"STEM" Curriculum for Physics Education and Science Fiction Development

Prof. Nahed Abdel Radi

Professor of Curriculum and Instruction

Faculty of Education - Minia University

Abstract

The curriculum of natural sciences, particularly physics, is among the most prominent sciences in the progress and prosperity of countries, It leads us to argue that Physics is the real factor responsible for the progress in other natural sciences and their technological applications. Natural sciences curriculum has gone through many reform movements to keep pace with scientific and technological development, "STEM" approach is considered one of the most important global movements and approaches to design curriculum. Enriching the content of physics curriculum in light of "STEM" approach with activities aimed at developing science fiction among learners is one of the most important goals of scientific and technological progress in the future.

Key words:

STEM" Curriculum - Physics Education - Science Fiction "

Introduction

The current era is witnessing a rapid progress in the fields of atomic research, and the diversity of the use of atomic energy in various purposes. Besides, space research has made scientific progress that exceeds everything that has been achieved in this field thousands of years ago. Science has also achieved tremendous achievements in the field of biological technology, genetic engineering and other fields.

Natural sciences curriculum, particularly physics, is among the most prominent sciences in the progress and prosperity of countries. It is due to most of the scientific progress that contributed to the interpretation of many natural phenomena, and the emergence of technological applications that contributed to the evolution of the structure of natural sciences. It has become clear that, in order for learners to understand the branches of other natural sciences, they must understand the science of physics. This leads us to argue that the science of

physics is the real factor behind the progress in other natural sciences, as well as their technological applications.

As a consequence of the reality of science education in many countries of the world, which does not allow the learner to practice scientific inquiry, and that content is not related to the life of the learner, many reform movements for natural science curriculum appeared to keep pace with scientific and technological development. In addition, it has been necessary to design on educational curriculum that matches the needs of learners.

"STEM" approach is one of the global approaches to curriculum design, in which the branches of science, technology, engineering and mathematics integrate . This com be don by effective activities and skills in technology and engineering design, with the aim of achieving the quality of the outputs of the educational system.

"STEM" Approach Philosophy

Bybee (2013) explains that this approach has first appeared in the nineties in the National Science Foundation (NSF). It is considered one of the most important global trends in curriculum design, which has proven effective over three decades of its application in the United States of America, the United Kingdom, South Africa and some Other countries.

The philosophy underlying "STEM" curriculum is based on providing educational activities and projects that rely on integration in order to stimulation learners' thinking and to acquire scientific knowledge that can be applied to other situations in the real world. this aims at solving the problems s/he faces, and achieving a connection between the school, society and the labor market. The teacher's role is limited to guidance, as s/he works with students to define questions and tasks, and to train them to produce and develop scientific knowledge.

What is "STEM"

Willim (2013) defines it as an educational system that combines the disciplines of science, technology, engineering and mathematics, so that they are taught in the form of a coherent

unit, this requires enabling teachers to understand the interrelated engineering and scientific practices of "STEM" fields. It requires also learning environments in the context of the real world, so that participants can enjoy the educational workshops and projects, and have access to comprehensive and in-depth knowledge of targeted scientific topics and issues, which reflect the nature of science.

Therefore, "STEM" can be defined as a teaching and learning approach in which science, technology, engineering and mathematics interact, This allows learners to integrate into realistic activities, workshops and educational projects, It also enables them to access comprehensive knowledge, and ending with the process of designing and inventing a new innovative product.

STEM domains

STEM domains are as follows :

1-Science: includes knowledge, skills, methods of scientific and creative thinking and decision-making

2-Technology: includes scientific, engineering applications and computer science.

3-Engineering: includes applying the principles of science and mathematics, through engineering design, to produce an innovative product as an output of applying knowledge.

4-Mathematics: includes studying the patterns and relationships between numbers and quantities and employing them in the study of science, engineering, and problem solving.

Principles and foundations of education based on STEM

The Principles and foundations of education incloude the following :

- Providing learners with an in-depth scientific knowledge that can be used and applied in their daily and professional lives.
- Combination of scientific inquiry and technological design.
- Use of engineering to solve problems, through learner's practice of realistic activities that include some problems.
- Integration between the four branches of science.

- Learner's practice of the skill of communicating their ideas to others in various ways, and practicing activities cooperatively.

