

# Effectiveness of Blending the Posner and Stepan's Models of Conceptual Change in Correcting Misconceptions in 9<sup>th</sup> Grade Students

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## Abstract

*This study aimed to investigate the efficacy of incorporating the Posner and Stepan's model of conceptual change in correcting misconceptions in the ninth grade students.*

*The two researchers followed the experimental approach, as the experimental study sample consisted of (144) male and female students from a community consisting of (3838) male and female students in the ninth grade in the South Hebron District, distributed in two groups, one is an officer and the other is experimental and each of them (72) male and female students in each From Al-Daheria Elementary Boys School and Doma Secondary Girls.*

*A test was constructed for misconceptions in the Engineering and Measurement Unit, where its validity was verified by presenting it to a group of experts and specialists, as well as finding the coefficient of stability, which amounted to 0.89.*

*Mathematical averages and standard deviations were calculated, the accompanying variance test (ANCOVA) as well as the effect size of the Eta Square ( $\eta^2$ ) was calculated.*

*The results of the study showed that there were statistically significant differences for the ninth grade students in the correction of misconceptions of misconceptions according to the teaching method that was carried out according to the proposed model in the study and in favor of the experimental group, and the absence of statistically significant in the test of correction of misconceptions according to the gender variable and the absence of statistically significant differences Depending on the interaction between the method and gender.*

*In light of these results, the study recommended employing the Posner and Stepan's model in the light of conceptual change strategies to correct misconceptions, and conduct further studies on conceptual change strategies to see their impact on other dependent variables such as attitudes and motivation towards mathematics.*

**Keywords :** *Effectiveness, Blending the Posner and Stepan's Models, Conceptual Change, Correcting Misconceptions*

## I. INTRODUCTION

The age in which we live is a technological revolution, a rapid educational change, and an acceleration in the pace of research aimed at ways of acquiring scientific concepts and the goals of acquiring them, and the processes of science involved in them, and in light of these data and this acceleration in the twenty-first century, and the requirements of the reality of the educational field and aspirations for the future, it has It was necessary to pay attention to knowledge and its components, such as concepts, facts, laws, theories, and others, in order to ensure the quality of the knowledge structures that will form the building blocks of later learning.

Whereas, learning from a constructive perspective is an active, continuous, and guiding process that does not take place randomly, as it is concerned with the adaptations that occur in the individual's functional schemes (systems schemes) for the individual to create a kind of balance between the contradictions that arise from the interaction of the individual with the data of the experimental world, and this represents The thought of Jean Piaget, who is considered to be the building blocks of structural theory [1].

Scientific concepts are of great importance, as they are the most important outcomes of learning by which knowledge is organized in a meaningful way, and in light of this importance that concepts occupy and the need to acquire them in a correct way, a group of global reform movements for practical education has emerged, perhaps the most famous of which is the National Standards for Practical Education movement ( NSES), as the Standards Movement sought to provide a future view of students' scientific culture, focusing on understanding key concepts, active structural learning, and individual and group investigation [2].

Whereas, mathematical concepts are the basic building blocks of the mathematics curriculum, and they represent one of the four essentials that make up the integrated and coordinated body of mathematics:

concepts, skills, algorithms, strategies and methods for solving a problem [3].

Bruner also stressed the importance of learners having correct scientific concepts that help them to understand scientific material and transfer them from rudimentary knowledge to correct and advanced knowledge [4].

The concept of misconceptions is related to structural theory, which is one of the effective contemporary theories in education in general, and emphasizes that the student builds his knowledge on his own, such as the plant that builds his food himself through the process of photosynthesis, and for this, the teacher who uses constructive strategies takes into account the difference in the way of learning from one student to another, As well as his previous knowledge that may be incomplete or contain some false or alternative perceptions [5].

Afaneh and AL-Gish (2008) confirm that conceptual change increases the procedures of the learner's awareness and wrong beliefs, and also helps the learner to correct his concepts and put him in educational situations that make him compare what he believes with what is right, and this reflects positively on the concepts of mathematics.

