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The Degree of Practicing Creative Thinking Skills by Physics Teachers in Irbid, Jordan

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Abstract

This study aimed to identify the degree of practicing creative thinking skills by physics teachers from two perspectives: their students' perspective, and the observers' inside the classroom. It also aimed to determine whether there are differences in the average of the practicing degree of creative thinking skills due to: (the teacher's gender, qualification, experience). To collect data, two tools were used; a questionnaire and an observation card. The questionnaire was distributed among 300 students who were chosen from 6 male and 5 female state schools of the ninth and tenth grade in Irbid Education Directorate. The observation card was used to notice the practicing of creative thinking skills by male and female physics teachers. The results of the study revealed that the degree of practicing creative thinking skills by physics teachers was moderate of (3.5) value from their students' perspective. Also, it was moderate of (3.37) value from the classroom observers' perspective. The results also revealed that the female physics teachers used creative thinking skills in their classroom teaching practices more than the male physics teachers did. However, there were no statistically significant differences in the practicing of creative thinking skills attributed to the effect of the teacher's academic qualification and experience. The results also showed that there is very high correlation between the degree of practicing creative thinking skills from the perspective of both the students and the observers. The study has recommended to hold training courses for physics teachers to teach them how to apply and activate creative thinking skills in their classroom teaching practices. It also has recommended to provide schools with the necessary equipment and material resources to carry out new and non-conventional activities and experiments related to physics.

Keywords: creative thinking skills, physics teachers, gender, teaching practices

Introduction

In the last few years the world has witness a magnificent revolution in many fields including science, industry, and technology, even digital and electronic revolutions accompanied by radical changes involving all aspects of life, and now, we are experiencing all these changes as natural facts. Which led to several qualitative and quantitative uplift in the education systems, and it became a major responsibility and even an obligation for teachers at any level of their education to obtain high thinking skills like, critical thinking and creative thinking because these skills will help to find people who can think creatively To cope with future prospects and adapt to them with sufficient flexibility, and have the ability to be unique (to do atypical creative things) while facing challenges and obstacles in new developments. Moreover, to find solutions to the problems faced by new world in an innovative and creative ways (Saadi, 2007; Al-Haddabi, Al-Fafali, and Al-Alayi,2011; Daud, Omar, Tariman, Osman, 2012).

Teaching how to think and obtain thinking skills is a necessity, that's why an educational approach must be applied to the teachers. Creative thinking is the finest type of human thinking because it contributes to the production of original ideas and innovative solutions to problems, and enables the learner to understand and interpret the various phenomena (Dnaoui, 2008). Furthermore, creative thinking is a unique thinking characterized by diversity and multiple outcomes, and some people consider the ability of solving problems in any situation exposed to the individual will lead to a result characterized by realism, novelty, originality, fluency and flexibility, therefore it's the perfect option to compare options between research and discussion.

Talens (2016) believes that creative thinking is the curve that increases students' knowledge, and widen their horizons in understanding and developing both knowledge structure and meta cognition abilities. Some researchers have identified creativity as the most important tool of excellence and success in facing the challenges of the 21st century.

Physics is one of the most knowledge fields in desperate need of creative thinking. It is the science of nature that studies everything in the universe, from the tiny quarks that we find in the atom to the great galaxies of this vast extended universe. Globalization and the growth of population are strongly related to the huge progress in physics; all the devices that fill our daily lives are based on physics, such as radar, radio, radio, television, telephone, mobile, computer, and medical diagnostic devices such as X-rays, MRI, radiotherapy, Telescopes, space probes, microwave ovens, electricity, transistor, microphone, etc. in addition to the great influence of physics in other fields of human knowledge.

The physics curriculum is a productive and viable environment for the development of creative thinking among teachers because it contains many subjects and activities related to reality, as well as the multiple situations and challenges that face their community. The student learns how to confront them, reduce their effects, and invent new solutions (Zaitoun, 1987).

Creative thinking is one of the fundamental principles of contemporary educational philosophy on which science curricula, programs and projects must be based (Baker & Öztekin, 2014). This is what was confirmed and recommended by the global development and reform orientations in the field of scientific education, science curricula, programs, orientations and projects. Among these global projects are: "Science for All" (AAAS, 1989), "Next Generation Science Standards" (NGSS, 2013), all of which emphasized the teaching of thinking, the development of creative thinking skills, problem solving and decision-making as the main goal of teaching science in all levels of education from K-12 (NRC, 2012).

These reform orientations and global projects have targeted all the countries of the world, including the Arab countries, especially Jordan, whose educational systems have tried to benefit from the development of their educational curricula in general and the curricula of science and programs in particular. These developmental projects, supported by international organizations such as Education Reform for Knowledge Economy (ERfKE) and the Integrated Science Education Development Project (SEED) teaching Integrative way (SEED) and the inquiry based science education project (MEJ, 2014).

These projects came as an attempt to promote science education in Jordan. The crisis, which has already been confirmed by the results of international assessment tests such as the PISA test (NCES, 2015a). And "Trends in International Mathematics and Science Study " TIMSS (NCESa, 2015). Where the average performance of the student unfortunately below the world average, and without internationally accepted performance for all participating Arab countries, including Jordan, and the absence of any significant improvement in the average performance in all the skills measured by this test (NCESb, 2015.

A number of descriptive analytical studies that analyze the content of science books in Jordan have shown that books are based on the NSES National Science Education Standard and are constructive with a cognitive-research orientation (Haddad, 2004; Nawasrah,2006; Hossnia, 2013; Khalaf, 2012). This raises questions as to whether the content of science books is equivalent to universally acceptable content. If there is an adequate number of science teachers with academic qualifications in various aspects of science, and our universities are loaded with academic and cognitive qualified teachers to transfer the scientific content of these books. So why didn't this reflect on the performance of our students who participated in the international tests?

This calls us to make some reconsideration of the teaching approaches and ways that are applied by teachers within classrooms, and how effective and useful are they? (Al-Omari, 2015). We should all work to transform from traditional, spoon-feeding approach based on book content to the teaching that is centered on thinking processes. Meaningful learning gives the student the ability to investigate scientific knowledge, understand its conceptual structure, employ it in practical life, and practice thinking skills and science processes.

Some of the procedures that a science teacher can take into consideration to develop the creative thinking are:

Providing a creative environment to stimulate creative thinking. By creative environment we mean the environment that makes the learner feel free to express his own thoughts, encourages him in dialogue and discussion and motivates him to propose new unconventional ideas and multiple answers. It is also an environment in which creative initiatives are proposed by learners and new variant teaching methods are used (Kendy, 2006).

Focusing on activating and stimulating learners' divergent thinking and avoiding convergent thinking. This is done by encouraging asking open-ended questions that require using the divergent not the convergent thinking to answer. Divergent thinking is defined as the ability to provide multiple solutions for a single problem with an opening ending and multiple wide-ranging explanations to a situation or a particular event in many directions. This kind of divergent thinking is considered the real director and stimulator towards the creative thinking. While closed-ended questions that have only one correct answer and need using the convergent thinking should be avoided as much as possible. Convergent thinking is considered to be creative thinking restraint (Diane & Dana & Ruth, 2003).

Researchers' vision of creative thinking has developed with time. De Bono (1989) defined it as a practical skill through which depending on experience mind is used to provide successful and reasonable decisions to solve problems.
through which sequent and deliberate steps are developed to convert knowledge to practical procedures that are applicable and reliable and to give that knowledge a higher functional value as a result to students' organized response to the problems they face. In that way, we could notice that creative thinking has been transferred in a procedural way from the knowledge and skills scope to the practical scope that is based on scientific theories.

