

The teachers' perception of the factors that promote the cultivation of creative thinking

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Abstract: In recent years, the subject of creative thinking has taken a central place in the various areas of life promoting these important areas by proposing innovative ideas and solutions. In a special way, the issue of creative thinking in the field of education has recently been found as a central issue, putting it in the central of many curriculums and calling for its cultivation among students. A major reason for that is that the world that has become dynamic and is changing rapidly in recent years, especially thanks to the rapidly advancing technology that affects all areas of our lives, educational, economic, social, political and others. So much so, in many educational systems, they started talking about preparing the learner for the unknown future. Since creative thinking is thinking that breaks rules and norms, it allows seeing or creating unknown connections between different components, thus enabling the creation of new and unknown ideas and solutions that will help the learner to successfully deal with everyday problems and promote himself successfully in all areas of life. As a result of what was said about the importance of creative thinking and the importance of cultivating it, a comprehensive study was carried out that examined the perception of science and technology teachers in Arab elementary schools in Israel on seven key dimensions in the context of creative thinking. The number of teachers who participated is 313 which cover the variables: age, seniority in teaching, academic degree, and geographical distribution of residences. A central dimension was the teachers' perception of the factors that foster creative thinking. A central

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reason for examining the teachers' perception is that the teachers and not others are the ones who carry out the teaching, learning and assessment processes in the school, they are the actual mediators between theory and application, so that the cultivation of creative thinking depends to a large extent on their way of activity. In addition, the teachers' perception was examined among science and technology teachers since the field of science and technology is found according to much research literature as a field with a high capacity for cultivating creative thinking. This article presents findings, conclusions and recommendations that arise in terms of the dimension of the teachers' perception of the factors that foster creative thinking. The article presents a picture in which the teachers' perception of the factors that foster creative thinking is in high agreement with what is said about these factors in the research literature, even if there is no research based on the teachers' perception, this is when the summary of this perception is that significant changes are required in most factors of school activity in order to cultivate creative thinking of the students, in methods, tools and environments of teaching, learning and assessment, the willingness of teachers to teach creative thinking and readiness for taking risks on the part of the teachers and students.

Key-words: Creative thinking, factors, fostering, teachers' perception, significant changes, Education systems, educational policies, school activities, students, methods, programs, environmental tools, teaching, learning and assessment

Introduction. What is creative thinking - its essence, meaning and definitions

In different dictionaries, different concepts were found to define creativity such as: imagination, vision, inventiveness, ingenuity, originality, and others. Many definitions for the term 'creative thinking' were found in the research literature (Al-Nouh, Abdul-Kareem, & Taqi, 2014: p. 74; Bronson & Merryman, 2010: p. 1; de Souza Fleith, 2000: p. 148; Turner, 2013: p. 24). In order to express the multiplicity of definitions and meanings that the concept of creativity has, Parkhurst (1999) in his paper "Confusion, lack of consensus, and the definition of creativity as a construct", notes that Repucci, in search of an answer to "What is creativity?", found about 50-60 definitions in the literature in the early 1960's. In order to move the concept of 'creativity' from concept level to performance level, Selker (2005) notes that the practical and applied translation of the concept 'creativity' is in the word 'create', which means to bring into the world products of creativity, in other words to bring creativity into practical reality (Selker, 2005).

One of the most comprehensive definitions and descriptions of creativity is that of Torrance (1969) who sees creativity as, a broad process in which one deeply feels the problem, seeks solutions to it, offers options for solution, when this process is based on original ideas, looking at the problem from different perspectives, reintegration of ideas or seeing new relationships between ideas (Torrance, 1969).

Creativity is expressed in the development of new, original, and unique ideas or products (Gallagher and Gallagher, 1994). It is a process that takes place in our imagination that aims to produce outcomes, that are both original and valuable (Feasey, 2005: 2).

Creative thinking can be defined as the ability to produce original ideas or solutions or answers (Duff, Kurczek, Rubin, Cohen and Tranel, 2013). Creative thinking is considered as the ability to perceive new connections between unrelated factors (Piawa, 2010). And creative thinking is one of the central cognitive processes (Chaffee, 2000; Sternberg, 2003; Rawlinson, 2017). Sternberg and Lubart (1996), state that creativity refers to the ability to deal with a given problem in authentic ways. This means the ability to look at a specific situation or problem from different perspectives allowing one to come up with creative solutions and

ideas. They define the concept 'creativity' as the ability to produce ideas or products that are also new, original, unknown, and usable.

Creativity can be defined as the synthesis and reconstruction of existing previous thoughts, i.e., as a redefinition of previous thoughts (Besis, 1973). Creativity is a basic skill that is included in all areas and aspects of human life and of human evolution (Sun, 1985).

Most thinkers and researchers in the field of creative thinking agree that creativity is a process of imagination and thinking that the person exerts on his feelings, experiences, knowledge and motives, a process that leads to the creation of products like objects, ideas and solutions that are original, effective, and useful (Runco et al., 2012; Sternberg, 1999; Vygotsky, 2004). Learning the different definitions of creative thinking suggests that what all the definitions have in common is that they all include the idea of creating something new or original that has a specific purpose (Al-Nouh et al., 2014: p. 74; Bronson & Merryman, 2010: p. 1; de Souza Fleith, 2000: p. 148; Turner, 2013: p. 24).

Yet, the elements of complexity, diversity, branching, innovation, lack of routine, breaking of norms and patterns, release from norms and patterns, activity in many different directions, solving problems in different ways, were found to be common to many definitions of creative thinking (Gruber, 1981; Standler, 1998; Gardner, 2006; Nakaimura & Czekozenbmchalji, 2001; Barrow, 2010; Escultura, 2012 ; Sternberg, Kaufman, & Pretz, 2002; Lubart & Guignard, 2004).

The importance of creative thinking and why it should be developed

Education systems in today's modern world are required to raise students with the ability to successfully cope with the many and varied everyday challenges, by developing their creative thinking ability, which will enable them to generate creative ideas and implement them to address these challenges and problems (Isaksen, Dorval, & Treffinger, 2010).