While [6] believes that a conceptual change is a mental process that occurs when the learner receives certain experiences or knowledge that do not agree with the existing concepts, then a process of compatibility occurs between what is acquired and what is presented with knowledge, so if the differences are clear between the acquired concepts and given to him, then The learner in this case acquires new concepts that have a different framework from the nature of the acquired concepts, and here we can say that the learner has undergone a conceptual change.

[1] see the conceptual change taking place according to Posner through two main phases:

First: The stage of revealing the wrong understanding patterns of the learner.

Second: The stage of using the appropriate strategy to present the scientific concept through:

A- Working to develop the learner's ability to distinguish the new concept in a clear, reasonable and beneficial way, by representing (assimilating) new ideas within his existing information network.

B- Achieving a process of accommodation between the new concept and the existing ideas, and replacing the new concept with the old one, by exchanging the new concept with the old one, by raising the value of the new concept at the expense of the value of the old concept.

Also among the important models is the Stepan's model of conceptual change, which he designed and developed based on structural philosophy as well, in order to bring about conceptual change and modify and correct misconceptions, and this is done by providing an educational environment that motivates learners to face their previous concepts and beliefs

with their colleagues, as it encourages cooperation Interact and participate to find solutions and correct perceptions according to specific steps [5] which are:

1- Commit to Outcome, so that learners are aware of their previous perceptions about the concept by thinking about it, then making predictions before starting any scientific activity or activity.

2-Expose Beliefs, and learners display their beliefs and perceptions through small cooperative groups, then these groups expand to include all students of the class.

3- Confront Beliefs, learners face their ideas by testing them and discussing them in small groups.

4- Accommodate The Concept, and learners work at this stage to solve the existing difference between the preconceptions held and between the perceptions and the correct concepts, and thus adopt the new concept or its absorption and harmonization.

5- Expand the concept: Here the learners expand the concept by making relationships and connections between the concept that he learned and other situations in life contexts.

6-Extend The Concept: Here the learner moves to follow additional questions and engages in solving problems or projects related to the concept.

The Stepan's model is characterized by the fact that it enhances the learner's participation in the learning process in partnering with others, and increases the learner's motivation towards what he learns.

## II. PROBLEM OF THE STUDY

The problem of the study is to correct misconceptions in the ninth grade students in the engineering and measurement unit in the book of mathematics.

### A. Objectives of the study:

This study aimed to identify the effect of the use of the Posner and Stephens model incorporation in correcting misconceptions of mathematics among ninth grade students, and to clarify whether this effect varies according to gender, method, and interaction between them.

### B. The Study Questions:

The study problem was identified in the main question which states:

"What is the effect of Blending the Posner and Stepan's models on correcting misconceptions in the 9<sup>th</sup> grade students? Does this effect differ according to gender, method and interaction between them?"

### C. Null Hypotheses:

This study seeks to test the following Null Hypothesis which states:

"There are no statistically significant differences at the level of statistical significance ( $\alpha \leq 0.05$ ) between the mathematical averages of the effect of the Posner and Stepan's model merger in correcting

misconceptions in the ninth grade students due to the variable (gender, method and interaction between them

#### **D. Importance of The Study :**

The importance of this study is that it is one of the few studies that have worked to incorporate the Posner and Stepan's models in correcting misconceptions in mathematics. This is why this study is an addition and enrichment of educational literature on conceptual change strategies.

#### **E. Limitations of The Study:**

The study was limited to the following limits:

-Time limits: This study was applied during the first semester of the academic year 2019/2020.

-Spatial limits: This study was conducted at Doma Secondary Girls' School and Al-Dahria Basic Boys School.

-Human frontiers: This study was limited to the ninth grade students in government schools in the South Hebron District.

#### **F. Terminology of Study:**

**-Model:** A simplified visualization that clarifies and summarizes the nature of the teaching and its components and the relationships that link those elements and the processes of building, designing and implementing the teaching according to sequential steps to achieve and follow the desired goals.