In order to change theories and scientific knowledge into practices, students should be trained through exposing them to perfect contexts where their knowledge would be transferred to practices with a scientific and functional value despite the differences of their responses degrees to this training. Lev Vygotsky who is mentioned in (Lindqvist, 2003) Believes that all people are able to create since they all have the most significant and important tool to do so which is imagination. Even if they are different in their abilities to unleash this tool, they can be trained to practice multiple skills that would help them to use creative thinking.

Modern educational interests have turned to focusing on the teacher's role in enhancing the students' creative thinking process. The science subject's nature needs the science's teacher to be conversant with activities that stimulate students' creative thinking and curiosity. Lindqvist (2003) thinks that teachers' lack of qualification regarding students' creative thinking stimulation is one of the main reasons that obstructs it. In the Educational Development Conference that took place in Amman at the beginning of August 2015, The Jordanian Ministry of Education was concerned of the importance of training teachers about creative thinking methods and skills in specialized centers and how to design creative activities for students.

The methods that can be used by teachers to stimulate students' creative thinking have been also an international concern not only at the level of institutions (Talens, 2016). Many researchers have done many studies to investigate the impact of using certain programs and teaching strategies on stimulating students' creative thinking. Malkawi& Malass (A. P.) study aimed to investigate the six thinking hats' effect on improving the creative thinking skills of fifth grade female students in Irbid Governorate in Jordan. Its results showed a positive impact of this strategy in developing creative thinking and motivation. The study of Al-zayedy (2009) results revealed that, teaching strategy based on using active learning developed creative thinking of third grade's female students in Mecca. Al-Zoubi (2014) as well carried out a study to investigate the effect of a teaching strategy based on problems solving in developing athletic creative thinking skills among pre-service teachers at faculty of education in Yarmouk University. The study showed a significant improvement in the athletic creative thinking skills of the students who participated in the study. Other researchers (Moma, Kusumah, Sabandra & Afgani,2013, Al-Aqeel, 2005; Zernouki,2007) did studies in the same field and for the same purpose. It all showed a positive effect of programs and strategies that were applied in developing students' creative thinking regardless their academic level and geographical background. It can be concluded that students' creative thinking skills can be developed because these skills are acquired and can be learnt under the appropriate circumstances.

Although studies have shown that creative thinking skills can be learned and acquired, training to acquire and practice is not easy, as Daud and his companions have described it (Daud et al., 2012) as a complex command, it is not easy to settle creative thinking skills in students' minds. Therefore, creative thinking skills training requires experienced teachers who possess these skills so they can train their students.

Larry believes (Larry, 2003) that the teacher can contribute to the development of creative thinking of his students by giving them enough time to think and reflect, and reward them for the ideas they provide and encourage them morally, as well as configure a positive and supportive environment in a safe and quiet classroom that prevail acceptance not coercion, and provide efficient and effective incentives away from fear and failure. On the other hand, Glenn (Glenn, 1997) believes that educational systems in general, and despite many research and studies that emphasize the need to adopt strategies that stimulate creative thinking and create a climate conducive to the development of creativity skills, but it is in fact still inadequate and does not help to provide such an environment.

There is no doubt that science teachers need to acquire special skills and systematic accumulative experience that helps them understand the process of thinking and identify the methods of development and promotion among students. The results of many studies confirmed the importance of practicing science teachers some of the teaching skills which are necessary to motivate their students to creative thinking and practice their skills. The study of Renzulli, Reis & Smith (1981) showed that Teacher takes the first place according to his importance in making gifted students' educational programs successful. When the teacher is flexible, students are given the opportunity to engage in dialogue, debate and

active positive participation, and to undertake scientific activities, experiment and find solutions to the problems that confront them, thus helping his students to develop their creative thinking (Abu-Jalalah, 2007).

Several studies have been conducted to identify the characteristics of creative teachers, as Hazkvitz's study (2007) whose results indicate many features that bring together creative teachers, the most important of which are: their capacity and ability to integrate between different sciences, and to establish the appropriate rules for dealing with students. And their ability to assess the needs of the students, and the ability to communicate effectively.

Others such as Levine (1997) went on to explore the most creative ways of thinking favored by teachers, explaining that the method of motivating students by interacting with their teachers was the most common among teachers In the sample for which the Torrance test of creative thinking was applied.

The study of Onosko (1990) aimed to compare teachers 'attitudes towards the development of students' thinking skills and their classroom practices Aimed at developing higher thinking skills, the sample of the study consisted of (10) American teachers, and the results indicated that the teachers who showed positive attitudes towards their understanding of the concept of thinking as a goal of education, their practices aimed at developing higher thinking skills were higher.

Levin also (Levine, 1997) made a study to identify the relationship between creative thinking and the preferred method among learners, by applying Torrance test for creative thinking. The study sample consisted of (16) teachers in one of the educational states in America, divided into two parts: those with high creativity, are the teachers who received (101) degree and above, and with low creativity are the teachers who received (98) degrees or less, also the teaching methods used by each of them in teaching were identified. The results of the study showed that the teaching method followed by the creative teachers is characterized by stimulating motivation and interaction between students and teachers, and between the students themselves. It was also found that students in primary school are more creative when the teacher is creative.

Several studies have been conducted to detect he degree to which teachers possess the skills that develop their students' creative thinking and the degree to which they practice these skills in the classroom: such as the study of Qashua (2001) which was aimed to identify the eighth grade students' perspective on science teachers' practices that help to develop their creative thinking. And the results showed that the degree of teachers' practices was medium, and There are differences in favor of female teachers.

Al-Shehabi (2006) investigated the degree of science teachers' practices which aimed at developing creative thinking skills among secondary students in Taiz city in Yemen. The results revealed a low level of teachers' creative thinking skills from their students' perspective and also, revealed no significant differences due to teacher's gender.

As well as Al-Azri's study (2007) which sought to reveal the extent of the practice of science teachers in grades (fifth through nine) for creative thinking skills within the classroom. The results showed that the exercise of creative thinking skills by the science teachers was moderate, and there were a significant differences attributed to gender and in favor of females, and there were significant differences due to experience. And the study by Abu Raya which its results revealed an average degree of practice among both male and female teachers of primary school in the Galilee region of Palestine, and there was a superiority of female teachers in practicing creative thinking skills.

While the study results of Zidane and Al-Awouda (2008) found that the Degree of Use of creative thinking Patterns in science teaching by teachers of lower basic grade in Hebron Governorate in Palestine was high and there were significant differences attributed

to of experience's variable. As for Al-Haddabi, Al-Fafali and Al-Aley (2012) have investigated the level of creative thinking skills among students in the scientific departments of a Saudi university and the results revealed a clear weakness in the students' degree of creative thinking skills. It also showed significant differences in the level of creative thinking skills according to the gender's variable, and in favor of female teachers.

The current study came to complement the line of previous studies in attempt to detect the degree to which physics teachers in northern Jordan practice creative thinking skills from both their students' and the observer's point of view. And the relationship of these practices with some demographic and functional variables of the study's sample.

Problem of the study

Based on the importance of creative thinking skills as one of the most significant skills of the twenty-first century. And based on the global trends in science curricula and methods of teaching (NGSS, 2013; NRC, 2012; NCES, 2014; NCESa, NCESb, 2015), all of which emphasized the need to develop creative thinking as a fundamental goal of teaching science at all levels of education (K-12).

Due to the requirement of addressing the crisis experienced by the system of learning and teaching science in Jordan, which was revealed by international tests such as tests "PISA" and TIMSS "" where there was a non-negligible decline in the performance of our students in science and mathematics; where the average performance of all Arab countries, including Jordan below the average International cooperation over all the years from 1999 to 2015.

And because the curriculum of physics is a productive environment suitable for the development of high thinking skills of learners, mostly the creative thinking among learners. The conceptual structure of physics, which by nature tends to abstraction and complexity, teaches these concepts require the learner to employ higher thinking skills and search for special teaching practices that stimulate students to think creatively which in turn go with the nature of the scientific subject that requires creative in-depth thinking away from conservative type.

