IN THE REALM OF MATHEMATICAL EDUCATION, THE ARAB SOCIETY IN ISRAEL STANDS AT A CRUCIAL CROSSROADS. AS EDUCATORS AND RESEARCHERS DELVE INTO THE DEPTHS OF EDUCATIONAL STRATEGIES AND OUTCOMES, IT BECOMES INCREASINGLY EVIDENT THAT THIS COMMUNITY FACES UNIQUE CHALLENGES THAT CALL FOR TAILORED, RESEARCH-BASED INTERVENTIONS. THIS BOOK AIMS TO SHED LIGHT ON THESE ISSUES, DRAWING ON EXTENSIVE RESEARCH AND ANALYSIS TO NOT ONLY HIGHLIGHT THE PROBLEMS BUT ALSO TO PROPOSE VIABLE SOLUTIONS THAT COULD SIGNIFICANTLY ALTER THE EDUCATIONAL LANDSCAPE FOR ARAB STUDENTS IN ISRAEL.

This work is written by Dr. Wafiq Ali Hibi. A researcher in the field of pure mathematics, he completed his doctoral studies in the Department of Pure Mathematics, University of Haifa, in 2004, after solving a mathematical problem in the topology of metric spaces and graphical theories in isometric spaces, which was open for nearly fifty years.

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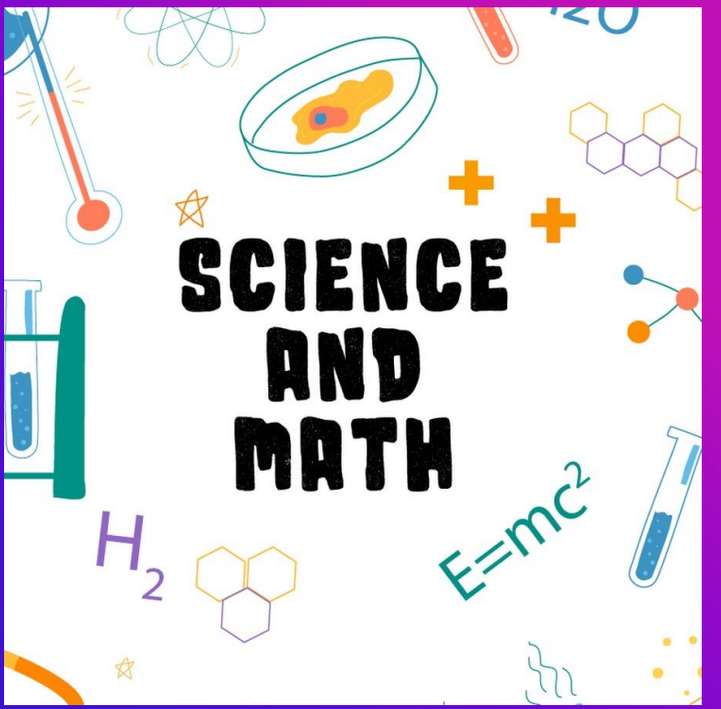
Selected Chapters in Teaching Mathematics and Science Education

Dr. Wafiq Ali Hibi



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In this book:

In the realm of mathematical education, the Arab society in Israel stands at a crucial crossroads. As educators and researchers delve into the depths of educational strategies and outcomes, it becomes increasingly evident that this community faces unique challenges that call for tailored, research-based interventions. This book aims to shed light on these issues, drawing on extensive research and analysis to not only highlight the problems but also to propose viable solutions that could significantly alter the educational landscape for Arab students in Israel.

The Arab society in Israel, characterized by its rich cultural heritage and linguistic diversity, presents a unique educational context. Historically, this community has grappled with a range of socioeconomic challenges, from higher rates of poverty to limited access to quality educational resources. These factors inevitably impact students' mathematical achievement and their overall educational journey. Research indicates that Arab students in Israel consistently score lower on national and international mathematics assessments compared to their Jewish counterparts. This disparity raises pressing questions about the equity of educational opportunities and the effectiveness of current teaching methodologies within the Arab education system.

One of the core issues at the heart of this disparity is the language barrier. Mathematics, with its universal language of numbers and symbols, is taught in Hebrew, a second language to Arab students. This not only makes the learning process more challenging but also affects students' confidence and engagement with the subject. Furthermore, cultural relevance in mathematical examples and teaching methods is often lacking, making it harder for students to connect with the material on a personal and practical level.