The development of creative thinking is one of the main goals of education systems in the world and in the discourse on 21st century skills it is customary to attach great importance to creativity, as an essential ability to integrate into the modern world of work (Barbot, Besançon, & Lubart, 2015). Creativity is a comprehensive and very important field in

which the quality of people's lives can be raised by proposing new ideas that significantly improve people's lives (Heleven, 2003). Bulut (2019) Notes that the most significant goal of education today is to train people to be creative and efficient, who can think flexibly, openly, and freely allowing them to successfully adapt to different conditions in today's world of rapid change. A central and clear expression of the place and great importance of creative thinking in human life, we found in San's definition when he states that creativity occupies a central place in human life by saying that creativity is a basic skill included in all areas and aspects of human life and all aspects of human evolution (San, 1985). Regarding the place and importance of creative thinking in educational systems, Turkmen and Sertkahya (2015) state that in educational systems, one of the most important skills which students should gain is creative thinking.

Creative thinking has become the new educational buzzword and the catchphrase of the 21st century due to its inclusion in many revised curricula around the world (Tapinos, 2016). An Australian study found that three-quarters of new graduates were considered unemployed and considered unsuitable by employers because their creative thinking skills were insufficient (Cropley, 2001). In this situation of many unemployed university graduates growing year by year, many countries around the world consider it very important to include creative thinking skills within their curricula (Tapinos, 2016). People characterized by creativity skills are considered key to developing the economy wherever they are and the well-being of their peoples (Brady & Edelman, 2012; Li, 2011).

Alismail and McGuire (2015) note that creative thinking found in new curricula, within 21st century skills, when these skills are integrated with common state standards in curricula, is beneficial not only to students and teachers, but also necessary to prepare youth for college and for their successful future life careers. Also, they state that, it is very important to allow students to be creative and develop their creativity, because education is based on standardized tests and that these standardized tests determine school success.

The importance of creative thinking can be described as becoming one of the central goals of many curricula in the world, which is to raise a generation of productive-creative people, to successfully cope with the rapidly changing world and to meet the ever-changing needs (Ceylan Dadakoğlu & Ozsoy, 2020).

In the evolving world, it is very important that people be thinking and aware of what is happening around them. This is because the world is rich in rapid and numerous scientific and technological developments that require people to be more open to innovation, creativity, constructiveness, and productivity (Aydeniz, 2017; OECD, 2016). Because of this, education systems need to place great emphasis on creativity and creative thinking. Therefore, creative thinking is emphasized in education in general and in science education, so science and technology teachers are expected to equip their students with this quality. In this concept, the development of creative thinking skills is directed in the elementary education curriculum prepared by the Board of Education and Discipline (MNE, 2017, as cited in, Ayşe & BÜYÜK, 2021). Due to the great importance of creative thinking, many education researchers have called for teaching creativity at all levels of education and training (Werry, 1949; Griffiths, 2014; Shaheen, 2010; Brundrett, 2007).

The global dynamics that lead to many changes have led to changes and developments in the education systems as well, including the implementation of innovative models in these education systems and a great investment in creative thinking as a way for greater development of humanity (Alencar & Fleith, 2003). So that, one can understand how important the application of creative thinking in education systems is, in that it addresses the global dynamics and the many and rapid changes taking place in our world, by preparing the future generation of student citizens with creative thinking abilities that enable them to cope successfully with this changing world.

When new challenges arise that we have not experienced before, the importance of creative thinking increases greatly in that it enables critical thinking, independent thinking, and creating new practices, encouraging inquiry, and thinking for improvement (Costa-Lobo et al., 2016; Costa-Lobo & Cabrera, 2017c). Countries that have invested in changes in their education systems, that believe in the importance and place of creative thinking in changing students' ways of thinking and have given creative thinking an important and central place within these changes, are at the forefront of education (UNESCO, 2017). Lin (2011) notes that in order to maintain successful general educational frameworks, it is necessary to emphasize the importance of the existence and integration of creative teaching, teaching for creativity and creative

learning. It is very important to create educational contexts in which creative thinking is at the heart and center of students' teaching, learning and assessment processes (Elisondo et al., 2013).

Science and technology for creativity

Literacy and knowledge in the fields of science and technology are very important for every student and every citizen to be active citizens in contemporary society, either not present or continuing a career in the various fields of science and technology (Craft, Chappell, & Twining, 2008; Jackson, 2004). There is great importance to innovations and inventions in applied sciences that can be reflected in the significant contribution of these innovations and inventions to the development of countries and to scientific-technological progress (Harmander & Çil, 2008). For this reason, many countries are making improvements to science teaching programs, better training teachers by equipping teachers with skills and equipping classrooms with the necessary tools, instruments, and resources (Ozmen, 2004). When there is a good science education program with clear learning goals, textbooks and tests that are carefully tailored to those goals, teachers who have the resources and skills to teach effectively and families committed to excellence, with these conditions in place schools and teachers and students will all succeed (Mirzaie, Hamidi & Anaraki, 2009).

Scientific creativity is defined as the creativity that creates original and useful ideas or products in the field of science (Sak, Ayas, 2013). Stencel (1995) describes scientific creativity in science, as the ability to make connections between events that other people do not know, analysing ideas and evaluating them by comparing them with other ideas, making abstract ideas practical and successful.

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The connection between scientific education and creative thinking or in other words the important place that creative thinking has in scientific education can be explained, as stated by the researchers Çepni (2019) and Loxley et al. (2016). They note that the purpose of science education is not to memorize the scientific knowledge by the students, but to equip the students with problem-solving ability that they can encounter in their daily lives in the future and in addition to equip the students with the required scientific skills that will enable them to acquire knowledge (Çepni, 2019; Loxley et al., 2016). Based on that, it can be concluded that the main goal of science is to cultivate among students the problem-solving ability and within it also the creative thinking in problem-solving.