Based on the important role of science teacher and the value of their teaching practices that were confirmed by the results of previous studies where they found that providing creative environment will change the educational reality of the students, turning them from the stage of conservative spoon feeding to research, thinking, analysis and conclusion to finally reach the level of creativity and innovation, The main target of these studies was to highlight the teaching practices of physics teachers in the public schools affiliated to the Directorate of Education of the brigade of the Irbid to investigate the degree of their practice of creative thinking skills.

Questions of the Study

Based on the study's problem and purpose, the following questions guided the study:

1. What is the degree to which physics teachers practice creative thinking skills from the point of view of their students?
2. What is the degree to which physics teachers practice creative thinking skills from the point of view of the observer in the class room?
3. Are there statistically significant differences at ($\alpha = 0.05$) in the average degree of physics teachers' creative thinking skills practices due to the variables (gender, qualification, experience?
4. Are there statistically significant differences at ($\alpha = 0.05$) in the average degree of physics teachers' creative thinking skills practices due to the students' variable (Ninth, Tenth grade)

5. Is there a significant relationship at ($\alpha = 0.05$) between the average degree of physics teachers' creative thinking skills practices from the point of view of both their student and the observers in the classroom?

Procedural Definitions of study terminology

Creative thinking: is a complex and purposeful mental process that generates an overwhelming desire to explore, search, and find original and unique results. It's characterized as profound and inclusive - and belongs to the complex higher levels of thinking - it has interconnected cognitive, emotional and moral elements that form a unique state of mind.

Creative thinking skills: they are creative, comprehensive, deep, purposeful activities that are oriented toward a specific goal. And is characterized by the depth and comprehensiveness of the individual to reach the largest number of new ideas, aimed for solving a problem, or the ability to make a decision, or to take certain actions toward certain situations exposed to it. In this study, it is intended to exercise the mind for its creative activity and intelligent solutions to the problems that will be faced by the physics teachers in Jordanian schools while doing the teaching process.

Fluency: An individual's ability to give the greatest number of responses (ideas) toward a particular situation in a given period of time. It is measured by the degree to which the teacher receives in each response in the questionnaire and observation card of the skills of fluency.

Flexibility: It refers to the ability of the individual to change his / her course of thinking as required by the situation or the stimuli, and is measured procedurally by the degree to which the teacher receives in each response from specific questionnaire and observation card.

Originality: It is the ability of individual to give unusual responses characterized by novelty and uniqueness from those around him (no one has ever asked him before), and measured by the degree to which the teacher receives in each response from the originality skills of the questionnaire and note card.

School students: are the regular students in the level of primary education represented in the ninth grade and the tenth grade, where they are between the ages of (15 - 14) years and the ages between (17-16) years respectively. Student who are studying physics in public schools in the Directorate of Education in Irbid region according to the Jordanian education system during the first semester of the academic year 2016-2015.

Limitations of the Study

• The sample of the study was limited to physics teachers of grades 9 and 10 in the public schools affiliated to the Directorate of Education in the Irbid region only, and did not include physics teachers who teach high school students.

• The sample of the study was limited of some student of ninth and tenth grade in the schools affiliated to the Directorate of Education in Irbid.

• The study period was limited to the time during the first semester of the academic year 2016-2015.

• Creative thinking skills measurement was limited to three skills; fluency, flexibility and originality only.

• The accuracy of the results of the study is determined by the accuracy of the study procedures and the tools used (the questionnaire and the observation card) in terms of integrity and consistency.

Methodology

Research Method

This study used descriptive method to investigate the degree of practicing creative thinking skills by physics teachers in Jordan.

Population and Sample

The population of the study included all physics teachers who teach 9th and 10th grade and their students at government schools in Irbid, Jordan during the school year 2015-2016. The population of the study consisted of 79 male teachers, 73 female ones and 14839 students. These students are distributed over (228) 9th grade sections and (212) 10th grade sections in (101) schools (JME, 2015).

The study sample consisted of (289) students who were chosen from (11) public schools that belong to Irbid Directorate of Education during the school year 2015-2016. These schools were chosen for being the largest and the best to represent the study population since they have enough number of 9th and 10th class room sections. The schools' administrations also were the most cooperative to allow applying the study in their schools. Descriptive information of the demographic features for the study sample are shown below in tables 1 and 2 below. It should be noted here that most schools in most Arab countries are not mixed, and female schools are separated from male schools.

Table 1

The descriptive information of the demographic features for the students' study sample.

	Category	Frequency	Percent
Gender	Male	138	47.8
	Female	151	52.2
Class	9th	150	51.9
	10th	139	48.1
	Total	289	100.0

Table 2

The descriptive information of the demographic and functional features for the teachers' study sample.

	Category	Frequency	Percent
Gender	Male	15	50.0
	Female	15	50.0
Academic Qualification	Bachelor	26	86.7
	Graduate Studies	4	13.3
Experience	5 years or less	0	00.0
	6 - 10 years	15	50.0
	11 years or more	15	50.0

Instruments

To determine the degree of practicing creative thinking skills by physics teachers from two perspectives: their students' perspective, and the observers' inside the classroom, two instruments were used. First, students' questionnaire which was designed with the help of previous literature review and studies related to creative thinking skills. This questionnaire consisted of (27) items representing the creative thinking skills practiced by the physics teachers in the class room. The items were divided into three creative thinking skills domains (fluency, flexibility, originality). The questionnaire included two parts, part 1 included the demographic information of the students and the second part concerned with

the questionnaire items which were distributed on creative thinking skills domains as follows:

Fluency skill: represented by items (1, 4, 7, 10, 13, 16, 19, 22, 25).

Flexibility skill: represented by items (2, 5, 8, 11,14, 17, 20, 23, 26).

Originality skill: were represented by items (3, 6, 9, 12, 15, 18, 21, 24, 27)

The second instrument of the study was the observation card which has been designed by the researchers. It contained the same items of the questionnaire. The observer marked the square that matched his observation on creative thinking items with cross symbol. This was done after the observers noticed physics teachers' practicing of creative thinking skills in the class room.

Validity and Reliability

Validity was ensured by presenting them to a panel of twelve faculty members who were specialists in the fields of curricula, teaching methods, measurement, evaluation and psychological counselling. Some changes were made based on reviewers' suggestions and their feedback.

Reliability was examined by distributing the final copy of the questionnaire to (40) students out of the study sample. The Cronbach Alpha was used to calculate the internal consistency for each domain and for the total scale. The values of internal consistency coefficient of the scale's domain were reported between (0.72 - 0.81) and of the whole scale was (0.78) as shown in table 3 below; this result means that the reliability coefficient was satisfactory for the purpose of this study (Odeh, 2010).

Table 3

Internal consistency coefficient of the scale's domain and of the whole scale

Skill	Internal Consistency
Fluency	0.79
Flexibility	0.81
Originality	0.72
Creative Thinking Skills (**Total**)	**0.78**

To verify the reliability of the observation card, the researchers observed performance of (6) teachers out of the study sample. The results were analyzed and the stability coefficient was tested according to the Cooper equation. The percentage of agreement between the two observers was (84.26%) which indicated the stability of the observation card and considered to be acceptable to achieve the study objectives (Odeh, 2010).

Data analysis

The instrument employed a five-point Likert scale. Degrees of practicing creative thinking skills were calculated in order to find high, moderate, and low categories. This was calculated by the following equation: upper limit minus the minimum limit divided by the number of desired categories. Therefore, (5 – 1 = 4) divided by (3) categories obtained the proportional scale of (1.33), this was then added to the minimum score to determine the limits of each category. Table (4) shows how the proportional staging statistical model was adopted.