However, this book does not merely aim to outline the challenges. It is also a beacon of hope, offering evidence-based solutions that have the potential to bridge these gaps. For instance, integrating bilingual education strategies can help overcome the language barrier, allowing students to grasp complex mathematical concepts more effectively. Additionally, culturally responsive teaching methods can make mathematics more accessible and engaging for Arab students by connecting mathematical concepts to their daily lives and cultural experiences.

Empowering teachers through professional development is another critical aspect of the proposed solutions. Teachers need to be equipped with the skills to address diverse classroom needs and to employ pedagogical strategies that are inclusive and effective for all students. Furthermore, increasing access to quality educational resources and technology can provide Arab students with more opportunities to engage with mathematics outside the classroom, fostering a positive learning environment and a culture of mathematical curiosity and excellence.

As we delve deeper into the specifics of these challenges and solutions throughout this book, it is our hope that educators, policymakers, and stakeholders will find a roadmap for creating a more equitable and effective mathematical education system for the Arab society in Israel. Through collaborative efforts and a commitment to research-based interventions, we can aspire to not only narrow the educational gaps but also to celebrate the rich cultural diversity that these students bring into the mathematics classroom.

Dedicated to my students at Sakhnin College

May this book inspire your mathematical journey, fuel your curiosity, and guide you towards innovation and excellence. Keep questioning, keep growing.

Table of Contents

Beliefs and Attitudes About Mathematics Among Students and Their Relationship To Their Achievement In Mathematics

Abstract

The subject was chosen because beliefs and attitudes about mathematics have an important impact on an individual's decisions about the amount and nature of mathematics one teaches in the future. Qatina and Legation (2021) indicate that Students' beliefs are oriented towards students' behavior and acceptance of the surrounding environment, as teachers focus and direct their students' thinking and communication towards how they study mathematics differently and thus their students' beliefs about learning mathematics are shaped, and beliefs are described as changing against their daily experiences. Students' attitude to mathematics is an important factor influencing students' achievement in mathematics. Beliefs and attitudes about mathematics show an important influence on an individual's decisions about the amount and nature of mathematics one teaches in the future.in other words, students' careers related to mathematics are likely to be influenced by their feelings and beliefs towards mathematics. Thus, behavioral structures either direct students to study mathematics fields or drive students away from jobs that require moderate math competencies, so the main goal for all teachers must be to teach learners with strong self-beliefs in mathematics and positive attitudes towards mathematics.

The research question therefore states: What do beliefs and attitudes about math among students have to do with their math achievement?

Introduction

The problem of study is highlighted through many issues in the educational system, including the problem of educational failure in mathematics, resulting in the loss of financial and human resources in society in various ways. This problem imposes many harmful educational and mental consequences on students and their families. Results suggest that one of the most effective factors in students' attitudes is that they understand the application of mathematics in their real lives. If students consider mathematics to be a lesson unrelated to their real lives, in this case, they hate mathematics, which is one of the biggest obstacles to learning this lesson.

Educational attainment in mathematics is influenced not only by knowledge structures and information processing, but also by motivational factors such as beliefs, attitudes, values and anxiety. Accordingly, a close relationship was found between the high level of motivation, positive attitude, low-level anxiety and performance in mathematics.

Students' beliefs or perceptions of intelligence and ability affect their learning and cognitive performance by referring to two types of students. The former believe that intelligence is flexible and they behave in a sophisticated way of thinking. They generally focus on learning goals in order to test and expand their intelligence and abilities. They transcend failure and tend to perform better in problem-solving situations. (Lucariello, et al, 2015).

Students' attitudes to the lesson may be negative or positive. Positive or negative attitudes are constant, and untenable beliefs acquired due to student experiences, mathematical attitude is among the predictors of achievement in mathematics. However, many factors have an impact on students' attitudes towards mathematics. Teachers, parents, peers, as well as the school environment, all have an impact on the individual attitude. It turns out that teachers, colleagues and positive parental support will help to create positive attitude and beliefs around mathematics and thus help to curb negative attitudes and beliefs (Giles, Byrd, Bendolph, 2016).

Beliefs are the views, ideas, and attitudes displayed by mathematics teachers towards many matters relating to the teaching and learning processes or the education system in general. Belief in general is defined as one's faith of confidence in a particular idea, and in a particular subject. It is shaped individually by one's acceptance of information about a particular subject, or an act of a particular situation. (Watson, Hunt-Ruiz 2015).

Theoretical background

The purpose of the study was to identify beliefs and attitudes about mathematics among students and their relationship to their achievement in mathematics.