How creative thinking can be cultivated:

Factors, tools, and ways to cultivate creative thinking

Since the end of the nineteenth century, people began to explore the question of what fostered creativity (Mirzaie, Hamidi & Anaraki, 2009). To foster creative thinking, education systems and schools need to be oriented towards this. Promoting the application of creative thinking in schools will be possible when the education systems change themselves, stop maintaining a structure and fixed patterns of action, which prepare the student according to the requirements of the next stage of education to higher education that if students do not meet these requirements will be found unsuitable. That is, they will stop complying with the set requirements so no doubt this will have a positive effect on the type of questions students ask and the way they exercise their creativity (Robinson & Aronica, 2015: pp. 31-36).

In addition, the perception of education systems in the world must be changed from the perception of education as a linear thing to the perception of education as a systemic thing, this will enable the existence of innovative pedagogy that will enable the application of creative thinking by teachers (Robinson & Aronica, 2015: p. 41). They state that in order to promote the application of creative thinking in schools, governments must allow teachers quality development and time to improve their

performance while quality pedagogy is considered the most important factor in improving educational outcomes (Robinson & Aronica, 2015: p. 100). And there is no doubt that at the center of these educational results is the promotion of creative thinking. In addition, new, high-quality pedagogy will enable the implementation of new curricula that include the new thinking styles and require teachers to implement them in all areas of study (McIlvenny, 2013: p. 18). Moreover, schools are required to design creative and unconventional environments for teachers and students that will push them to be creative (Moran, 2010; Starko, 2013).

Tran, Ho, and Hurle (2016) found in their comprehensive study that teachers focused more on creativity and used creative tools, only when it was required of policies and curricula. Means that, to develop creativity in schools, it is necessary to implement the authorities' policy that calls for the development of creative thinking alongside curricula that call for creative thinking and, moreover, to evaluate students' creativity (Tran, Ho & Hurle, 2016). Barbot and colleagues (2015) determine and emphasize the importance of the school environment for cultivating the creative potential. According to their approach, the learning environment in the school influences the cognitive traits associated with the creative process and activates the creative potential inherent in the personal traits. At the same time, they state that learning also provides opportunities for creativity in different contexts and in different fields of knowledge. They conclude by saying that as education systems set themselves the goal of cultivating creativity, they must broadly define it, and locate the diverse conditions required for its cultivation (Barbot, Besançon & Lubart, 2015).

Education systems, office policies, curricula and school environments that promote creativity found to be key conditions for the development of creativity (Banaji et al., 2010; Ferrari et al., 2009; Moran, 2010). Studying science and technology at school can promote creative thinking. Much has been written about this in the research literature. For example, it was found that the subject of science and technology in the school has great importance for innovations and inventions in applied sciences that can be reflected in the significant contribution of these innovations and inventions to the development of countries and scientific-technological progress (Harmander & Cil, 2008). It can be concluded that the main goal of science is to cultivate among students the problem-solving

ability and within it also the creative thinking in problem-solving (Cepni, 2019; Loxley et al., 2016).

The special connection between creative thinking and technology, and of course the science underlying this technology, can be described, in that technology and creativity work together to successfully meet the needs and solve problems arising from the many and rapid changes taking place in the world at any moment and without interruption (Ceylan Dadakoglu & Ozsoy, 2020).

Pedagogy plays a key role in promoting students' creative thinking. planning and implementing curricula that connect students with their real daily lives, is the way to active learning in which the learner is at the center, that allows him to better understand what is learned, to increasing his motivation for learning and to prepare him better for the future, in terms of thinking skills, including innovation and creative thinking skills (Lombardi, 2007). Bulut (2019) states that attractive, interesting, and student-centered teaching methods instead of teacher- centered ones, are leading to active students and he mentions the peer teaching method as a leading method for active learning, and states that the peer teaching method influences the academic achievement and creative thinking skills of the individual positively. Students' creative thinking can be developed by having an appropriate pedagogy, in which the world's education systems will be based on the perception of education as a systemic thing instead of the perception of education as a linear thing (Robinson & Aronica, 2015: p. 41). In addition, new, high-quality pedagogy will enable the implementation of new curricula that include the new thinking styles and require teachers to implement them in all areas of learning (McIlvenny, 2013: p. 18). Another factor to promote the creative thinking is the teacher training and willingness to teach creative thinking. Developing creative thinking requires teacher readiness to teach creativity, teacher training in colleges and professional development in schools to teach creativity, office policies that encourage creativity, emphasizing creativity in curricula and school environments (Banaji et al., 2010; Ferrari et al., 2009; Moran, 2010).

Using tools for developing creativity can be a good way to cultivate it. The term 'creative tools' refer to means for developing creativity, i.e., the means used in creative processes in which creative tasks are performed to reach creative products (Brady & Edelman, 2012; De Bono, 1970;

Vygotsky, 2004). Brady and Edelman (2012) found in their research that tools and techniques for creativity are perceived as a major challenge for raising creativity. Over the years many creative tools have been developed, some more familiar and some less familiar.

Methodology:

Population and the study sample

The research population is science and technology teachers in Arab elementary schools in the State of Israel. It is important to note that the teachers (N=313) who participated in the study and answered the questionnaire reflect the main professional variables of the entire population of science and technology teachers in the Arab elementary schools in Israel: gender (male and female), age (21-30, 31-40, 41-50, over 50), years of teaching experience (1-10, 11-20, 21-30, over 30), academic degree (BA, MA, PHD). In addition, the teachers who answered the questionnaire cover and reflect the geographical distribution and residential areas of the Arab population in Israel (the various regions: north, center and south of the country).

Research tools

The study examined the perception of the Arab science and technology teachers in Israel of the following important dimensions of creative thinking: the teachers' perception of the essence and meaning of creative thinking, the teachers' perception of their ability to cultivate creative thinking among students, the teachers' perception of the factors that hinder teachers in general from cultivating creative thinking among the students, the teachers' perception of the factors that hinder the teacher personally from cultivating creative thinking among the students, the teachers' perception of the factors that promote the cultivation of creative thinking among the students, the teachers' perception of the importance of creative thinking, and the teacher's perception of the personal application of creative thinking for the promotion of creative thinking of the students.

