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The Role of the Secondary Education in Developing Scientific Literacy

APhD.Ed.Thesis

Submitted By

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Summary of the study

Introduction

Education is a changeable and continuous process that depends on social and cultural changes in order to go with recent trends. Education is intended to provide individuals with facts, concepts, knowledge, skills, and attitudes that are included in the cultural heritage of the society.

The connection between education and culture is due to the fact that the former is the basic means of building the individual scientifically, which in turn helps building a science-oriented society by incorporating science culture in the culture of the society. This interconnection will help in building an individual that is educated and aware of the actions that take place around him and will help him be able to interact with these actions. This is particularly important because science and its applications have become of great value as they are two cultural development tools that provide a lot of new communication means which lead to rapid exchange of information and knowledge.

The Egyptian society witnesses rapid scientific and technological changes, which affected all aspects of life, especially people's culture and identity. Science and technology

revolutions played a big role in reformulating people's value system as a result of the accumulation of scientific discoveries and theories and their technological applications. Hence, science has become essential for people's life especially that scientific revolution resulted in more human needs that should be put into consideration. These needs are known as "the need for scientific literacy".

Nowadays, scientific literacy has played a great part in teaching science in all stages of education. As a result, building a citizen that is scientifically educated is a basic aim of teaching science. In this respect, the national Arabic conference in 2001 recommended that scientific literacy needs to be disseminated in the society. This emphasizes the responsibility of social institutions especially schools and universities in this matter. In addition to this, government organs represented in educational institutions, research centers, and specialized institutes, have to make a real revolution in scientific research aiming at creating a scientific environment that is enriched with science where individuals value science, scientists and scientific literacy.

School, as an effective educational institution, affects students' behaviors, attitudes and abilities, and is a mediator institution that has an important cultural role in transmitting values, meanings, types of activities and thinking from one generation to another. School is a social institution that works within the national framework of society, and it derives its

philosophy and attitudes from that society, and in turn it selects its instructional experiences. So, school needs to keep this national framework within its ideologies and to develop this framework by subjecting it to more research and thinking in light of the social, political, and economic changes.

The secondary school has a distinctive role as it is a mediation between basic and higher education, and is considered the last stage in public education. Secondary school is also considered a crossroad for its students as it is responsible for preparing them mentally and scientifically for the university stage. It not only provides them with information, but also it helps them acquire principles and attitudes that help them develop their personalities.

Importance of the scientific dimension in building students' personalities in the secondary school is apparent in two sides these are: (1) scientific enlightenment that helps students cope with the scientific developments, and use recent cultural products in a safe way, and (2) students' attitude towards science issues and the goals of scientific development.

Consequently, there has been a need to explore the functional role of secondary education in developing students' scientific literacy, and to find out the requirements and means of activating this role.

Problem of the study

Looking into the status-co of secondary education, it can be noticed that science textbooks are still taught as separate units of chemistry, physics, biology, and geology, without any interconnection between these materials. This resulted in neglecting a lot of interrelated information that is important for the student. This is in spite of the fact that we live in a society that is full of changes and transformations, some of which are the following:

- Transformation from information society to extensive information society.
- Transformation from knowledge society to meta knowledge and meta-cognition society.
- Transformation from communication society to communication revolution society.
- Transformation from a society whose progress was measured by muscle power and industrial rise, to a society whose progress is measured by intellectual power and the realization of thought.

This is added to secondary stage teachers" reluctance to teach scientific materials (chemistry, physics and biology) because of the large amount of abstract concepts included in these materials. Also, science is known of the difficulty and dryness of its content, it also is always not related to students' lives and problems. Another important issue is that curricula and methods

of teaching are still emphasizing on knowledge and memorization, without paying any attention to developing scientific thinking and skills. This is reflected in classroom teaching methods that focus on stuffing students' minds with information, laws and theories. Another reflection of using traditional methods of teaching is in building tests and classroom activities and homework that do not develop higher order thinking skills such as analysis, criticism, evaluation, and other skill.

Furthermore, science textbooks in the secondary stage do not include all the fields of science education (cognitive, psychomotor, and emotional), instead they are limited to the cognitive field. Even when these textbooks deal with other fields, they do not point out the relationship between science, technology and the environment.

Consequently, teaching science should be functional in a way that develops students' scientific knowledge, skills, attitudes, and tendency, and develops the interaction between science, technology and the environment, the scientific method of thinking, and enlightenment. **So, the problem of the study could be tackled through answering the following main question:**

"What is the role of secondary education in developing scientific literacy, and the mechanisms for activating this role?"

This question can be sub-divided into the following questions:

1. What are the components, factors, and the techniques of acquisition, and development of scientific literacy?
2. What are the contributions of secondary education in Egypt in developing scientific literacy?
3. What are the most important international experiences regarding the role of secondary education in developing scientific literacy?
4. What are the mechanics of activating the role of secondary education in Egypt in developing scientific literacy?

Importance of the study

The study is important for the following considerations:

1. Importance of scientific literacy as it is considered a necessity for all citizens because it helps them understand and cope with the surrounding environment and the problems facing the community where they live.
2. Importance of the secondary stage for students because it prepares them for university education. It is also a mediator between basic and higher education. So, it is located at the heart of education system.
3. Importance of the current study for educators as it tried to help them understand their responsibilities in facing the problems related to scientific and technological

development, by pointing out the scientific function of education, and investigating the role of secondary education in developing scientific literacy.