#### **Misconceptions:**

[5] defines it as alternative mental cognitive ideas and perceptions that the learner may carry or adopt, and its meaning does not agree with the scientific meaning approved by scientists, and when these perceptions exist before passing learning experiences, they are tribal concepts of the learner.

[6] also defines it in the field of mathematics as "those perceptions that students have formed of mathematical concepts as a result of passing inappropriate teaching methods and experiences, or that have been dealt with in an inappropriate intellectual way, and students use those ideas or beliefs in mathematical situations thinking that they are intact.

#### **G. Theoretical Framework and Previous Studies**

[4] Believes that wrong perceptions are characterized by being fixed elements in the cognitive structure of the individual and resistant to learning and change, which makes traditional teaching strategies not lead to change in them, and that these wrong perceptions arise through different cultures, environments and different actions and

affected by the common language. In the environment in which the learner lives, it may be considered incomplete, incomplete, inaccurate or distorted perceptions of some scientific concepts or natural phenomena, and contribute to the interpretation of these phenomena in part and for an average extent.

#### **H. Conceptual Change Strategies and Models:**

##### **First: Posner's Strategy of Conceptual Change**

Posner, Strick, Hewson, and Gertzson at Coronel University in America have strategically developed a structural theory mainly for them, known by his name, in which Posner and his companions explain how central and organizational concepts of people change from one set of concepts to another set of concepts incompatible with the first group, and they proposed two types of conceptual change :

1- Absorption: This describes the process of students using existing concepts to deal with new phenomena.

2- Adaptation: Describes the moment a student changes, replaces, or differentiates it to central concepts and others [7].

Posner also emphasizes that the individual's central concepts can be linked to previous experiences and experiences, to appear intuitive and clear, as he considers them through which a certain field becomes a perceptible understanding, and if one wants an understanding of possessing a mental image, then the perception, images and others should be related to the physical objects and processes that are related [8].

Strick and Posner acknowledge the active role social factors play in the learning environment, and point out that all parts of the conceptual structure including scientific concepts and errors must be seen as a dynamic matter, and in constant interaction and development [9].

Posner's strategy of conceptual change is defined as the process of replacing an individual's erroneous understanding with a correct scientific understanding that is consistent with scientific principles and this is done through the use of a number of strategies that are integration, discrimination, alteration, and conceptual bridging [7].

This strategy is implemented in two successive phases:

1- Explore the individual's misunderstanding patterns.

2- Using a method for processing and choosing the appropriate strategy to provide a sound scientific understanding that is through representation, which

is concerned with developing the individual's ability to clearly distinguish the new concept of benefit, and barter, which means achieving the individual's process of accepting the new concept completely, by raising the value of the new concept and reducing The value of the old misconception. (Sabarini and Al-Khatib, 1994)

### *Second: Stepan's Model*

The Stepan's model emerged as a reaction to traditional teaching methods that ignored the role of the learner and considered it a recipient of knowledge only, as it developed it by relying on a constructive approach to place the learner in an educational learning environment that encourages them to face their previous concepts as well as those of their previous colleagues, and then work towards a solution and conceptual change[10].

[10] believes that using the model does not require additional time compared to traditional methods and models, because the depth of understanding that occurs in learners reduces the time normally required to review the content and re-teach it continuously. The model focuses on providing a stimulating learning environment for learners by activating teamwork and engaging the learner within the group to counter his misconceptions in order to effect a conceptual change, and this is done according to specific steps which are:

- 1- Commit to Outcome: Students become aware of their previous perceptions by thinking and contemplating them, and then making predictions and commitment to outcomes before they start any scientific activities or activities.
- 2- Expose Beliefs: Students present their beliefs by sharing them with small groups at the beginning and then with all the class students.
- 3- Confront Beliefs: Students face their beliefs by testing and discussing them in small groups.
- 4- The concept "Accommodate the Concept". Students work to solve the difference and mental struggle between their ideas based on the preconceptions and announcements and class discussion and their observations, thus adopting, representing and assimilating the new concept and its compatibility.
- 5- Extend the Concept: Students expand the concept by making connections or relationships between the concept that was learned in the classroom and other situations, including their daily lives.
- 6- Go Beyond the Concept, and this is done by following up on additional questions, problems and projects that he has chosen that have to do with the concept.