As mentioned earlier, this article only deals with one dimension out of seven creative thinking dimensions in this study whose perception by the teachers was examined in this large study.

This dimension is the teachers' perception of the factors promote the cultivation of creative thinking among the students.

To examine the teachers' perception of these seven dimensions of creative thinking, a questionnaire which is the main research tool in this study was designed and built. The questionnaire prepared to examine the teachers' perception of seven important dimensions of creative thinking was prepared based on what is found in the research literature. Thus, the contents of statements are based on the findings of the research literature in the field of creative thinking in general and not on the teachers' perception of creative thinking. This is because no studies were found that examined the seven dimensions of teachers' perception of creative thinking that are examined in this study. The questionnaire was built, updated, and improved many times before being filled out by the teachers participating in this study.

Many stages in the construction of the questionnaire: determining the dimensions examined in the study, searching for research literature regarding each dimension, formulating the statements accordingly, examining the questionnaire by seven content experts in the field of thinking and pedagogy and improving it accordingly, personal zoom meetings with seven teachers in which each teacher is required to read each statement and describe how he understands it and improvement accordingly, a personal phone conversation with each of the forty teachers who participated in the pilot questionnaire about the goals of the study and its importance in which they were asked to answer the questionnaire after thinking deeply about each statement, sending a link of the pilot questionnaire to the teachers in the form of Google Forms via personal WhatsApp, collecting the findings of the teachers' responses and implementing Reliability test of the pilot questionnaire by a statistician which was extremely high 0.94, making further improvements of the questionnaire until determining its final structure and form. Thus, the process of preparing the questionnaire took many months.

The part of the questionnaire that examines the teacher's perception of the factors that foster students' creative thinking, consists of 12 statements, which describe and measure the teacher's perception of factors that foster students' creative thinking. Statements such as: the use of unconventional teaching and assessment methods will lead to the cultivation of creative thinking; the use of teaching, learning and

assessment methods in which the student is active will lead to the development of creative thinking; students' creative thinking can be fostered in learning through problems that allow multiple answers instead of exercises that have one correct answer; encouraging diverse and unconventional answers will develop creative thinking; lack of judgment on the part of the teacher to the students' answers will promote creative thinking and the additional statements (See all these statements in the table 1 later). The scale of answers to the statements is of the 5-degree Likert type, grade 1 expresses full opposition to the statement and grade 5 expresses full agreement, grades 2, 3, 4 express intermediate grades. This is according to the following breakdown: 1 disagreeing at all, 2 disagreeing, 3 not sure, 4 agree and 5 strongly agree. Each participant was asked to express their degree of agreement on each statement by choosing a rank that expresses and reflects the degree of his / her agreement / opposition to the statement.

Finding discussion

The teachers' responses regarding all the statements in the questionnaire were categorized into three categories as seen in table 1 below. So, the teachers' answers to the statements that make up this part of the questionnaire, which relate to factors that foster students' creative thinking, were grouped into 3 grades instead of 5 to present a clear and exhaustive picture – as seen in table 1, with grades 1 (disagreeing at all) and 2 (disagreeing) grouped into one grade 1 expressing opposition to the statement, grade 3 (not sure) was converted to 2 with the same meaning, grades 4 (agree) and 5 (strongly agree) were grouped into one grade 3 expressing consent to the statement.

Table no. 1: Distribution of participants' answers to the statements that relate to factors that foster students' creative thinking.

Statement No.	The Statement	Disagree	Not sure	Agree
52	Using unconventional teaching and assessment methods will foster creative thinking	16 (5.1%)	41 (13.1%)	256 (81.8%)

53	Using digital technologies in teaching will foster creative thinking	19 (6.1%)	45 (14.4%)	249 (79.6%)
54	Using teaching, learning and assessment methods in which the student is active will result in the development of creative thinking	10 (3.2%)	32 (10.2%)	271 (86.6%)
55	Creative thinking can be nurtured using existing learning materials and textbooks only if the teacher uses methods and tools that enable the cultivation of creative thinking	34 (10.9%)	64 (20.4%)	215 (68.7%)
56	Only the use of learning materials and textbooks specifically designed to cultivate creative thinking will result in the cultivation of creative thinking	161 (53.1%)	81 (26.7%)	61 (20.1%)
57	The teacher's use of methods and tasks that enable multi-directional thinking (divergent thinking) will foster creative thinking	8 (2.6%)	34 (10.9%)	271 (86.6%)
58	Students' creative thinking can be fostered in the application of learning, through problems that allow for multiple answers instead of exercises that have one correct answer.	13 (4.2%)	52 (16.6%)	248 (79.2%)

59	Encouraging diverse and unconventional answers will foster creative thinking	12 (3.8%)	45 (14.4%)	254 (81.2%)
60	Lack of judgment on the part of the teacher to the students' answers will promote creative thinking	34 (10.9%)	91 (29.1%)	188 (60.1%)
61	Diversification in the learning environments used by the teacher will encourage the cultivation of creative thinking	3 (1%)	48 (15.3%)	262 (83.7%)
62	Taking risk on the part of the teacher and students will result in the development of creative thinking	25 (8%)	80 (25.6%)	208 (66.5%)
63	Entrepreneurship and innovation will develop creative thinking	3 (1%)	26 (8.3%)	284 (90.7%)

The variable “Teacher's perception of factors that foster students' creative thinking” was constructed by calculating the average of participants' responses to all statements in this part. Each participant received a value between 1 and 5 describes his perception of the factors that foster students' creative thinking. High value indicates that the teacher believes more in these factors as promoting the students' creative thinking.