4. The study results could help activate the role of secondary education in developing students' scientific literacy.

Aims of the study

The current study aimed to

1. Identify the components and importance of scientific literacy in the age of information.
2. Investigate the contributions of secondary education in Egypt in developing scientific literacy.
3. Explore the most important international experiences regarding the role of secondary education in developing scientific literacy.
4. Determining the considerations that should be put in mind when trying to activate the role of secondary education in Egypt in developing scientific literacy.

Method of the study

The researcher used the descriptive method for collecting and categorizing data and facts in order to point out the components of scientific literacy and its mechanics, and the role

of secondary education in developing scientific literacy, and also to investigate the most important international trends in this area.

The researcher also used content analysis technique in order to explore the dimensions of scientific literacy in chemistry and psychology and sociology textbooks.

Instruments of the study

The researcher used a questionnaire addressed to secondary school teachers and administrators in Fayoum governorate in order to identify the obstacles that hinder secondary education from playing its role in developing scientific literacy, and also to determine the mechanics for activating this role.

Limitations of the study

The study was limited to

1. Studying the role of secondary education in developing the following dimensions of scientific literacy:

    - Science content including facts, concepts, generalizations, and theories which are interrelated and interconnected in the shape of a cone starting with facts (at its base) and ending with theories (at its head).
    - The inter-relationship between science, technology and the society.
    - Science processes including mental and practical abilities and skills needed for applying scientific thinking in a right way.

- Scientific attitudes referring to the individual's relatively stable feeling that determines his responses regarding accepting or refusing a certain topic or issue.

2. Analyzing the content of chemistry and psychology and sociology textbooks introduced to third year secondary students.

Terminology of the study

1. **The role**

   The role is procedurally defined as "a group of functions, behaviors, and procedures practiced by secondary education institutions represented in (teachers, curricula, school administration, and school activities) for achieving educational aims to develop students' scientific literacy.

2. **Secondary education**

   According to Education Law number 139 in 1981, secondary education was defined as "the education that aims to prepare students for life as well as for university education, or prepare them for participating effectively in production and services, in addition to consolidating religious, behavioral and national values.

3. **Scientific literacy**

Scientific literacy is defined as " possessing a suitable amount of the following dimensions of learning: (1) cognitive dimension aiming to understand the nature of science and the interrelationship between science and technology and how they affect the society, (2) psychomotor dimension aiming to develop some science processes skills in a functional way, and (3) emotional aiming to develop students' scientific tendency and interests, on one side, and helping them acquire desired attitudes and values that help them participate and take decisions in their daily life, on the other side.

The Study Steps:

The researcher addressed the current study through two aspects:

First: the theoretical aspect includes:

- Preparing the study outline specifying an introduction, the study problem, the previous studies, aims, importance, method, limitations, terminology and steps.
- Discussing the concept of the scientific literacy and its components and the mechanisms of teaching and developing it.
- Studying the reality of the contributions of general secondary education in developing the scientific literacy through a content analysis for psychology, sociology and chemistry subjects.
- Studying the most important contemporary international experiences to the role of pre-university education in developing the scientific literacy.

Second: the field aspect includes:

Applying a questionnaire to a sample of teachers, administrators and mentors in general secondary schools, both public and private education in Fayoum Governorate to identify the obstacles to the role of general secondary education in scientific literacy and developing the mechanisms of activating that role from their point of view.

Results of the Study:

In light of discussing the field study results, the following could be presented:

A. The obstacles to the role of general secondary education in developing the scientific literacy:

- Members of the three categories agree on the following obstacles as the most important impediments prevent achieving the role of general secondary education in developing the scientific literacy:
  - Weakness the budgets allocated by the Ministry of Education to practice the scientific activities.
  - Weakness the allocated government resources to the scientific production and science education.
  - Extra padding to subjects and the weakness of students' ability to be accommodated.
  - Weakness of the interest of the scientific trips and field visits to the scientific centers and the museums.
  - Weakness the role of science clubs in developing the scientific literacy to the students.

- The study sample also agree on the weakness of importance the following obstacles:
  - Weakness the interest of formulating clear objectives for developing the scientific literacy.
  - Ambiguity concept of the science culture among some teachers and confined to the knowledge of some scientific topics.

- Lack of teachers' caring with the individual differences among students.
- Shortcomings the school activities practice and confined to some students but not others.
- Lack of containment of a variety and modern scientific sources in the school library.

B- The mechanisms of activating the role of secondary education in developing the scientific literacy.

- Granting material and moral rewards for high achievers students in the sciences.
- Increase the financial support and the allocated budget to practice the scientific activities.
- Use of modern teaching aids produced by the technology in the field of teaching.
- Encourage the students to take part in the scientific activities provided by the teachers.
- The attention to providing an appropriate school climate for developing the scientific literacy.
- Follow the teacher in the classroom to raise the students' level continuously by the school principals.
- Providing the school library with the latest books and scientific references.
- Providing various learning sources to enrich the environment and classroom climate during learning to encourage the practice of the mental skills.

- The study sample also agree on the decline of importance the following mechanisms:

- The formulation of clear and specific objectives for developing the scientific literacy.
- Taking into account providing the scientific culture through the Arabic language, social studies, as well as the curriculum of the mathematics and science.

- Put a special course of the scientific culture for high school students in theoretical disciplines.
- Adoption of a variety and objective tools for the students' assessment such as research, projects, reports, estimating Gradual performance registries and the achievement files and others.
- Providing guidance publications and brochures about the scientific culture and issues associated with it.
- The flexibility in taking the encouraging procedures for the teachers to organize scientific trips and field visits to the scientific centers and museums.

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In light of the theoretical part of the study, and the results of the field study, the researcher put forward some recommendations for the concerned parties of the general secondary education, in order to activate the role of the school in developing the scientific literacy to the students.