Table 4
Proportional staging used for determining frequency categories

Degree of Practice	Computational Mean
High	More than 3.66
Moderate	2.33- 3.66
Low	Less than 2.33

The questionnaire and the observation cards were downloaded. The data was analysed using a current version of the Statistical Packages for Social Sciences (SPSS). Means, standard deviations, Percentages, T-Test, one-way ANOVA and Pearson correlation coefficient test were used in the analysis, with findings presented next.

Results and Discussion

Results of this study introduced and discussed in terms of answering the study questions. A (0.05) Alpha level was applied to all results to find significance.

First: To answer the first research question Means and standard deviations were used. Figure 1 illustrates this result

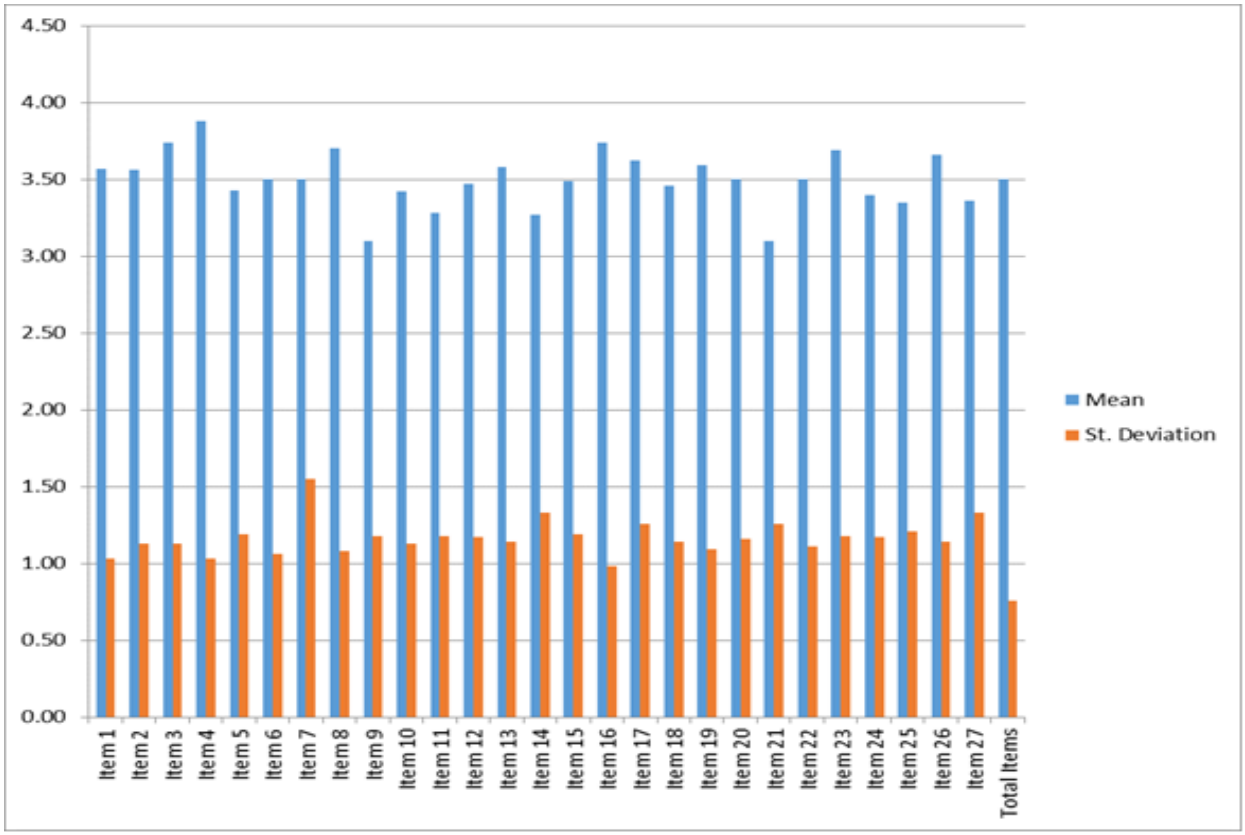

Figure 1: Means and standard deviations of the scale Items of practicing creative thinking skills by the physics teachers from the point of view of their students.

As shown in Figure 1, the results revealed that the arithmetic mean of the degree of male and female physics teachers' practicing of the creative thinking skills as a whole from their students' perspective was (3.50) with a moderate rating. The arithmetic means of the scales items ranged between (3.10 - 3.88) and the standard deviations ranged between (0.99-1.56).

In terms of the items' rank, item (4) which states "Answers the various scientific questions posed by their students" came first, with an arithmetic mean of (3.88) and a high rating level. This indicates that the physics teachers have a sufficient scientific knowledge of physics enabled them to answer any question posed by students in the classroom. Teachers also have a great passion to teach their students and help them understand the scientific material as much as possible by answering their questions. While items (3) and (16) came in second and third places, with an arithmetic mean of (3.74) and a high level rating. the items state respectively, "Uses modern teaching methods that help students get the correct scientific knowledge" and "help students to retrieve their previous knowledge related to the subject of the lesson adequately". Item (8), which states "Follows the logical scientific dialogue with students during the discussion of the lesson ideas" ranked fourth with a mean of (3.70) and a high level rating. The other items of the questionnaire were of a moderate rating.

There were two items (9) and (21) that came in the last rank with a mean of (3.10) each and a moderate level rating. Item (9) which states "Uses modern non-traditional evaluation methods such as student portfolio, peer assessment and self-assessment". This indicates that the traditional method of student assessment is still prevalent among physics teachers and often comes after the completion of the teaching process as if it is separate from it and not a part of it. It could be reduced in the paper tests as the basic or the only way to evaluate the students. It may be due to some teachers' lack of knowledge of the modern evaluation methods, especially those who do not have any educational qualification except for the bachelor degree. These teachers graduated from the Science Faculty and directly started teaching in schools without receiving any educational rehabilitation or training on modern teaching and evaluation strategies. This result could be interpreted by some as wanting to hold on to the old and resist all that is new and reject it. They do not like to apply new evaluation methods and leave what they have been used to since they were students.

This result has agreed with the study of Kashwa (2001), Abu Raya (2004) and Al-Azri (2007) which showed a moderate level of teachers' practice of creative thinking skills. While it differed with the study result of AlHadaby, AlFulfuly and AlOlayee (2011) that revealed a low degree of creative thinking skills' practicing among the students of scientific departments in a Saudi university. This difference can be explained by the difference of the study sample of the Saudi university students who are still in university and lack the experience and the practice, while the sample of this study are all 5 years or more experienced. It also differed with Al-Nafi'i' (2009) study which also revealed a low degree of practice by science teachers among middle school students in Riyadh. This difference shows that some Arab countries still need to do more to raise and improve the level of science teachers.

Second: Means and standard deviations were calculated to answer the second research question. Figure 2 illustrate this.