The reliability of this part was tested using an internal consistency test by Cronbach's alpha coefficient, and it was found that the alpha value is equal to 0.812 which is considered to indicate high reliability. This high reliability means that this part of the questionnaire can be seen as a very solid part in a research aspect, so that findings, conclusions, and recommendations can be based on it based on the teachers' answers to the statements included in it. The hypothesis that was formulated for this part of the questionnaire to examine the teachers' perception of the factors that foster creative thinking is “It will be found that most teachers believe that in order to foster creative thinking of students, many significant changes

are required in, methods, tools and environments of teaching, learning and assessment, learning materials and in the willingness of teachers to teach creative thinking". Distribution of participants' answers to the statements that relate to the teacher's perception regarding factors that foster students' creative thinking, shows an overall and clear picture, in which most teachers believe in each of the factors mentioned in the statements in this part of the questionnaire, as a factor that fosters the students' creative thinking. All the factors that foster students' creative thinking that appeared in this part of the research questionnaire, are based on significant changes in the following school categories: methods, tools, and environments of teaching, learning and assessment, learning materials and the willingness of teachers to teach creative thinking.

In order to give a clearer picture of the teachers' agreement with the factors, included in this part of the research questionnaire, as factors that foster students' creative thinking, according to the teachers' answers to the statements in this part (part E) of the questionnaire that examine these factors, the statements with the percentages of agreement were arranged, from the statement that received the highest percentage of agreement of the teachers as factors that foster students' creative thinking, to the statement that received the lowest percentage of agreement of the teachers as factors that foster students' creative thinking (See below table no. 2). In other words, the factors in part E of the questionnaire that foster students' creative thinking, were arranged, from the factor that the teachers believe is the most fostering students' creative thinking to the factor that the teachers believe is the least fostering students' creative thinking. This is how it looks:

Table no. 2: The percentage of teachers who agree with this factor as a factor that fosters students' creative thinking in descending order

Statement/ factor that fosters students' creative thinking	The percentage of teachers who agree with this factor as a factor that fosters students' creative thinking
Entrepreneurship and innovation will develop creative thinking	90.7%

Using teaching, learning and assessment methods in which the student is active will result in the development of creative thinking	86.6%
The teacher's use of methods and tasks that enable multi-directional thinking (divergent thinking) will foster creative thinking	86.6%
Diversification in the learning environments used by the teacher will encourage the cultivation of creative thinking	83.7%
Using unconventional teaching and assessment methods will foster creative thinking	81.8%
Encouraging diverse and unconventional answers will foster creative thinking	81.2%
Using digital technologies in teaching will foster creative thinking	79.6%
Students' creative thinking can be fostered in the application of learning, through problems that allow for multiple answers instead of exercises that have one correct answer.	79.2%
Creative thinking can be nurtured using existing learning materials and textbooks only if the teacher uses methods and tools that enable the cultivation of creative thinking	68.7%
Taking risk on the part of the teacher and students will result in the development of creative thinking	66.5%
Lack of judgment on the part of the teacher to the students' answers will promote creative thinking	60.1%
Only the use of learning materials and textbooks specifically designed to cultivate creative thinking will result in the cultivation of creative thinking	20.1%

Examining the table, clearly and unequivocally shows that the levels of agreement of the teachers with all the factors included in this part of the questionnaire as factors that foster the students' creative thinking are found to be very high levels of agreement. And to clarify this, we note that in each of the 8 of the 12 factors that are 75% of the factors examined in this part of the questionnaire as factors that foster the students' creative thinking, get a percentage of agreement between 80% and 91%, this means that in each of these 8 factors found that 80% to 91% of teachers agree that this is a factor that fosters students' creative thinking. In three additional factors, agreement was found between the teachers ranging from 60% to 70%, which is also high. In only one factor, found a low percentage of agreement, with 20% of teachers agreeing that it is a factor that fosters creative thinking. This picture clearly shows a very high agreement with all the factors in this part of the questionnaire as factors that foster creative thinking among students.

Detailing this picture, start with the 8 factors each of which received a percentage of agreement between 80% and 91%, so that in each of them it was found that 80% to 91% of the teachers agree that this is a factor that fosters the students' creative thinking. These are 8 factors, in descending order, in the percentage of teachers who agree with each factor as fostering students' creative thinking: entrepreneurship and innovation will develop creative thinking with a percentage of 90.7% teachers agree, using teaching, learning and assessment methods in which the student is active will result in the development of creative thinking with a percentage of 86.6% teachers agree, the teacher's use of methods and tasks that enable multi-directional thinking (divergent thinking) will foster creative thinking with a percentage of 86.6% teachers agree, diversification in the learning environments used by the teacher will encourage the cultivation of creative thinking with a percentage of 83.7% teachers agree, using unconventional teaching and assessment methods will foster creative thinking with a percentage of 81.8% teachers agree, encouraging diverse and unconventional answers will foster creative thinking with a percentage of 81.2%, using digital technologies in teaching will foster creative thinking with a percentage of 79.6% agree, students' creative thinking can be fostered in the application of learning, through problems

that allow for multiple answers instead of exercises that have one correct answer with a percentage of 79.2% teachers agree.

This very high percentage of teachers agreeing with each of these eight factors, as a factor that fosters the students' creative thinking, finds a very high level of support in the research literature, which means that this state of agreement is found both in the teachers' perception and in the research literature. Thus, the research literature agrees as well as the teachers and points to these factors as significant factors for the cultivation of creative thinking. To clarify this picture of support, we will mention examples from the research literature that can explain and support the high level of agreement on the part of the teachers with these factors as fostering students' creative thinking.