### *I. Previous studies:*

[11] aimed to investigate the effectiveness of some strategies in correcting misconceptions of second-year secondary students in mathematics in Taif, the researcher followed both descriptive and experimental analytical approaches, the study sample consisted of 102 students represented in 50 students for the control group and 48 students for the experimental group, the researcher used In this study, a test to identify error perceptions, and the results showed statistically significant differences in a test to identify error perceptions in favor of the experimental group.

[12] aimed to show The effect of using some conceptual change strategies in modifying alternative mathematical concepts among the tenth grade students in Gaza was investigated in this study, and the researcher used the descriptive and experimental approaches. The descriptive study sample consisted of 326 students, where the researcher used a diagnostic test to define alternative concepts in the logic unit for the class The tenth, and the experimental sample consisted of 170 male and female students divided into four divisions, two male divisions, one controlling and the other experimental, and two female divisions, one controlling and the other experimental.

[13] That aimed to investigate the effectiveness of Posner's conceptual change model in treating erroneous perceptions of mathematical concepts among elementary school students in Menoufia governorate, and the researchers followed the experimental approach, where two schools were chosen, one as a control group and another experimental group, and the number of students in each of them (31) students, The researchers identified the false perceptions through a questionnaire for teachers and supervisors and then prepared a test with them. The results showed the effectiveness of the Posner model in treating misconceptions of mathematical concepts.

[14] aimed to study the effect of the Posner model on correcting erroneous engineering concepts among high school students, where the study was applied in a government education school in Najran, where the study sample (197) students from the first secondary class were divided into two control groups and the other is experimental, and was used The researcher used the open questionnaire for teachers and the diagnostic test of the wrong engineering concepts to achieve the goals of her study, while she adopted the descriptive analytical approach to analyze all units of the first-grade secondary book to determine the engineering concepts contained therein, as well as the semi-experimental approach to using the Posner method.

The results showed statistically significant differences at the level of significance (0.05) in the results of the test of correction of engineering concepts for students of the experimental group in favor of the post-test, which indicates the effectiveness of the Posner model in this.

[15] The researcher's goal in his study is to investigate the effect of using the Stepan's model in modifying conceptual errors among tenth grade students in mathematics and improving their ability to mathematical justification and the level of metacognition skills. To achieve the goals of his study, the researcher followed the experimental approach where the study sample consisted of (44) students divided into two groups One is control and the other is experimental, and the study adopted each of the tools: a diagnostic test, a measure of metacognitive skills, a test of conceptual error modification, a test of the ability to mathematical justification, and the results showed statistically significant differences in favour of the experimental group in the test of modifying conceptual errors and a test of the ability to mathematical justification and a scale

Metacognition skills.

[16] This study investigated the effectiveness of the Stepan's model of conceptual change in developing mathematical concepts and retaining them among the tenth grade students in Jordan, where the experimental study sample reached (70) students from Al-Qweismeh School for Boys in Jordan, and to achieve the goals of the study, the researcher used a diagnostic test consisting of (19) A paragraph of the multiple choice type that includes some of the concepts mentioned in the triangles unit, and prepared an educational subject according to the Stepan's model, and carried out a post achievement test, and the results showed that there were statistically significant differences in favour of the experimental group in the post test, and the researcher recommended training mathematics teachers to employ the Stepan's model in learning And teach mathematics.