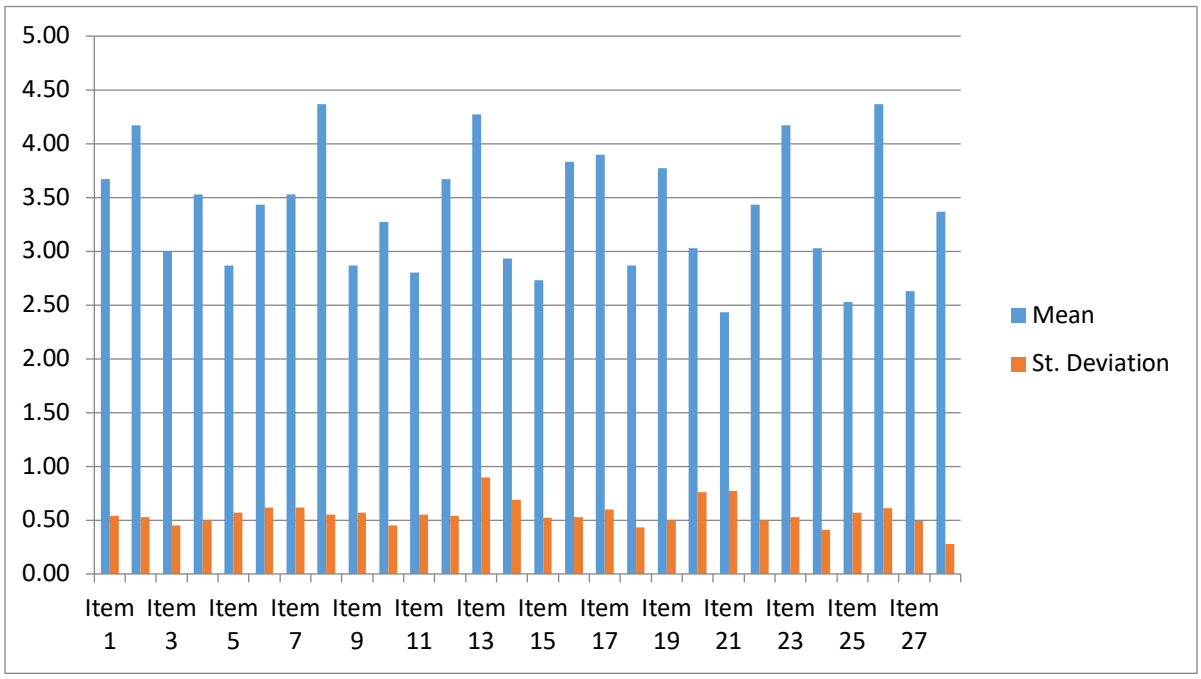

Figure 2: Means and standard deviations of the scale Items of practicing creative thinking skills by the physics teachers from the observer's point of view

As shown in Figure (2), the value of the arithmetic mean of the physics teachers' practicing of creative thinking skills as a whole from the observer's perspective reached (3.37) with a moderate level rating. The values of the arithmetic means ranged between (2.43- 4.37). And standard deviations between (0.414 - 0.907), indicating that there was a convergence in the responses of the observers within the classroom on all the observation card's items.

This result accords with the results of Al-Azri (2007) study which showed that the science teachers' practicing degree of creative thinking skills was moderate. On the other hand, this results differs with Zaidan and Al-Ouda (2008) study that showed a high degree of physics teachers' practicing of creative thinking skills. This difference may be due to the difference in the sample, which is the teachers of the first grades (I, II and III) and it may be easier to practice creative skills during teaching this stage than to practice it in teaching a purely scientific subject that is rigid, complex and abstract.

In terms of the items' rank, items (8) and (26) came in first and second places, respectively, with an arithmetic mean of (4.37) each and a high level rating. They state respectively, "Follows the logical scientific dialogue with the students during the discussion of the lesson's ideas" and "organizes the science lesson elements sequentially and logically". While item (13) which states "ask students open-ended scientific questions which may have more than one correct answer" came in third place with a mean of (4.27) and a high level rating. Items (2) and (23) came in fourth and fifth places, respectively, with a mean of (4.17) each and a high level rating. They state respectively, "Makes the class environment comfortable for students to discuss scientific ideas" and " trains students the steps to solve the problem in a scientific way". This result indicates that physics teachers give their students the intellectual freedom and tend to dialogue and persuasion in dealing with them away from authoritarianism and imposing scientific ideas on them without discussion.

Physics teachers are keen to plan, pre-prepare, arrange and organize their ideas in advance before presenting them to students in the class.

The physics teachers' practice of presenting controversial issues for dialogue and discussion came in the penultimate order with a moderate level rating approaching the weak level. This may be due to the lack of time in which the teacher's focus is on providing physical knowledge and solving problems especially that physical concepts are difficult ones characterized by complexity and abstraction. The teacher spends most of the time in explaining them to the students and has no time left to present controversial issues to discuss. Item (21) which states that "Gives students the chance to try scientific experiments and activities with unusual ways" ranked the last with a mean of (2.43) and a moderate level rating approaching the weak. It is noted that this item had the minimum rating from the students as well, with a mean of (3.10) and standard deviation (1.26). Although the mean of student estimation for this practice is higher, its high standard deviation indicates the fluctuation of students' judgment on this practice, which proves that physics teachers do not encourage their students to conduct experiments and activities in new ways. This may be interpreted as a result of the teachers' lack of time needed to give students the opportunity to do experiments in new ways especially that the physics books content for the tenth and ninth grade are full of knowledge, and the weekly time allocated to physics is only three classes, 45 minutes each. This time is barely enough to cover the book's content which is full of physical knowledge. Another explanation for this result may be the lack of the necessary scientific laboratories in some schools, or the lack of equipment, devices and material resources.

Third: To answer the third research question, it has been transformed into **three null hypotheses**:

The first null hypothesis: There are no statistically significant differences at (α = 0.05) in the average degree of physics teachers' creative thinking skills practices due to the teacher's gender variable.

To validate this hypothesis, T-Test was used to reveal the significance of the statistical differences, due to the teacher's gender variable and table 5 illustrates this.

Table 5

T-test results to detect the significance of the difference in the average degree of creative thinking skills practices due to the teacher's gender variable

	Male		**Female**		T value	Statistical significance
	Mean	Standard deviation	Mean	Standard deviation		
Physics teachers' creative thinking skills practices from the observer's point of view	3.26	0.287	3.48	0.244	-2.308	0.029

Table (5) shows that there are statistically significant differences at the level of (α = 0.05) in the average degree of physics teachers' creative thinking skills practices attributed to the gender of the teacher. It means, female teachers in the sample used creative thinking skills in the classroom more often than their male counterparts. Figure 3 illustrates this result.

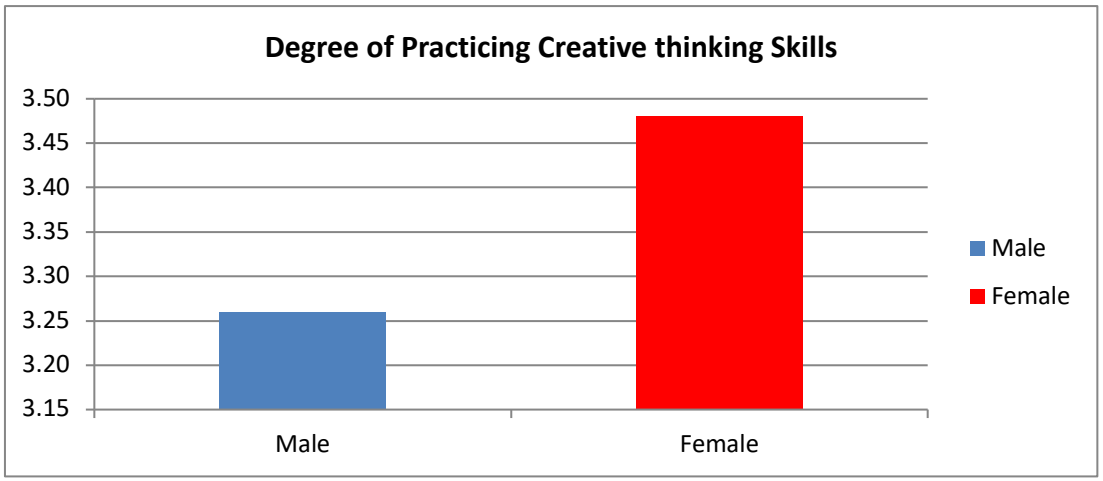

Figure 3: Differences between the average degree of creative thinking skills' practices by male and female physics teachers from the observer's point of view.