The first factor among the eight factors that received the highest percentage of agreement from the teachers, as a factor that fosters the students' creative thinking, is "entrepreneurship and innovation will develop creative thinking" with a percentage of 90.7% teachers agree. This factor has a lot of support in the research literature, that can explain the highest percentage received, such as for example, entrepreneurship is the process that leads to the creation of an enterprise, or a business or a new value (Watts & Wray, 2012). Entrepreneurship also includes exploring and discovering opportunities, exploiting these opportunities, and using them (Shane & Venkataraman, 2000). The findings from the analyses in the study conducted by Tican (2019) showed that a very positive and significant correlation was found between the perception of personal entrepreneurship, of early teachers and the overall propensity scores of creative thinking. To this end, the researcher recommends encouraging early teachers to take the "Economics and Entrepreneurship" course and participate in certificate programs on entrepreneurship (Tican, 2019). The conclusion from all that has been said is that entrepreneurship is a cornerstone for the cultivation of creative thinking and creativity which is found in high agreement as a factor that cultivates creative thinking in the perception of the teachers in this study. In addition, creativity occupies an important, central, and special place in the fields of science as an important condition for innovation and future progress (Barak and Shachar, 2008; Braben, 2004).

The second factor among the eight factors that received the highest percentage of approval from the teachers, as a factors that foster the

students' creative thinking, is “using teaching, learning and assessment methods in which the student is active will result in the development of creative thinking” with a percentage of 86.6% teachers agree. This factor has a lot of support in the research literature, that can explain the highest percentage received, such as for example, planning and implementing curricula that connect students with their real daily lives, is the way to active learning in which the learner is at the center, that allows him to better understand what is learned, to increasing his motivation for learning and to prepare him better for the future, in terms of thinking skills, including innovation and creative thinking skills (Lombardi, 2007). Bulut (2019) states that attractive, interesting, and student-centered teaching methods instead of teacher- centered ones, are leading to active students and he mentions the peer teaching method as a leading method for active learning, and states that the peer teaching method influences the academic achievement and creative thinking skills of the individual positively.

The third factor among the eight factors that received the highest percentage of approval from the teachers, as a factors that foster the students' creative thinking, is “the teacher's use of methods and tasks that enable multi-directional thinking (divergent thinking) will foster creative thinking” with a percentage of 86.6% teachers agree. This factor too, has a lot of support in the research literature, that can explain the highest percentage received, such as for example, the perception of education systems in the world must be changed from the perception of education as a linear thing to the perception of education as a systemic thing, this will enable the existence of innovative pedagogy that will enable the application of creative thinking by teachers (Robinson & Aronica, 2015: p. 41). Creative thinking is considered high order thinking and is the art of creating original solutions through imagination and logic (Okpara, 2007) and it is based on lateral thinking that allows people to see things in new and unconventional ways (De Bono, 1970). To develop creative thinking, teachers need to develop basic skills that are part of creative thinking and are included within it, such as lateral thinking skills (DeBono, 1970). Moreover, to promote creative processes and develop students' creative thinking, it is necessary to create educational contexts with characteristics such as diversity, originality and alternatives and others (Elisondo et al., 2013). These characteristics of diversity, originality and alternatives are based on and enable multi-directional thinking (divergent thinking).

The fourth factor among the eight factors that received the highest percentage of approval from the teachers, as a factors that foster the students' creative thinking, is “diversification in the learning environments used by the teacher will encourage the cultivation of creative thinking” with a percentage of 83.7% teachers agree. On diversity in the learning environments that the teacher uses to foster creative thinking among the students, many reinforcements and support in the research literature, were found such as, for example, schools are required to design creative and unconventional environments for teachers and students that will push them to be creative (Moran, 2010; Starko, 2013). Diversity in the school learning environments and school environments that promote creativity found to be one of the key conditions for the development of creativity (Banaji et al., 2010; Ferrari et al., 2009; Moran, 2010). In addition, teachers must provide a creative learning environment that is characterized by openness and freedom that allow students to think, plan, and express their opinions and ideas without restrictions (Vygotsky, 2004).

The fifth factor among the eight factors that received the highest percentage of agreement from the teachers, as a factors that foster the students' creative thinking, is “using unconventional teaching and assessment methods will foster creative thinking” with a percentage of 81.8% teachers agree. A lot of research literature discusses this factor as having a great influence on the cultivation of creative thinking. For example, Bulut (2019) states that teaching methods that are different from what usually exists in the classroom, that are attractive, interesting, put the student at the center and activate him like peer teaching, improve the academic achievements and creative thinking skills of the individual in a positive way. In order to carry out teaching that facilitates the cultivation of creative thinking, teachers are required to conduct among their students processes of imparting knowledge about the essence of creativity, knowledge about creative processes in addition to the implementation of practical learning activities that facilitate creativity through the use of creative methods and tools (Moran, 2010; National Advisory Committee on Creative and Cultural Education NACCCE, 1999). The above indicates that, in order to foster creative thinking, unconventional teaching methods with the above-mentioned characteristics must be used. What has been said so far is about the part of the fifth factor that deals with unconventional teaching methods to cultivate creative thinking. Regarding the part of this

factor that deals with non-routine and unconventional assessment methods to foster creative thinking, it is said, among other things, that teaching creativity should also be accompanied by an assessment of the students' creativity. The teachers will do this by assessing how their students' thinking is original, open, free of influences, sophisticated and flexible (Torrance, 1979), as well as evaluating the students' products and the way in which they create, imagine, discover, solve, invent, and predict (Sternberg, 2012: p. 8). The meaning of these words is that the development of creative thinking requires not only unconventional teaching methods but also unconventional assessment methods with the specified characteristics.

In conclusion, this factor that states that in order to cultivate creative thinking, unconventional teaching and assessment methods must be implemented in the classroom, it is found in the research literature that in order to promote creative processes and develop creative thinking of students, it is necessary to create educational contexts in which creative thinking is the core of students' teaching, learning and assessment processes, which allows diversity and originality (Elisondo et al., 2013).

The sixth factor among the eight factors that received the highest percentage of agreement from the teachers, as a factors that foster the students' creative thinking, is "encouraging diverse and unconventional answers will foster creative thinking" with a percentage of 81.2%, which has also been written about extensively in the research literature, as a factor that fosters creative thinking, for example, creative problem solving may be used as a tool for effective learning in primary school and that it is an accessible tool for learning and creativity (Hooijdonk et al, 2020). Of course, this is about the way to unconventional answers and solutions that are the basis of creative thinking.