[17] which aimed to investigate the effect of the Stepan's model on conceptual change in modifying alternative mathematical concepts and the ability to solve mathematical problems in Jordan, the researcher used the experimental approach, where the study sample reached (60) students from the ninth grade distributed in two control and experimental groups, and the researcher used Two tests in the application of this study, one of which is to uncover alternative mathematical concepts consisting of 25 paragraphs of multiple choice type in the two units of coordinate geometry and trigonometric ratios and the other about the ability to solve problems It consists of 12 paragraphs of

the multiple choice type and 8 paragraphs with an open answer, and the results showed that there were statistically significant differences in the examination of the detection of alternative mathematical concepts due to the Stepan's model as well as in the ability to solve mathematical problems *as well*.

**J. Methodology and Procedures of the Study:**

Study Methodology:

An experimental approach and a quasi-experimental design were used to investigate the effect of using a proposed model in light of the Posner and Stepan's model of conceptual change in correcting misconceptions in ninth grade students

Study Society:

The study population included all the ninth grade students in government schools affiliated to the South Hebron District, who are studying mathematics for the academic year 2019/2020 for the first semester, and their number is 3838 students, according to the latest statistics of the Planning Department in the South Hebron Directorate.

Study Sample:

The sample of the study consisted of two schools (males and females) that were chosen intentionally, and they are government schools in the South Hebron Directorate are the two primary schools for boys and the Duma Secondary School, because both schools contain an appropriate number of sections.

The two divisions that represent both the control group and the experimental group were chosen randomly in both schools, so that the Blending of the two models is applied in the division that represents the experimental group, while the application is carried out in the usual way in the division that represents the control group, and Table I shows the distribution of the sample in Male and female control and experimental groups.

**TABLE I**

**Distribution of the study sample according to the school and the control and experimental group**

School	Control group	Experimental group	Total
Dahrieh basic school	34	33	67
Doma Girls School	38	39	75
Total	72	72	144

Study tools

To achieve the aim of the study to investigate the effect of a proposed model developed in light of the Posner and Stepan's model, a misconception test was constructed. Includes (18) multiple choice items. Where it was worked out

**Validity of the test**

The test was initially presented to a group of experienced and specialized arbitrators, including university professors, supervisors and teachers of mathematics.

**Reliability of the test**

To find the Reliability factor, the test-retest method was used, where the test was applied to a survey sample from the study community and outside the experimental sample of (30) students, and the test was re-applied to the same sample after two weeks, and the Pearson correlation coefficient was calculated between The results of the two tests were (0.89), and this parameter is considered acceptable in the study.

**Study Variables**

First: independent variables Teaching method at two levels (traditional, proposed model for conceptual change) Gender at two levels (male, female) Second: dependent variables Correcting misconceptions in the 9th grade students.

**III. Conclusions**

Results related to the main question Which states: "What is the effect of Blending the Posner and Stepan's models into correcting misconceptions in the 9th grade students? Does this effect differ according to gender, method, and interaction between them?" Which transfer to the null hypothesis which states, "There are no statistically significant differences at the level of statistical significance ( $\alpha \leq 0.05$ ) between the arithmetic mean for the effect of Blending the Posner and Stepan's model in correcting misconceptions in the 9th grade students due to the variable (gender, method and interaction between them)".

To answer the main question, arithmetic means and standard deviations were calculated as shown in Table II and Table III.

**TABLE II**

**Arithmetic Means and standard deviations in the pre- and post-test for misconceptions due to the teaching method**

Group	Numbers		Pre-test	Post-test
Experimental	72	Means	9.8	14.3
		St. Deviation	2.7	2.07
Control	72	Means	9.5	11.8
		St. Deviation	2.8	2.7

It is cleared from Table II that there are apparent differences in the arithmetic mean in the test between the control and experimental methods.

**TABLE III**  
**Mathematical Means and Standard Deviations in Pre and Post Test due to Gender Variable**

Gender	Number		Pre-test	Post-test
Male	65	Means	10.2	13.6
		St. Deviation	2.7	2.8
Female	79	Means	9.1	12.6
		St. Deviation	2.7	2.6

It is noted from Table III that there are apparent differences in the mathematical means of students' scores in both the pre and post test due to the gender variable, to verify the hypothesis and to see whether these differences are statistically significant at the level of significance ( $\alpha \leq 0.05$ ), the researcher used ANCOVA analysis as shown in Table IV.