Speculated this was due to female teachers being more willing to apply new teaching methods, had greater flexibility to accept new ways of teaching, and were more inclined to have a climate of intellectual freedom in the classroom. This result is consistent with the study of Abu Raya (2004), Al-Azri (2007) and Al-Haddabi and others (2011), which showed differences in favor of female teachers. This study result did not agree with Al-Shehabi (2006) study, which revealed the low level of creative thinking skills practices for both teacher's gender. This disagreement can be attributed to the deterioration of educational conditions in Yemen and the lack of materials and equipment available to both male and female schools.

This result, perhaps, should not be all that surprising based on past results, but the reason for this difference still does not seem clear. Female students in Jordan scored higher than males on the TIMSS (2015) test. They also scored higher than males on every iteration of the test going back to 1999 as shown in Figure (4) below.

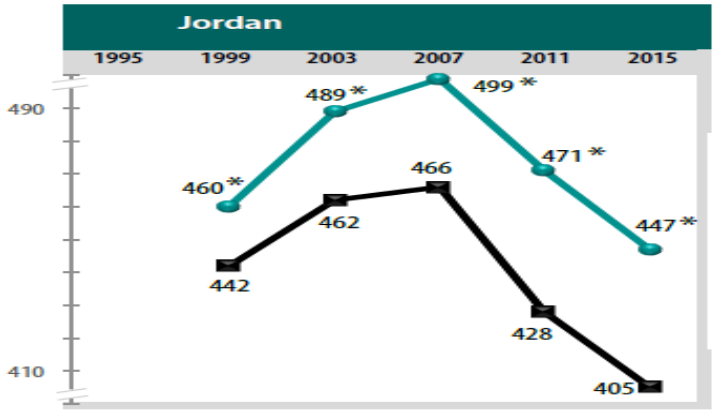

Figure 4: Trends in achievement by gender among eighth-grade students who were participated in the TIMSS. (Taken from the official website for: TIMSS, www.timss.org)

It is worth mentioning here that, female's students scoring higher than males is not only seen in Jordan, but throughout all Arab countries participating in this TIMSS test (NCESa).

UNICEF's report labelled with "Progress for Children" revealed very exciting facts. It discovered an exclusive information of the Arab world that females have exceeded males in the past decade in nearly all academic fields, and that primary school enrolment rates for boys and girls are nearly the same and the number of Arab girls in primary schools is equal to or surpassed the number of boys (UNICEF, 2012).

This gender result also agrees with several other studies that looked at gender differences in education in the Arab world. For example, Al-Otaibi (2015) also found female students performed better than males in a study conducted in Saudi Arabia. That researcher speculated that female schools were more serious and committed than male schools in Saudi Arabia. The researcher also felt that females paid more attention and were more committed to studying than male students who were preoccupied with many other things outside of the home. As well, the study of Abed Al-Hai (2012), which aims to measure the level of academic self-efficiency in Jordan's secondary level students. The results revealed that females surpass males. The researcher attributed this superiority to the fact that females are more committed than males to follow their education and more effective and motivated to learn. And more consistent in pursuing their studying and they are excellent when it comes to the attempt of them to prove them self and have an independent personality.

In Palestine, the researcher Abu-Ayesh (2003) analyzed the results of TIMSS 2003 study to explain the reason behind female superiority over males in achievement in science. She attributed this superiority to cultural and social factors belonging to the Arab community, such as the inconsequential role of women, especially in public life, and the socio-cultural restrictions on their freedom and discrimination against them from the moment of their birth. This creates a challenging environment for women, making education the easiest tool to prove their competence and conceal their marginalization in the society, and to improve their social and economic conditions and relative freedom. Education is the most legitimate and acceptable way for women to enter the public life. And by working on their education they will have significant chances of employment. According to the researcher, the culture and education of Arab society whose girls are expected to become mothers early in their lives begins to prepare them for adult life and taking responsibility very early which in turn, makes their childhood period shorter than that of males and deepens their sense of responsibility, independence and commitment earlier than males. All these responsibilities will positively impact the way women face the tasks they must perform. In addition, because of the social constraints that are imposed on female activity and the freedom given to the male actions, females spend most of their time at home while males spend their time more outside. Therefore, females are expected to devote more time than males to homework and study, which may reflect positively on their achievement and negatively on males. The Jordanian society is not so far from the Palestinian society, so we agree in our interpretation of the result of our study with all the factors mentioned by the researcher.

In Iraq also, Hussein (2014) attempted to explain the reason behind remarkable academic superiority that females showed over males in scientific subjects and in all subjects when the results of the secondary school in Iraq was announced. The remarkable distinction indicated by the views of specialists in the field of education in Baghdad. The researcher attributed the reasons for this to social, economic and psychological factors. The social factor represented by the social environment in which the female lives so that they spend most of their time in the home and thus can only study and perform their duties. The economic factor is that the male is responsible for providing money and food and all the fundamental needs for the family in addition to helping the parents economically, which leads to a decline in the level of males without females. Also, males are keen to neglecting their studies and spend a lot of time playing and entertaining.

This study is consistent with its interpretation of the superiority of female teachers over male teachers in their practice of creative thinking skills with the explanations provided by these studies for the superiority of females to males in scientific fields and all fields of study and their relation to the psychological, social, cultural and economic factors affected by the Arab environment and the Arab society.

The second null hypothesis: There are no statistically significant differences at (α=0.05) in the average degree of physics teachers' creative thinking skills practices due to the teacher's qualification's variable.

To validate this hypothesis, T-Test was used to reveal the significance of the statistical differences, due to the teacher's qualification variable and table 6 illustrates this.

Table 6

T-test results to detect the significance of the difference in the average degree of creative thinking skills practices due to the teacher's qualification variable

	Bachelor		**Graduate Studies**		T value	Statistical significance
	Mean	Standard deviation	Mean	Standard deviation		
Physics teachers' creative thinking skills practices from the observer's point of view	3.34	0.249	3.54	0.474	-1.311	0.201

Table (6) shows that there are no statistically significant differences at (α = 0.05) in the degree of practice due to the impact of the scientific qualification carried by the teacher. In other words, the degree of creative thinking skills practices by physics teachers is equal regardless of their academic qualifications, whether bachelor or other higher educational levels. This can be attributed to the fact that the programs applied in advanced post graduate education that these teachers have joined have not worked to improve their teaching practices associated with creative thinking.

The third null hypothesis: There are no statistically significant differences at (α = 0.05) in the average degree of physics teachers' creative thinking skills practices due to the **teacher's experience variable**.

To validate this hypothesis, T-Test was used to reveal the significance of the statistical differences, due to the teacher's experience variable and table 7 illustrates this.

Table 7

T-test results to detect the significance of the difference in the average degree of creative thinking skills practices due to the **teacher's experience variable.**

	6 - 10 years		**11 years or more**		T value	Statistical significance
	Mean	Standard deviation	Mean	Standard deviation		
Physics teachers' creative thinking skills practices from the observer's point of view	3.38	0.229	3.36	0.341	0.163	0.872

Table (7) shows that there are no statistically significant differences at (α = 0.05) in the degree of practice due to the number of years the teacher spent in teaching. That is, the degree to which physics teachers practice creative thinking skills, regardless of how many years of experience are the same for all. This finding can be explained by the fact that the nature of creative practices and creative ideas is not usually related to the how many years

spend in teaching, as much as it relates to a person's talent and desire for change and creativity. This finding is consistent with the study of Al-Azri (2007), which did not show differences in the experience years, whereas it differs with the study of Zidane and Al-Awouda (2008) which showed statistically significant differences due to teacher's experience.