Foundations of STEM curriculum design

Such foundations are as follows :

- Building on the national standards for the integration of science and mathematics, and linking them with their technological applications in the classroom.
- Teaching a mathematical, scientific, conceptual base integrated with its technological applications.
- Designing practical scientific activities that depend on action and reflection.
- Linking teaching at school to experience.
- Providing a positive environment that allows all learners to participate.

Based on the foregoing, "STEM" curriculum transforms students' traditional education of science and mathematics into immersion in scientific knowledge, the practice of inquiry and creative problem solving, and the practice of scientific thinking.

Science education and science fiction development

Science fiction is one of the global and local trends in science education, which is the basis for innovation, It is one of the most important goals of science education, and its development among learners contributes to forming their personalities away from the stereotypes in thinking and to unleashing creativity and problem solving.

What is science fiction?

Robin (2006) defines science fiction as the individual's ability to anticipate what will happen in the future, in the light of organized scientific explanations of natural phenomena.

Science fiction can be defined as "an individual's mental activity that includes a predictive vision based on studied scientific hypotheses, in which s/he envisions the future changes that science can bring about to solve private or societal problems.

The development of science fiction through the teaching of science in general, and the teaching of physics in particular, is important because of the great role that science fiction plays in reaching many different scientific discoveries.

Science fiction goals

The goals of science fiction are as follows:

- Teaching scientific facts and concepts in an interesting and exciting way.
- Urging learners to reflect and think flexibly.
- Creating a positive attitude among learners towards accepting change and prepare them to accept what the world will be like in the future.
- Raising the thinking of learners to find various solutions to one problem.
- Developing creativity, problem-solving skills, and ability to think critically.
- Developing the skills of scientific thinking and imaginative.
- Activating the minds of learners through the ability to predict scientific discoveries and inventions in the future.
- Developed countries have realized the role of science fiction in preparing and raising a generation of scientists and creators, so they have included it in the various educational curriculum, opened academic disciplines in a number of universities in the field of science fiction literature, and emphasized that the study of science fiction is an integral part of future strategies.

Due to the importance of developing science fiction for learners, many studies in natural sciences in general and physics in particular explored it, such as the study of (Cavanaugh, Terence & Cavanaah, Catherine, 1996). The American physicist, Amet Gosoamy at the University of Oregon in America taught physics using science fiction. By doing so, he succeeded in removing the dullness and boredom of the physics subject. This study concluded that the use of science fiction during science education allows learners to acquire various experiences in many scientific fields that cannot be gained with direct experience, such as radiation, space and the negative effects of progress and human civilization.

Science fiction elements

The elements of science fiction include :

- Time frame, e.g. to be in the future.
- Spatial frame, such as outer space, or in other worlds.
- Characters, such as strangers from space, android, robots.
- Future technology, such as laser guns, computers.
- New scientific principles, such as travel through time, wormholes, and travel faster than light.
- Super powers, such as mind control and being in two places at the same time.
- universes and other dimensions and travel between them.

It is clear from the above mentioned that some elements of science fiction are closely related to the science of physics as one of the branches of natural science, and its interaction with mathematics, technology and engineering in "STEM" curriculum that contributes to the development of science fiction among learners and gives them the ability to visualize. Therefore, it is considered as an essential approach to developing creativity and early detection of the creative and distinguished students, so as to prepare a generation of creative scientists in various fields of science and knowledge, so that our Arab world can occupy a prominent place in the world of the future.

In light of the foregoing, "STEM" curriculum based on the integration science, technology, engineering and mathematics, and the activities and projects it contains seek to prepare an enlightened generation in these areas, and has the ability to imagine things and events in the future, and They also have the ability how to prepare for challenges, through the application of projects adopted by the learner that ends with the design of an innovative product that contributes to solving a problem.

Recommendations

The current paper recommends the Following:

- educational institutions need to adopt an integrative "STEM" approach across disciplines in teaching natural sciences with its various branches through different academic levels.

- designing the educational curriculum using the integrative "STEM" approach, to include creativity and innovation skills and science fiction dimensions.
- training students teachers in integrative " STEM " curriculum, and how to implement it.
- holding training sessions for in-service teachers, on how to plan, design and implement "STEM" curriculum at all levels of education.
- enriching the content of physics curriculum in light of "STEM" approach with activities aimed at developing science fiction among learners, as the physics curriculum content is based on the idea of imagining scientific progress in the future.

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