**TABLE IV**

**The results of the ANCOVA analysis of variable correction of misconceptions due to the teaching method, gender, and the interaction between them.**

Source Of variece	Sum Of Squares	Df	Mean Squares	F-value	Sig.	Effect Size
Pre-test	514.5	1	514.5	299.406	0.001	0.683
Method	200.2	1	200.2	116.521	0.001*	0.456
Gender	1.889	1	1.889	1.09	0.29	0.08
Method*Gender	3.032	1	3.032	1.76	0.18	0.013
Error	238.8	139	1.719			
Total	25511	144				

**Results related to the variable method of teaching**  
TABLE IV shows that the value of the calculated significance level (0.001) which is less than the value of the statistical significance level ( $\alpha \leq 0.05$ ), and therefore there are statistically significant differences in correcting misconceptions in the 9th grade students due to the teaching method based on The Blending of the Posner and Stepan's model, and to find out in favor of the two groups these differences were found Marginal Estimated Means and standard Errors due to the teaching method as in TABLE V

**TABLE V**  
**Marginal Estimated Means and Standard Errors**  
**due to the teaching method**

Methods	Marginal Estimated Means	Standard Errors
Experimental	14.236	0.156
Control	11.860	0.155

As can be seen from Table V, the adjusted mean for the experimental group that was studied according to the proposed model and whose value reached (14.236) is higher than the adjusted mean for the experimental group whose value reached (11.860), and accordingly the differences are in favor of the experimental group.

The results also indicate in TABLE IV that the magnitude of the effect by calculating the ETA square for the method of teaching has reached (0.456), and therefore the proposed model in light of Posner and Stepan's model has a high impact in correcting misconceptions.

#### Results related to the gender variable

The results in TABLE IV show that the calculated significance level was its value (0.296) which is greater than the value of the statistical significance ( $\alpha \leq 0.05$ ), and therefore there are no statistically significant differences attributed to the gender variable.

Results related to the interaction between the method and Gender

It is noted from TABLE IV that the calculated significance level reached its value (0.186) which is greater than the level of statistical significance ( $\alpha \leq 0.05$ ), and therefore there is no effect of the interaction between the method and gender variables.

#### Discussions and Recommendations

Discuss the results related to the main question which states:

"What is the effect of using the Posner and Stepan's model combinations to correct misconceptions in 9<sup>th</sup> grade students? Does this effect differ due to gender, method, and interaction between them?"

It is clear from the results of the analysis of the presence of statistically significant differences in the mean marks of the experimental and control groups in the test of correction of misconceptions according to the method of teaching and in favor of the experimental group that was studied by combining the Posner and Stepan's models, and therefore this merger is effective in correcting misconceptions in the ninth grade students.

This effectiveness is attributed to the following reasons:

- This group of students at this age stage have the ability to perceive concepts and relationships between them, and thus prepare to receive and accept the modifications that occur in the cognitive structure, and for you because the model provides an

opportunity to challenge, suspend and benefit from using the correct perception in solving problem situations.

The current study concerned with the engineering and measurement unit because it is rich in many concepts and generalizations necessary and essential for the student to achieve the goals of the educational stage, as well as the nature of the vertical extension of this unit in the subsequent grades.

#### IV. Recommendations

Based on the results of the study, the following recommendations were produced:

Instructing mathematics teachers to take an interest in the tribal cognitive structure, revealing patterns of common perceptions they have before beginning and during the teaching process as well, as this is important in developing their teaching methods, building the necessary study plans to address these errors, which are a basic structure for new learning, and caring for preparing diagnostic tests for perceptions Wrong sports for students at all educational levels, Including the math curriculum and the teacher's guide for the different grades include a part of the misconceptions expected by students, and for activities and guidance that harmonize the proposed model and concepts of conceptual change contribute to its correction, and work to train mathematics teachers to activate the conceptual change model and its strategies for all stages.

