesis.

Table 10. Correlated-samples t-test results showing significant differences between the mean scores of the research group on the pre-application and post application of the aspects of appreciation scale

Number of research group students	Difference between mean scores	Standard Deviation (SD)	t-value	Degrees of freedom (df)	Significance level
52	37.807	8.03	33.39	51	0.001

Table 10 shows that the t-value equals 33.39 at a degree of freedom 51 and significance level 0.001, which is less than 0.05,

thus expressing a significant t-value. Therefore, the research hypothesis stating: "There is a statistically significant difference between the mean score of the research group students (who study the selected unit of the developed curriculum) in pre-measurement and that of the post-measurement of aspects of appreciation in chemistry, in favor of the post-measurement" was verified. That is, the selected unit had an effective impact on developing the research group students' aspects of appreciation in chemistry.

Testing the fourth hypothesis: Table 11 shows results of testing the fourth hypothesis.

Table 11. Results of Black's modified gain ratio on the achievement test of comprehensive development requirements in chemistry

Mean score of the pre-application	Mean score of the post-application	Black's modified gain ratio
12.64	27.1346	1.32

To investigate the impact of the proposed unit, the researcher checked the effect size by calculating the value of eta square (η), which was 0.832. Since this value is greater than (0.14- 1), it indicates a high effect size of the unit on developing the students' achievement of comprehensive development requirements in Egyptian society.

Testing the fifth hypothesis: Table 12 shows results of testing the fifth hypothesis.

Table 12. Results of Black's modified gain ratio on the scale of aspects of appreciation in chemistry

Mean score of the pre-application	Mean score of the post-application	Black's modified gain ratio
41.826	79.634	1.205

To investigate the impact of the proposed unit, the researcher checked the effect size by calculating the value of eta square (η), which was 0.95. Since this value is greater than (0.14- 1), it indicates a high effect size of the unit on developing the students' aspects of appreciation in chemistry.

Discussion and interpretation of results

Results of tables 9 and 11 indicate that there was a statistically significant difference between the mean scores of the research group students in the pretest and posttest of achievement on comprehensive development requirements in chemistry, in favor of the posttest. This result is attributed to the following:

1. Teaching the selected unit of the developed chemistry curriculum provided the research group students with knowledge about comprehensive development requirements of Egyptian society in all dimensions: economic, social, scientific, cultural and technological. It also helped consolidate underlying behavioral values across the curriculum.
2. The research group students felt comfortable and had fun learning through the selected unit (chemistry in our lives), due to their awareness of the various requirements of comprehensive development in Egyptian society.
3. A variety of teaching strategies were used in teaching the selected topics of the unit.
4. A variety of educational activities were used pertaining to requirements of comprehensive development in chemistry.
5. A variety of evaluation methods were used in the unit.

This result consists with recent research results (e.g. Chin, Ming and Hua, 2013; Goodrum & Rennie, 2014).

Results of tables 10 and 12 indicate that there was a statistically significant difference between the mean scores of the research group students (who study the selected unit of the developed curriculum) in the pre-application and post-application of the scale of appreciation aspects in chemistry, in favor of the post-application. This result is due to the issues integrated in the chemistry curriculum in ways that stimulate appreciation of the creator and His magnificent creation and emphasize aspects of Arab and Muslim scientific contribution in

the development of Science. This result consists with result of recent research conducted by Glazar and Sasa (2012).

Recommendations

In light of the research findings, the researcher recommends the following:

1. Ensuring that science textbooks in various stages of education emphasize the importance of science and address issues relevant to everyday life so that learners appreciate the importance of science in their life.
2. Re-envisioning the Science curriculum in general education and developing it to keep pace with comprehensive development requirements in Egyptian society, paying more attention to enrichment rather than pure achievement.
3. Experimenting with the rest of the units of the proposed curriculum to avoid any shortcomings before generalization.
4. Ensuring that science courses taught in teacher preparation programs at faculties of education include comprehensive development requirements of Egyptian society in all aspects of daily life.

Suggestions for further research

In light of the findings of this research, the researcher provides the following suggestions for future research:

1. Investigating the effectiveness of the proposed framework for developing the chemistry curriculum in light of the requirements of comprehensive development in Egyptian society of a larger sample of secondary stage students.
2. Conducting a similar study on the primary stage science curriculum.
3. Applying a re-structured unit of the curriculum and investigating its effectiveness in developing students' aspects of appreciation compared to the same unit before re-structuring it.

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