Fourthly: To answer the forth question, it has been transformed into following hypothesis:

"There are no statistically significant differences at ($\alpha = 0.05$) in the average degree of physics teachers' creative thinking skills practices due to the student's grad variable (ninth, tenth). To validate this hypothesis, T-Test was used and Table 8 illustrates this:

Table 8

T-test results to detect the significance of the difference in the average degree of creative thinking skills practices due to the **student's grad variable.**

	Ninth grade		**Tenth grade**		T value	Statistical significance
	Mean	Standard deviation	Mean	Standard deviation		
Physics teachers' creative thinking skills practices from the observer's point of view	3.38	0.229	3.36	0.341	0.163	0.872

Fifthly: To answer the fifth question, it has been transformed into following hypothesis:

"There is a no significant relationship at (α=0.05) between the average degree of physics teachers' creative thinking skills practices from the point of view of both their student and the observers in classroom? To validate this hypothesis, T-Test was used and Table 9 illustrates this:

Table 9

Pearson correlation coefficient and its statistical significance between the average degree of physics teachers' creative thinking skills practices from the point of view of both students and the observer.

	Correlation coefficient	**Sig.**	**Decision**
Creative thinking skills (Questioner)	0.910	0.000**	Sig.
Creative thinking skills (Observation Card)			

As shown in Table 9 the correlation coefficient value reached (0.91), which is statistically significant at (α=0.05). This indicates a correlation between the degree of physics teachers' practices from the point of view of both their students' and the observers. The (0.91) correlation coefficient value indicates a high correlation relationship Gurtner (2008). This confirms and reinforces the sincerity of the outcome of the study.

The data were collected through two tools: first, the questionnaire that the students answer by observing their teachers' teaching practices in physics classes over the course of their extended period of study throughout the semester. The second is through an observation card by answering its paragraph that correspond with the questionnaire paragraphs that are originally from physics teachers with extensive experience in physics teaching. They have knowledge of the concept of creative thinking skills and its practices and they are more qualified than student to make decisions related to it.

However, there are some shortcomings. There are many practices related to creative thinking that are difficult to observe and reveal in one teaching position or by observing

teacher behavior in a classroom. Moreover, the observers might be affected by the behavior the one being observed, as some individuals, when they feel they are observers and try to change their behavior and fake something that may not be realistic or honest. So they add the assessment of students who have experienced their teacher's experience, because of their continuous presence for long periods of time in the classroom and their direct interaction with them, to the assessment of the expert observer who may be aware of things that the students may overlook. The very high correlation between their assessments together reinforces the validity of the study's findings.

Conclusion

The essence of this study is its focus on the importance of the subject of creative thinking skills, which is one of the most important skills in the 21st century and one of the most important elements of scientific and technological progress in this era. This study also focuses on physics teacher since physics is an appropriate environment for the development of creative thinking skills among learners. In order to achieve this, it needs a creative physics teacher capable of practicing creative thinking skills. This study sought to provide a realistic description of physics teachers' practicing of some creative thinking skills and the relationship between these practices and some demographic and functional variables. Data on teaching practices of teachers was collected through their students and their behavior was detected in the classroom by two experienced and specialized observers in the field of physics teaching. The results of the data analysis revealed a moderate degree of creative thinking skills practicing from the perspectives of both students and observers. The results also showed a strong correlation between the degree of physics teachers' practicing of creative thinking skills from the students' perspective and the observer's. It all confirms and reinforces the reliability of the study findings through what is known as intersectal truth across people. The study also revealed the superiority of the degree of female teachers' practicing of creative thinking skills over the male teachers'. This result was not odd but was expected as proved by previous studies in which it was noted that most studies conducted in the Arab world and dealt with gender as an experimental variable reached out to such a result. The superiority of females to males in scientific fields and even in most areas of study has become a remarkable phenomenon and many studies need to be conducted to find out the reason behind this superiority.

Another finding of the study is that the degree of physics teachers' practicing of creative thinking skills was not affected by the academic qualification of the teacher, the experience and the class grade taught by the teacher. Several conclusions can be obtained from this result. First, the curricula for the graduate programs that these teachers had need to be reconsidered because they add no further skills to the bachelor degree's. Second, creative practices and innovative ideas are not usually associated with a certain experience as much as they relate to the person's talent and passion for change and creativity. Thirdly, the teacher's practices do not differ according to the class he teaches. The creative teacher practices the same level of creativity and spares no effort on his students.

The results of this study may be beneficial for the teachers themselves in obtaining feedback from some of their teaching practices and identifying their strengths and weaknesses which will help them develop themselves to be in accordance with the standards of the 21st century's science teacher. The results of this study may also be used in the development of teachers' qualifying and training programs. It is hoped that the results and recommendations of this study would be helpful for the physics supervisors when evaluating the performance of the physics teachers and the decision makers in the educational process and that some of these results will be employed in order to adopt and install the strategies and skills of creative thinking in the educational process. In addition, this study provided a

tool to measure the degree of creative thinking skills' practicing of the science teacher during his teaching process.

Recommendations

According to the results from the current study, the researchers recommend the following:

- The development of physics books for ninth and tenth grades when it comes to creative thinking approach, they include problems and activities that will stimulate teachers and students to use creative thinking skills as part of the mandatory curriculum.
- Inclusion of practical lessons in the physics curriculum manuals that illustrate the steps and procedures of employing strategies to stimulate and develop creative thinking skills in physics lessons.
- Conduct training courses for physics teachers to develop them professionally and impart theoretical and practical knowledge of creative thinking skills and strategies of employing them in physics lessons, along with teaching practices that stimulate creative and critical thinking.
- Include the preparation of science teachers' programs at the university courses targeting teaching thinking, especially creative and critical thinking, and give them the competencies of applying and practicing these skills in the science class.
- Include teachers' assessment reports (whether by student, principal, or educational supervisor) a number of items that measure the teacher's practice of creative thinking skills. With the promotion and motivation of the teacher in accordance with the degree to which these skills are practiced, and that's by the competent authorities supervising these reports.
- Provision of equipment, Material resources and appropriate conditions for carrying out physical activities and experiments that stimulate creative thinking.

Suggestions

- Conducting similar studies for new samples in different geographical areas, and for the other stages of education such as the secondary stage, as well as different scientific subjects such as chemistry, biology, geology and environment.
- Conducting a study to discover the relationship between the degree to which science teachers possess creative thinking skills and their practice in the classroom.
- Conducting a content analysis study to determine the extent to which the objectives of teaching physics include the skills of creative thinking as one of the most important 21st century skills.
- Conducting Survey studies on large samples of students and science teachers from both universities and schools, to detect the level of creative thinking depending on the variable sex.
- Conducting studies to explain the reason for the superiority of females to males in the various scientific fields, which became a familiar phenomenon and reality for everyone, and confirmed by the results of most studies that dealt with this variable as one of the independent study variables.

References

Abed Al-Hai, Y. (2012). Academic self-efficacy among the intermediate and secondary levels students in the southern triangle area in the light of the sex and gender variables. Unpublished master's thesis, Yarmouk University, Jordan.

Abu- Jalalah, S. (2007). Science curricula and the development of creative thinking. Jordan, Amman: Dar Al Shorouk for Publishing.

Abu-ayesh, E. (2013). Analytical Study of the TIMSS 2003 Results: Gender Differences among Palestinian Students in Science. Retrieved 12/7/2015 from: http://www.rooad.net/print.php?id=722

Abu-Raya, S. (2004). The role of teachers in the development of creative thinking among primary school students in the Jalile region in Palestine. Unpublished MA, Yarmouk University, Irbid, Jordan.

Al-Aqeel, M. (2011). The impact of the use of proposed enrichment activities in the development of creative thinking among gifted students in the primary stage. Unpublished doctoral dissertation, King Saud University, Saudi Arabia.