The seventh factor among the eight factors that received the highest percentage of agreement from the teachers, as a factor that foster the students' creative thinking, is "using digital technologies in teaching will foster creative thinking" with a percentage of 79.6% agree. This factor is one of the factors for which the most literary support was found in its description as a central factor in the cultivation of students' creative thinking. For example, Loveless (2002) notes that information and communication technologies support and develop creative thinking. He explains this by pointing out that the use of information and

communication technologies will lead to the development of original ideas, the creation of collaboration and communication between the users of these technologies that increases creativity. Which leads to the conclusions that the use of digital technologies will lead to improved people's creativity and problem-solving skills. Cakıroglu et al. (2015) state that the use of digital technology in student education will improve the high order thinking skills of students. Like them, Erol and Tas (2012) state that technology has an important and central place in the development of higher-order thinking skills such as, creative, critical, logical, and meta-cognitive thinking.

As for the eighth factor among the eight factors, that received a percentage of agreement between 80% and 91%, which is, "students' creative thinking can be fostered in the application of learning, through problems that allow for multiple answers instead of exercises that have one correct answer" with a percentage of 79.2% teachers agree, much has been written about it in the research literature, such as, for example, the perceptions of education systems in the world should change from the perception of education in all its aspects as a linear thing, to the perception of it as a systemic thing, this will enable the existence of an innovative pedagogy that will enable the application of creative thinking by teachers (Robinson & Aronica, 2015: p. 41). That means that, linear thinking will always lead to only one answer and systemic thinking will open the thinking in many different directions and allow to receive different and diverse answers which is the basis of creative thinking.

Regarding the three factors that are at the second level of agreement among the teachers, in which agreement was found among the teachers as factors that enable the cultivation of creative thinking, an agreement ranging from 60% to 70%, which is also high. The first among these factors is, "creative thinking can be nurtured using existing learning materials and textbooks only if the teacher uses methods and tools that enable the cultivation of creative thinking" with a percentage of 68.7% teachers agree. The meaning of this factor is that the methods and tools used by teachers to develop creative thinking are more important than learning materials and textbooks, so the teachers agree with that, that creative thinking can be developed with the usual learning materials and textbooks if they use methods and tools that promote creative thinking. Much has been written about the use of methods and tools for the

development of creative thinking in the research literature, mentioned a lot earlier about methods that promote creative thinking, so it will be noted here about tools that foster creative thinking. Tran, Ho, and Hurle (2016), found that, to improve students' creativity, teachers need to be highly aware of creativity, teach creativity, incorporate students' assessment of creativity as part of their assessment and practice and use creative tools (Tran, Ho, & Hurle, 2016). One of the processes that teachers are required to do in order to develop creative thinking among their students, is teaching in which practical learning activities are implemented that enable creativity through the use of creative methods and tools (Moran, 2010; National Advisory Committee on Creative and Cultural Education NACCCE, 1999). To develop creative thinking, teachers must practice tools and techniques designed to develop creative thinking (De Bono, 1970; Moran, 2010).

The second factor at the second level of agreement among the teachers, found to be "taking risk on the part of the teacher and students will result in the development of creative thinking" with a percentage of 66.5% teachers agree. Much has been written in the research literature about taking risks on the part of the teacher and the students as a factor in the development of creative thinking. Many researchers point to the characteristic of taking risks on the part of teachers and students, as a condition on the way to creative thinking, for example, curricula should be designed to allow for some application of improvisation, thus allowing for some degree of spontaneity, freedom, and the creation of the unexpected (Sawyer, 2011; Beghetto & Kaufman, 2011). In order, to fulfil this, the teacher must have the ability to take risks and train his students to do so, since he does not know where processes in this situation will lead him in the students' thinking.

The third and last factor at the second level of agreement among the teachers, is "lack of judgment on the part of the teacher to the students' answers will promote creative thinking" with a percentage of 60.1% teachers agree. Regarding the only factor, which has a low percentage of agreement, when 20% of the teachers agree, that it is a factor that fosters creative thinking, which is "only the use of learning materials and textbooks specifically designed to cultivate creative thinking will result in the cultivation of creative thinking", this factor is the opposite (worded in reverse) of the factor "creative thinking can be nurtured using existing

learning materials and textbooks only if the teacher uses methods and tools that enable the cultivation of creative thinking” with a percentage of 68.7% teachers agree, which is at the second level of agreement among the teachers, in which agreement was found among the teachers as factors that enable the cultivation of creative thinking.

The fact that only 20% of the teachers agree that the factor “only the use of learning materials and textbooks specifically designed to cultivate creative thinking will result in the cultivation of creative thinking” is a factor that fosters creative thinking, emphasizes the finding regarding the factor “creative thinking can be nurtured using existing learning materials and textbooks only if the teacher uses methods and tools that enable the cultivation of creative thinking”, so this percentage of agreement (20%) can be explained on the same way has been said there, that is, the meaning of this factor, is that the methods and tools used by teachers to develop creative thinking are more important than learning materials and textbooks. As a result, the teachers agree with a low degree of agreement (20%) that creative thinking can be developed by only using of learning materials and textbooks specifically designed to cultivate creative thinking.

Based on the wide-ranging discussion in this part (part E) of the research questionnaire, which deals with the perception of factors that foster students' creative thinking, we come to the conclusion that it fully and completely supports and reinforces the hypothesis formulated in this part, which is “it will be found that most teachers believe that in order to foster creative thinking of students, many significant changes are required in, methods, tools and environments of teaching, learning and assessment, learning materials and in the willingness of teachers to teach creative thinking”.

In addition, to prove the correctness of the hypothesis statistically a t-test was conducted for a single sample to examine the variability and diversity in teachers' responses regarding the factors that foster students' creative thinking, found ($t = 146.308$, $p < 0.001$), this indicates high variability and great diversity in teachers' responses to the factors fostering students' creative thinking. Therefore, the research hypothesis was confirmed and accepted.

