Effectiveness of a proposed teaching program in physics based on the integration of the inquiry model (4E×2) and thinking maps in modifying alternative conceptualizations of scientific concepts and developing the skills Of science inquiry and visual thinking For secondary school students.

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Abstract

This study aimed to identify the effectiveness of using a proposed program for teaching physics based on the integration of the investigation model (4E×2) and thinking maps in modifying alternative perceptions of scientific concepts and developing the skills of scientific investigation and visual thinking among a group of first-year secondary school students, selected from secondary school students. New Girls in Minya Governorate; Their number is (30) female students, and the study followed the mixed research approach, where the descriptive approach was used in preparing: A list of physics curricula content standards and indicators related to the concepts of electricity and magnetism in the field of physical sciences - the developed framework for physics curricula content related to the concepts of electricity and magnetism in the light of the standards of the field The physical sciences for the three grades of the secondary stage, including

curriculum maps, and the experimental approach based on a quasi-experimental one-group design in teaching the proposed program in physics about concepts related to electricity and magnetism based on the combination of the investigation model (4E×2) and thinking maps, and the study found the effectiveness of the program The proposal in modifying the alternative perceptions of scientific concepts among the students of the study group, the effect of the proposed program in developing the skills of scientific investigation among the students of the study group, but it is ineffective, the effect of the proposed program in developing visual thinking among the students of the study group, but it is also ineffective, the study also recommended the need to develop Physics curricula at the secondary stage in the light of the results of studies to achieve ie the field of physical sciences.

Keywords:Model (4E×2) - thinking maps - alternative perceptions - scientific investigation - visual thinking

Introduction

Natural sciences curricula, physics on top, are among the most prominent sciences that contribute to the progress and prosperity of countries. Physics is the key to most of the scientific progress that contribute

end to the interpretation of many natural phenomena. It has become clear that in order for the learner to understand the other branches of the natural sciences, he must have an understanding of physics, or at least acquire the basics of this science. (Nahed, 2009,P.14)

Many movements and projects to reform science curricula appeared in the general education stages, the most prominent and most important of which is the NSES movement, which is concerned with meeting the needs of all students in terms of knowledge, work and ability to be scientifically educated in the various stages of study.(Ayesh , 2010,P. 421)

The national standards for scientific education along with the Arab and international standards are among the most prominent projects that lead to the achievement of the goals that society seeks to reach. Therefore, standards are one of the most important foundations in light of which physics curricula are developed.Taking into consideration (Mohamed, 1998,P P. 1-19) the current gap between the natural sciences curricula and international standards which is getting wider by time, we need to develop curricula in public education stages in order to face the challenges that hinder our progress.

Several studies have recommended the need to pay attention to developing the content of the physics curriculum and its fulfillment of international standards and the importance of linking what students learn in physics to life, including including the study of (Amr,, 2019),(Aref, 2018),(koponen&Huttunen, 2013), (Mustafa,et. al, 2012),(Ahlam,E,2010),(Nahed,, 2006).

It is clear now that the curricula's failure to keep pace with these developments leads to the formation of alternative conceptualizations of scientific concepts among students, which requires the development of the content of physics curricula.Therefore, I have developed modern strategies and models in the light of constructivist thought to modify these conceptualizations, including the integration of the inquiry model (4E×2) which combines key components ofinquiry instruction(Engage, Explore, Explain, Extend) with Formative Assessment and reflective practiceintegrated into each of theinquirycomponents (Marshall, et al, 2011, P. 12) and thinking maps which are a set of eight graphic organizer techniques(Circle Map, Bubbles Map, Duple Bubbles Map, Tree Map, Brace Map,

Flow Map,Multi-Flow Map, Bridge Map)used in education to provide a common visual language to information structure(Alikhan,, 2014, P P.2-5) in addition to developing the science inquiry skills and visual thinking skills.

The current study aims at the recognition of:

The effectiveness of a proposed teaching program in physics based on the integration of the inquiry model (4E×2) and thinking maps in modifying alternative conceptualizations of scientific concepts and developing the skills of science inquiry and visual thinking among first year secondary school female students.

The Study problem:

The recentStudy problem has been set with alternative conceptions related to electricity and magnetism for first secondary school female students. This, in addition to a limit in physics curricula in dealing with the content of physics curricula in the light of the standards of the field of physical curricula connected to the first and second secondary grades, So, The recent Study tried to suggest a program in the light of the content of the physics curricula for the secondary stage. based on the integration of the inquiry model (4E×2) and thinking mapswhich may help in modifying alternative conceptualizations of the electricity and magnetism.