The concept of beliefs in mathematics:

Mathematics is the foundation of life organized for the present day, and without numbers and mathematical evidence, we will not be able to resolve many issues, which are more indispensable in mathematics than in everyday life. This is how math forms are not only a mandatory part of the curriculum until the secondary level, often necessary in the third stage next stages. While mathematics is associated with enjoyment and pleasure by a few amateurs of this subject, some people, or a fear and aversion consider it more by others. So mathematics is essential in the long planning of life and the daily planning of any individual – (Kundu, Ghose, 2016).

The beliefs of a mathematics teacher are the views on his/her competence and ability to perform specific math teaching tasks at a certain level of quality in the context of the school. Self-competence is based on subjective perceptions of particular behavior and is a sensitive area; This has led to the development of multiple tools to measure the self-proficiency of pre-service teachers and their praise in various fields.

The effectiveness of teaching mathematics in teachers refers to their beliefs in their ability to teach mathematics effectively (Giles, Byrd, Bendolph, 2016).

(Kim, Sihn, Mitchell, 2014) indicated that teachers' beliefs influence both class practices and students' learning opportunities. It has also been shown that teacher attitudes are the best way to teach mathematics and to organize students in a lesson. The studies emphasize the importance of beliefs and their impact on teaching performance, and that their impact is reflected in pupils' level and orientation towards mathematics, and that primary-level attitudes towards mathematics and academic achievement are more easily influenced by their teachers than by secondary-level students.

Student beliefs and its relation to mathematics:

Because of the importance of mathematics and its relationship to life, success in this subject plays a major role in improving motivation towards it. Motivation increases the sense of division of mathematics, and thus the student has positive beliefs towards mathematics. This is why the main guiding beliefs of human behavior in various aspects of life, and the beliefs of students about mathematics largely determine their attitude towards studying it. Mathematical beliefs have a strong influence in assessing students' own abilities and will to interact with their tasks.

Students' beliefs guide students' behavior and acceptance of the surrounding environment. When teachers focus and direct their students' thinking and communication with them, students will learn how to study differently and thus their students' beliefs about learning mathematics are shaped. Then, the beliefs are describe as changing and reshaped with the individual values and beliefs against his or her daily experience (Qatina and Legation, 2021).

Students' beliefs or perceptions of intelligence and ability affect their learning and cognitive performance by referring to two types of students. The former believe that intelligence is flexible and they are characterize in a sophisticated way of thinking. They generally focus on learning goals in order to test and expand their intelligence and abilities. They transcend failure and tend to perform better in problem-solving situations. (Lucariello, et al, 2015(.

The extent to which beliefs affect students' orientation towards mathematics:

Students' beliefs about mathematics influence their learning and teaching and determine how the student chooses his or her strategy to solve the problem. Beliefs are linked to the motivation of the students, and the ability to solve the problems. There are many factors that affect students' beliefs: class teaching, peer interaction, social environment, teacher training programs and research that results in mathematics teaching methods. In addition, the association of students' beliefs with their practices affects their level of learning participation and mission delivery as well as their impact on students' problem-solving

strategies, and the possibility of changing and developing beliefs by changing practices (Sokolov & College, 2017).

Future teachers' beliefs are influenced and influenced by the professional and educational knowledge they receive while enrolled in their educational programs. The knowledge and skills acquired by future teachers are organized according to the value understanding of the knowledge they carry towards their teaching behavior, indicating the importance of vocational and specialized training in shaping teachers' beliefs towards different roles.

However, there are many factors that influence students' attitudes towards mathematics. Teachers, parents and peers, as well as the school environment, all have an impact on the individual attitude of behavior that teachers and colleagues and positive parental support will help to create positive attitude and beliefs about math and thus help to curb negative attitudes and beliefs. The home environment of and access to the student can have an impact on his/her status and achievement (Abosalem, 2015).

Attitudes towards mathematics and students' orientation:

One of the most important factors of attitude is the emotional response given to a particular attitude. In addition, teacher competence, social and psychological classroom environment, classroom management and organization influence student attitudes in mathematics. Studies have shown that mathematics teaching methods and teacher personality have had an impact on student positivity towards mathematics; Teachers with no interest in students and no personal effort in teaching mathematics can barely involve students in the classroom, and pupils can love or enjoy or vice versa, can hate mathematics. Attitude can be described as positive or negative long-term and emotional behavior towards mathematics. The application of mathematics in life situations contributes to a positive outlook among students, and increases their self-confidence, thereby increasing their motivation to learn mathematics. Teachers' beliefs about learning mathematics may influence their students' beliefs and may have a negative impact on students' beliefs (Lucariello, et al., 2015).