Suggestions

In light of the objectives of the study and its results, the following can be suggested:

- 1- Studying and diagnosing misconceptions of students with other subjects and different ages.
- 2- Studying the effectiveness of conceptual change strategies and models in correcting misconceptions in various subjects and different educational stages and in other dependent variables such as student attitudes toward the topic according to the strategy or model under study.
- 3- Analytical studies of mathematics curricula and their impact on building and forming misconceptions among students.

#### ACKNOWLEDGMENT

The Researcher wishes to acknowledge Al-Quds University for helping, contributing and their encouragement .

#### REFERENCES

- [1] H Zaytoun, K. Zaytoun. "Learning and teaching from the perspective of structural theory", 2nd floor, book world, Cairo, 2006.
- [2] A. Zaytoun, "Contemporary Trends in Science Curricula and Instruction", Dar Al-Shorouk for Publishing and Distribution, Amman, Jordan, 2010.
- [3] I. Afaneh, Kh. Al-Sirr, M. Ahmad, N. Al-Khazandar "Mathematics teaching strategies in general education stages", University Book House, Gaza, Palestine, 2010.

- [4] A. Abdul-Salam, "Modern Trends in Teaching Science", Arab House of Thought, Cairo, Egypt. 2001.
- [5] Zaytoun, "A Structural Theory and Strategies for Teaching Science", Dar Al-Shorouk, Amman, Jordan. (2007).
- [6] I. Afaneh, "The interrelation between conceptual knowledge and procedural knowledge in teaching and learning mathematics," *Journal of Educational Research and Studies*, Palestine, 2001.
- [7] Posner, trike, K. ,Hewson, P. ,Gertzog, W. "Accommodation of a conception: Toward a Theory of Conceptual Change", *Science Education*, 66(2), 211-227. (1982).
- [8] D. Stenhouse . "Conceptual Change In Science Education Paradigms And language games", *Science Education*, 70(4). (1988)
- [9] Tyson, M.. "A multidimensional Framework For Interpreting Conceptual Change Events" In *The Class Room*, Science education, 81(3). (1997)
- [10] Stepan. "Targeting students science – misconceptions, published and distributed idea factory," Interview, U.S.A. (1996).
- [11] F. Al-Qurashi "Employment of some strategies in correcting misconceptions of second-year students in mathematics, unpublished master's thesis", Umm Al-Qura University, Saudi Arabia, 2014.
- [12] H. Al-Balawi, "The effect of using some conceptual change strategies in modifying alternative mathematical concepts among 10<sup>th</sup> grade students in Gaza", unpublished Master Thesis, Islamic University, Gaza, Palestine, 2009.
- [13] A Qandil, A. "The effectiveness of Posner's conceptual change model in treating erroneous perceptions of mathematical concepts among elementary school pupils", published research, *Journal of Mathematics Education*, 20 (1), pp. 260-223.
- [14] S. Al-Yami, "The Influence of Posner's Model on Correcting Mistaken Engineering Concepts among High School Students", *Education Scientist*, Arab Foundation for Scientific Consultation and Human Resources Development, Cairo, Egypt, 7 (59), P (199-223), 2017.
- [15] A Mousa, "The effectiveness of the Stepan's model in modifying students' conceptual errors and in improving their ability to mathematical justification and metacognitive skills," unpublished doctoral dissertation, Yarmouk University, Jordan (2017).
- [16] M. Hamza, "The effect of using the Stepan's model of conceptual change on developing and retaining mathematical concepts among 10<sup>th</sup> grade students in Jordan", *Educational Journal*, 32 (128) pp (301-331), Kuwait University, Kuwait, 2016.
- [17] M. Abu Sarar "The effect of using the Stepan's model on conceptual change in modifying alternative mathematical concepts among upper secondary stage students and their ability to solve mathematical problems," unpublished PhD thesis, University of Jordan, Amman, Jordan, 2013.