In order to address this problem, the Study tried to find:

1. List of content standards for physics curricula related to the concepts of electricity and magnetism in the field of physical sciences at the secondary stage.

2. The availability of standards related to the concepts of electricity and magnetism in the field of physical sciences at the secondary stage.
3. The proposed framework on electricity and magnetism for the physics content for the secondary stage in the light of the standards of the field of physical sciences.
4. The proposed program for teaching the unit "Electricity and Magnetism" in the light of the integration of the inquiry model (4E×2) and thinking maps for first year secondary school female students.
5. The effectiveness of teaching the developed unit "Electricity and Magnetism" based on the integration of the inquiry model (4E×2) and thinking maps in modifying alternative conceptualizations of some scientific concepts among first year secondary school female students.
6. The effectiveness of teaching the developed unit "Electricity and Magnetism" based on the integration of the inquiry model (4E×2) and thinking maps in developing the science inquiry skills for first year secondary school female students.
7. The effectiveness of teaching the developed unit "Electricity and Magnetism" based on the integration of the inquiry model (4E×2) and thinking maps in developing visual thinking for first year secondary school female students.

Study importance

1. Preparing a list of content standards for physics curricula related to the concepts of electricity and magnetism, and providing those responsible for

developing the content of physics curricula with this list to take into consideration during their preparation for the physics curricula at the secondary stage.

2. Presenting a framework including curriculum maps of electricity and magnetism that those in charge of preparing and developing the content of physics curricula for the secondary stage and teachers can benefit from.
3. Providing teachers and specialists with alternative conceptualizations of the scientific concepts included in the "electricity and magnetism" unit, to give it more attention during teaching.
4. Developing a proposed conception for teaching the unit "electricity and magnetism" in light of the national standards for teaching science, which may be useful in building similar curricula in other educational stages.
5. The Study contributes to presenting a book to the student that includes the unit "Electricity and Magnetism" for first year secondary students, which is formulated according to the integration of the inquiry model (4E×2) and thinking maps, and it can be used as a guide for teachers and specialists in formulating other units.
6. It contributes to providing a guide for the teacher to teach a unit in "electricity and magnetism" to first year secondary students, which is formulated according to the integration of the inquiry model (4E×2) and thinking maps, and it can be used by science teachers.
7. It contributes to providing the following tools: (modifying Alternative Conceptualizations Test -

Science Inquiry Skills Test - Visual Thinking Test) that can be used by teachers and researchers.

Study materials and tools:

- A list of content standards and indicators for physics curricula related to the concepts of electricity and magnetism in the field of physical sciences.
- The proposed conception of the framework for the content of the physics curriculum "electricity and magnetism" in light of the list of standards and indicators of the field of physical sciences for the three grades of secondary school, including curriculum maps.
- The proposed program in teaching physics about concepts related to electricity and magnetism is based on the integration of the inquiry model (4E×2) and thinking maps, and it includes:
  - Student worksheets.
  - Teacher's guide
- Testing modifying alternative conceptualizations about the scientific concepts included in the "electricity and magnetism" unit proposed for first year secondary school female students (prepared by the researcher).
- Testing the science inquiry skills for first year secondary school female students (Barry Fraser test: translated by Salam Sayed Ahmed).
- A test of visual thinking for first year secondary school female students (prepared by the researcher).

Study Sample

The study group was selected from among the female students of the first secondary school - at the New Girls Secondary School in Minya Governorate; And their number is (30) female students, for the academic year 2019/2020.

Study hypotheses

In light of the theoretical framework of the current study and the results of the previous studies related to the subject of the study, the current Study sought to verify the following assumptions:

1. There is a statistically significant difference at level (0.05) between the average scores of the Study group students, pre and post measurement, in the test of alternative conceptualizations in favor of the post application.
2. There is a statistically significant difference at level (0.05) between the average scores of the Study group students, pre and post measurement, in the test of science inquiry skills in favor of the post application.
3. There is a statistically significant difference at (0.05) among the average scores of the Study group students, pre and post measurements in the test of visual thinking in favor of post application.

Study Methodology: the researcher did the following:

The approach used in this Study is the mixed research approach based on the integration between quantitative and qualitative research, where it used the descriptive approach in preparing the proposed concept for the framework for the physics curriculum in light of the standards and

indicators of the field of physical sciences for the physics curriculum at the secondary stage, and the experimental approach based on the quasi-experimental design with one group in measuring the effectiveness of teaching the proposed program (the unit of electricity and magnetism) in light of the integration of the inquiry model (4E×2) and thinking maps of first year secondary school female students.