Final conclusions

As discussed earlier, according to the teachers' answers to the statements in this part of the questionnaire which examines the teachers' perception of the factors that foster the students' creative thinking, it was found that the teachers agree with a high degree of agreement with all the statements, that is, with all the factors included in these statements as factors that foster the creative thinking of the students. This is when 8 of the 12 statements (75% of them) received very high degrees of agreement from the teachers as factors that foster creative thinking ranging from 80% to 90% agreement and the other four statements also received high degrees of agreement ranging from 60% to 70% agreement (see table no. 2 above). Since these statements describe situations and ways that constitute changes from what exists in the school, it turns out that the teachers' agreement at high levels with these statements means that substantial and many changes are required in the school such as in the methods, tools, and environments of teaching, learning and assessment, etc. As a result, the hypothesis "it will be found that most teachers believe that in order to foster creative thinking of students, many significant changes are required in, methods, tools and environments of teaching, learning and assessment, learning materials and in the willingness of teachers to teach creative thinking" that was formulated for this part of the questionnaire and which expresses the essence of these statements and indicates in general the factors that foster creative thinking that were included in this part of the questionnaire, this hypothesis was found in the statistical T-test for a single sample to be correct and it was accepted. In addition, and as previously discussed, these high levels of agreement with all the statements, that is, the factors that promote creative thinking, find many expressions of support in the research literature.

Based on this triangle of high levels of agreement of the teachers with the statements as factors that foster creative thinking, the acceptance of the hypothesis and the support from the research literature, it is possible to reach the overarching conclusion, which is that significant and many changes are required in all the components of the school's activity including, educational policy, professional development of teachers, curricula, learning materials, learning environments, teaching methods

and tools, learning and assessment and teachers' willingness to teach creative thinking and more.

These significant changes find many solid foundations and support in the research literature. Examples for that express these required significant changes, were found in the research literature such as, that in order to cultivate creative thinking, the education systems and schools need to change themselves, especially stop maintaining a fixed structure and patterns of action, which prepare the student in accordance with the requirements of the next stage of education up to higher education, that if the student is not prepared in accordance with these requirements, he will not be admitted to the next stage of education, a situation that interferes with cultivating the students' creative thinking (Robinson & Aronica, 2015: pp. 31-36). In addition, the perception of education systems in the world must be changed from the perception of education as a linear thing to the perception of education as a systemic thing, this will enable the existence of innovative pedagogy that will enable the application of creative thinking by teachers (Robinson & Aronica, 2015: p. 41). Also, the implementation of new curricula centered on new and important types of thinking will be possible through fundamental pedagogical changes that allow the implementation of a new and high-quality pedagogy (McIlvenny, 2013: p. 18). Furthermore, in order to cultivate students' creative thinking, schools are required to make fundamental changes in the learning environments and design creative and unconventional environments for teachers and students that will push them to be creative (Moran, 2010; Starko, 2013).

It is stated that in order for the teachers to work to cultivate the students' creative thinking, the existence of several conditions is required: an educational policy that will require the development of this thinking, curricula aimed at creative thinking and evaluating the creativity of the students (Tran, Ho & Hurle, 2016). Education systems, office policies, curricula and school environments that promote creativity found to be key conditions for the development of creativity (Banaji et al., 2010; Ferrari et al., 2009; Moran, 2010).

Fundamental changes must be made in the pedagogy and the curricula, so that it will be possible to connect what is learned to the student's daily life, thus enabling active learning in which the student is at the center and which prepares the student better for the future by

imparting thinking skills, including innovation and creative thinking skills (Lombardi, 2007).

Significant changes are also required in teacher training, that is, in the set of professional development for teachers, so that these professional developments will emphasize creative thinking and be directed towards it (Banaji et al., 2010; Ferrari et al., 2009; Moran, 2010).

Therefore, based on all the above, it was found that the research literature supports the findings of this study which state that, many changes mentioned earlier, are required to cultivate the students' creative thinking. On the other hand, these research findings regarding the required changes, based on the teachers' perception confirm and support this research literature.

Summary and recommendations

This study examined the perception of the science and technology teachers in the Arab school in Israel regarding the factors that foster creative thinking. The study does this through a part of a questionnaire built to examine the teachers' perception of several very important dimensions of creative thinking. The presented findings, the discussion and the analysis raise a very important main conclusion regarding the cultivation of the students' creative thinking based on the teachers' perception. This conclusion is that significant changes are required in most factors of school activity in order to cultivate creative thinking of the students, in methods, tools and environments of teaching, learning and assessment, the willingness of teachers to teach creative thinking and readiness for taking risks on the part of the teachers and students

This study proves the correctness of many factors for the cultivation of creative thinking that are found in the research literature, and it does so from a place of the teachers' perception of these factors. This is essentially the innovation and importance of the research, on which it is possible to build much research-based conclusions and recommendations that will form the basis for the education systems and schools, for planning programs for the cultivation of creative thinking. All this, as based on the perception of the teachers since they and not others are the ones who carry out the teaching, learning and assessment processes in the school, and they are the actual mediators between theory and application, so that the

cultivation of creative thinking depends to a large extent on their way of activity. Based on the findings and conclusions, many recommendations can be made regarding the ways and nature of the factors that foster creative thinking and the changes required for this purpose. The main recommendation is addressed to the various educational systems, to educational policy makers and to the schools, and it is that the findings and conclusions of this study constitute a solid research basis upon which they can plan action plans and determine outlines, rules, and principles for the purpose of cultivating creative thinking. In this, the recommendation is that they can use all the factors that foster creative thinking that appeared in all the statements of this part of the questionnaire, as a basis for the planning, construction and operation of these programs, since all of these factors received the consent of the teachers with high degrees of agreement in addition to the statistical acceptance of the hypothesis that was formulated in the spirit of these statements and factors, as factors that foster students' creative thinking.

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