Behavioral combinations either direct students to study mathematics fields or drive students away from jobs that require moderate math competencies. So the main goal for all teachers must be teaching learners with strong self-beliefs in mathematics and positive attitudes towards mathematics. Thus, there has been a significant shift in the study of the contributions of emotional variables, such as self-competence, treatments and disposal, to cognitive skills (Kabissi, 2015).

There is a strong impact that students' beliefs about mathematics have on their achievement. The demand for an understanding of the importance of mathematics and understanding its nature and its sense of pleasure in learning it increases its understanding of its fundamentals, which helps to achieve, self-

proficiency in making sound and appropriate decisions in scientific problems. In addition, the mastery of learning contributes to raising students' level of mathematical prowess and its success leads to the formation of positive beliefs about learning mathematics (Ke)

The improvement of mathematical beliefs is one of the important benefits of the development of mathematical prowess in students. When ideas are well understood and meaningful, students tend to develop themselves positively to increase their confidence in their abilities of learning and understanding math. Students have a blunt sense of words rather than fear. On the other hand, automated understanding of mathematics plays an effective role in maximizing student mathematics anxiety (Chimeric, 2019).

Math anxiety:

Mathematics anxiety is defined as a learner's sense of distress and tension towards solving a mathematical problem, trying to evade solving a mathematical problem because of his or her sense of fear of failing to solve it. There are various factors that affect the increased concern of mathematics. Factors related to the individual character such as, orientation and self-confidence of one's abilities in mathematics, sense of success or failure, self-esteem in mathematics. Factors related to the school environment and attitudes such as social and economic situation (Kepner & Huinker,2012).

Math anxiety can be an obstacle to the student's academic achievement and career aspirations. It also makes learners avoid math courses and get concerned of mathematics. Some people can get stress and worry in everyday situations that include many tasks (win, 2018)

Reasons of math anxiety:

- The difficulty of math, the tuff subject and the lack of relevance to life situations
- Evaluation methods and lack of training for students prior to tests
- The student's own behavior in expecting failure and thus escaping from math studies
- The teacher's teaching method is not concerned with student activity.
- Always threatening a student with failure, showing his or her weak abilities in math. (vitasari, et al, 2010).

Research Method

Research question:

What's the relationship between students' beliefs and attitudes about math and their math achievement?

Research method:

The descriptive approach in quantitative style was followed by questionnaire that examined the beliefs of teachers in mathematics. The questionnaire that includes 25 question is seen as a test that measures motivation, importance and motivation of students' mindsets about the concept of mathematics.

Math orientation categories:

	Category	Question Number
1	Mathematics as laws and processes involves a single correct answer	1,2,3,6,7,21,22,24,25
2	Mathematics as a constant body of knowledge throughout human life	4, 12, 13, 14,15,16,23
3	External stimulus versus internal motivation and the importance of the teacher's role in creating the right educational environment and making decisions on his own	9, 17, 18, 19, 20
4	Trust and math enjoyment: Feeling confident and having fun while teaching or learning mathematics is a favorite subject	11, 5
5	There is a close relationship between mathematics and everyday life versus the separation of mathematics from everyday life	8, 10

Research community and samples:
Questionnaire forms were distributed to 70 students to examine beliefs and trends in mathematics, and to measure student orientation for promotion and treatment in general. School students (2020/202) were selected to measure and examine attitudes towards mathematics.
Research stream:
The form was distributed to 70 students, and after the forms were completed, it was collected and analyzed in order to obtain results for interpretations of students' opinions on beliefs about mathematics in order to promote and process at the same time. The form was considered an important part of scientific research for the credibility of research results in general, after which the results were summarized and discussed.

Results

This chapter contains a statistical analysis of the data generated by the study in order to answer its questions.
Student beliefs and attitudes about mathematics:
In order to achieve results, the arithmetic averages and standard deviations of students' beliefs and attitudes about mathematics have been extracted, as shown in Table 1.