Study procedures:

First: procedures for preparing Study tools:

1. Preparing a list of content standards for physics curricula related to the concepts of electricity and magnetism in the field of physical sciences.
2. Preparing an analysis tool for the content of the physics curricula related to the concepts of electricity and magnetism for the secondary stage.
3. Analyzing the content of physics curricula for grades (first - second - third) secondary edition (2014/2015) in light of the list of standards and indicators for the field of physical sciences.
4. Determining the shortcomings in the content of physics curricula related to the concepts of electricity and magnetism in the light of the analysis tool.
5. Preparing the proposed framework in electricity and magnetism for the physics content of the secondary stage in the light of the standards of the field of physical sciences, including curriculum maps for the three grades of the secondary stage.

6. Reaching the final image of the program framework after making the required modifications.
7. Preparing a list of scientific concepts related to electricity and magnetism in the proposed program and presenting it to the arbitrators.
8. Designing the proposed program in teaching physics about concepts related to electricity and magnetism, based on the integration of the inquiry model (4E×2) and thinking maps, and it includes:
   - Student worksheets.
   - Teacher's guide
9. Preparing the alternative conceptualizations test about the scientific concepts included in the "electricity and magnetism" unit proposed for first year secondary school female students (prepared by the researcher).
10. Preparing the test of science inquiry skills for first year secondary school female students (Barry Fraser test: translated by Salam Sayed Ahmed).
11. Preparing the test of visual thinking for first year secondary school female students (prepared by the researcher).
12. Presenting the initial image of the Study tools to a group of arbitrators to make the appropriate modifications.
13. Conducting the exploratory experiment to calculate the statistical invariances of the measurement tools.

Second: procedures for carrying out the Study experience

1- Selecting a Study group.

2- Tribal application of Study tools on the Study group.

3- Teaching the proposed unit "Electricity and Magnetism" by integrating the inquiry model (4E×2) and thinking maps.

4- Post application of the Study tools to the search group.

5- Getting data and carrying out statistical processing thereof; to get Study results.

6- Analyzing and interpreting the Study results in light of the Study hypotheses.

7- Presenting recommendations and proposed Study in the light of the Study results.

Study findings:

The Study reached the following results:

1. The effectiveness of the proposed program in teaching physics based on the integration of the inquiry model (4E×2) and thinking maps in modifying alternative conceptualizations of scientific concepts among the female students of the Study group.
2. Influence of the proposed program in teaching physics based on the integration of the inquiry model (4E×2) and thinking maps in modifying science inquiry skills among the female students of the Study group, but it isn't effective.
3. Influence of the proposed program in teaching physics based on the integration of the inquiry model (4E×2) and thinking maps in developing visual thinking among

the female students of the Study group, but it isn't effective.

Study recommendations:

In the light of the findings of the current Study, it is recommended that:

1- The need to periodically evaluate the content of physics courses in light of the national standards of education to be in line with modern trends.

2- Taking into consideration the development of physics curricula at the secondary stage in the light of the results of studies in order to achieve the standards of the field of physical sciences, and the preparation of curriculum maps for physics courses, taking into account the extent and sequence in terms of presenting the topics of physics courses from the first grade to the third grade of secondary school.

3- The importance of diagnosing the alternative conceptualizations that exist among students in all branches of science and for the different academic levels by more than one modern means so that it can be familiarized with and corrected.

4- The necessity of integrating modern teaching strategies that help to think, reflect and link new and previous concepts so that students have integrated knowledge structures and learning becomes meaningful for them.

5- Paying attention to the development of visual thinking and science inquiry skills among secondary school students, and that is through the use of modern teaching strategies that encourage this so that these strategies continue to be used throughout the school year and in

different courses until there is enough time for their thinking to grow.

Proposed researches:

In extension of the current study, it is suggested to conduct the following researches:

1. A proposed program in teaching physics based on the integration of the inquiry model (4E×2) and thinking maps to modify alternative conceptualizations of scientific concepts and develop creative thinking skills and scientific attitude for second year secondary school students.
2. A proposed program in teaching physics based on the integration of the Conceptual Change model and mind maps to modify alternative conceptualizations of scientific concepts and develop critical thinking skills among first year secondary students.
3. Developing physics curricula at the secondary stage in light of some scientific education standards.
4. Evaluating science curricula in the light of standards and indicators of the field of physical sciences for the content of science in the basic education stage.

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