Al-Azri, M. (2007). The extent to which science teachers practice the skills of developing creative thinking within the classroom and their reflection on student work files. Unpublished Master Thesis, Sultan Qaboos University, Sultanate of Oman.

Al-Haddabi, D. , Al-Fafali, H. and Al-Alayi, T. (2011). The level of creative thinking skills of students in the scientific departments of the Faculty of Education and Applied Sciences. The Arab Journal for the Development of Excellence, 2 (3), 34-57.

Al-Khalaf. T. (2010). Assessing Science Textbooks according to the Content Standards, Involvement and Type of their Questions. Unpublished MA, Yarmouk University, Irbid, Jordan.

Al-Nafi'i, N. (2009). The extent to which science teachers for some skills development for creative thinking among students in school in Riyadh. Master thesis, Imam Muhammad Bin Saud Islamic University, Saudi Arabia, Riyadh.

Al-Omari S. (2015). The extent to which science teachers practice the principles of effective teaching from the point of view of the teachers themselves and their relation to some variables. Journal of the Federation of Arab Universities for Education, 13 (4), 88-116.

Al-Otaibi, M. (2015). The effectiveness of learning cycle strategy (7E's) on acquiring and retention of the chemical concepts among the First-Secondary Grade students' in the Kingdom Saudi Arabia, Unpublished master's thesis. Yarmouk University, Jordan.

Al-Shehabi, M. (2006). The degree of the science teacher's practice of the skills that develop the creative thinking of secondary students from the students' point of view. Scientific Journal of the Faculty of Education, Thamaar University, 1 (1), 150-169.

Al-Zayedi, F. (2009). Effect of active learning in the development of innovative thinking and academic science achievement of third grade students in the government schools in Makkah city. Unpublished MA, Um Al-Qura University, Makkah.

Al-Zoubi, A. (2014). The impact of a problem - based teaching strategy on the development of Athletic Creative Thinking Skills among Pre-Service Teachers. Jordanian Journal of Educational Sciences, 10 (3), 305-320.

American Association for the Advancement of Science AAAS. (1989). Science for All Americans: Project 2061. New York: Oxford University Press.

Baker, S. & Öztekin, E. (2014). Creative Thinking Level of Preservice Science Teaching In Terms Of Different Variables, Science Education, 13(2), 231-242.

Daud, A., Omar, J., Turiman, P. & Osman, K. (2012). Creativity in Science Education. Procedia - Social and Behavioral Sciences 59, 467 – 474. Available online at www.sciencedirect.com

De Bono, E. (1989). Six Thinking Hats for school. Hawker Brownlow Education, Melbourne.

De Bono, E. (1992). Teach your children how to think. London: Penguin Books.

De Bono, E. (1995). Serious Creativity. The Journal for Quality and Participation, 18, 12-18.

Diane, E., Dana, G. & Ruth, D. (2003). Creativity, Child Development Atypical Approach. New York: The Mc Graw, Hill Companies, 233-237.

Dnaoui, S. (2008). Developing creative thinking skills. Jordan, Irbid: The World of Modern Books.

Gashua, F. (2001). The role of the science teacher in the development of creative thinking from the point of view of the eighth grade students. Unpublished MA, Birzeit University, Palestine.

Glenn, R. (1997). SCAMPER for student creativity. Education Diges., 62) 6(, 23-67.

Gurtner, G. (2008). Learning How to Think. One-Person Library, 24 (10), 10-11.

Haddad, N. (2004). The extent to which science books for the fifth, sixth, seventh and eighth grades in Jordan include the Global standards for the science books' content. Unpublished MA, Yarmouk University, Irbid, Jordan.

Hazkvitz, A. (2007). Top 11 traits of a good teacher. Retrieved from: http://www.reacheverychild.com/feature/traits.html.

Hossnia, Gh. (2013). Evaluation of the ninth grade physics book in Jordan according to the global content standards of scientific education. Jordan, Al-Albeit university, Al-Manara Magazine, 19 (3), 173-201.

Hussein, F. (2014). Female superiority over males is a global phenomenon. Retrieve from Source: http://www.sutuur.com/Inverstigations-ports/5432-fatn.html

Jordanian Ministry of Education JME. (2014). Development projects. Publications of the Ministry of Education

Jordanian Ministry of Education JME. (2015). Irbid first directorate of education, retrieved from: http://www.moe.gov.jo/Directorates/DirectoratesPage.aspx?DirectoratesID=15

Kendy, M. (2006). From teacher quality to quality teaching. Journal of Educational leader ship, 63(3), 14-19.

Larry. R. (2003). Creativity. Journal of Teach directions, 63 (3), 70-79.

Levine, J. (1997). Personal creativity and classroom teaching style of second-year, inner city teachers. Digital research and Fordham DAI, 57 (10), 4260.

Lindqvist, G. (2003). Vygotsky's Theory of Creativity. Creativity Research Journal, 15 (2 & 3), 245–251.

Malkawi, A. & Malass, S. (Accepted for publication). The Effect of Teaching Science Using Six Thinking Hats Strategy on Developing the Creative Thinking Among Fifth Grade Female Students at Alramtha Public Schools in Jordan. Jordanian University, Dirasat: educational sciences, 2016.

Moma, L., Kusumah, Y., Sabandar, J. & Afgani, J. (2013). The enhancement of junior high school students mathematical creative thinking abilities through generative learning. Mathematical Theory and Modeling, 3(8), 146-156.

National Center for Education Statistics (NCESa). (2015). TIMSS, the Trends in International Mathematics and Science Study. Retrieved at 5 March 2015, from the source: http://nces.ed.gov/timss/

National Center for Education Statistics (NCESb). (2015). Program for International Student Assessment "PISA". (2015). Retrieved at 10 December 2015, from the source: https://nces.ed.gov/surveys/pisa/

National Research Council NRC (2012). A Framework for K-12 Science Education: Practices, Core Ideas, and Crosscutting Concepts. Washington, DC: National Academy Press.

Nawasrah, M. (2006). The inclusion of universal standards for the content in science books of first and forth basic grades in Jordan. Unpublished MA, Yarmouk University, Irbid, Jordan.

NGSS Lead States. (2013). Next Generation Science Standards. Washington, D.C.: National Academy Press.

Odeh, A. (2010), Measurement and evaluation in the teaching process (5th ed. (Amman: Dar Alamel.

Onosko, J. (1990). Comparing teachers' instruction to promote students' thinking. Journal of Curriculum Studies, 22 (5), 443-461.

Renzulli, J., Reis, S. & Smith, L. (1981). The revolving door identification model. Mansfield Center, CT: Creative Learning Press. Saeki, N.

Saadi, L. (2007). Excellence, talent, creativity and decision-making vision from the reality of curricula. Jordan, Amman: Dar Al-Hamed for Publishing and Distribution.

UNICEF. (2015). Progress for Children: A report card on adolescents. Retrieved from the source: https://www.unicef.org/search/search.php?q=Progress%20for%20children

Talens, j. (2016). Influence of problem–based learning on the creative thinking skills of physical science students of de la salle lipa. Journal of Education, Arts and Sciences, 02 (1). 15-40.

Zaitoun, A. (1987). Developing creativity and creative thinking in science teaching. Jordan, Amman: Directorate of National Libraries and Documents.

Zernouki, N. (2007). The Effect of Using Computer in the Development of Creative Thinking and Academic Achievement in the Physics Course among Second Grade Secondary Girls in Jeddah. Unpublished MA, Umm Al-Qura University, Makkah, Saudi Arabia.

Zidane, A. and Al-Awouda, F. (2008). The Degree of Use of creative thinking Patterns in science teaching by teachers of lower basic grade in Hebron Governorate. Journal of the Islamic University (series of humanitarian studies), 16 (2), 667-691.