Table 1:

Arithmetic averages and standard deviations of student beliefs and trends in the south of the country:

Paragraph	Arithmetic Average	standard deviation	Grade
Mathematics as laws and processes involves a single correct answer.	4.45	0.72	medium

Mathematics as a constant body of knowledge throughout human life	4.34	0.71	high
External stimulus versus internal motivation and the importance of the teacher's role in creating the right educational environment and making decisions on his own.	3.90	0.87	medium
Trust and math enjoyment: Feeling confident and having fun while teaching or learning math is my favorite subject.	4.59	1.01	high
The relationship between mathematics and everyday life is close versus the separation of mathematics from everyday life.	4.49	1.04	medium
Total grade	4.35	0.67	medium

The results of the above table show that the beliefs and trends of students in the south of the country were intermediate, with an arithmetic average of 4.35 with a standard deviation of 0.67, the highest area. (Confidence and enjoyment in mathematics) with an average arithmetic (4.49) and a standard deviation (0.67), the lowest field obtained (External stimulus versus internal motivation and the importance of the teacher's role in creating the right educational environment and making decisions on his own) with an average arithmetic (3.90) and a standard deviation (0.87).

Mathematics as laws and processes involves a single correct answer:

In order to achieve results, arithmetic averages and standard deviations of mathematics have been extracted as laws and processes involving a single correct answer, as shown in table 2.

Table 2:

Arithmetic Averages and Standard Deviations of Student Self-Confidence on Trends and Beliefs in Mathematics

Paragraph	Arithmetic Average	standard deviation	Grade
Mathematical ability is something that remains relatively constant throughout a person's life.	4.04	1.74	medium
Students who really understand mathematics get the right answer quickly.	4.64	1.25	high
When a student makes a particular error in front of the rest of the students, it is preferable to ask another student to do the job.	3.86	1.46	medium

Students without correct answers need to be trained on other issues	4.71	1.22	high
There's usually one way to solve the mathematical problem.	4.12	1.32	medium
In mathematics, answers are either true or wrong.	3.83	1.37	medium
Individuals have a specific mathematical capacity where they can't do much to change it.	4.01	1.51	medium
Students who finish sports quickly understand matter better than those who take longer	4.37	1.31	high
Students who provide correct answers have a better understanding of mathematical concepts.	4.52	132	high
Total grade	4.4 5	0.72	medium

From the data given in the table, the field of self-confidence among students about trends and beliefs in mathematics came to an average of 4.45 with a standard deviation of 0.72.

The most important ranks are:
• Students without correct answers need to be trained on other issues.
• Students who really understand mathematics get the right answer quickly.
• Students who provide correct answers have a better understanding of mathematical concepts.

Mathematics as a constant body of knowledge throughout human life:

In order to achieve results, the arithmetic averages and standard deviations of mathematics have been extracted as a constant body of knowledge throughout human life, as shown in Table 3.

Table 3:

Arithmetic Averages and Standard Deviations of the Field of Mathematics as a Fixed Body of Knowledge throughout Human Life.

Paragraph	Arithmetic Average	Standard Deviation	Grade
To understand math, students need to work independently in their tasks.	4.71	1.12	high
Some people have a talent for math, while others do not.	4.26	1.33	medium
I can improve my math skills, but I cannot change my basic ability.	4.12	1.28	medium
All students can be good at math if they work harder.	3.48	1.47	medium
In mathematics, you can be creative and discover things yourself.	4.78	1.18	high
The best way to understand math is	4.78	1.15	high

to solve many exercises.			
In mathematics, there is always some students who don't understand the subject, no matter how much they try.	4.66	1.44	high
Total grade	4.34	0.71	high

From the data in the table, mathematics as a constant body of knowledge throughout human life came to a high degree, with an arithmetic average of 4.34 with a standard deviation of 0.71.

The most important ranks are:
• In mathematics, you can be creative and discover things yourself.
• The best way to understand math is to solve many exercises.
• To understand math, students need to work independently in their tasks.

External stimulus versus internal motivation and the importance of the teacher's role in creating the right educational environment and making decisions on his own.

In order to achieve the results, the arithmetic averages and standard deviations of external stimulus versus internal motivation and the importance of the teacher's role in creating the appropriate educational environment and making decisions on his own have been extracted, as shown in table 4.

Table 4:

Arithmetic averages and standard deviations of the field of external stimulus versus internal motivation and the importance of the teacher's role in creating the appropriate educational environment and decision-making.

Paragraph	Arithmetic Average	standard deviation	Grade
I feel confident because I understand math.	4.05	1.74	medium
The more students enjoy solving problem tasks, the more they learn.	4.03	1.74	medium
When my answer to a mathematical question is different from someone else's, I usually assume that my answer is wrong.	3.96	1.51	medium
I don't enjoy doing math.	3.11	1.73	low
When I learn math, I often find it difficult to explain my answers.	3.83	1.39	medium
Total grade	3.90	0.87	medium

According to the data in the table, external stimulus versus internal motivation and the importance of the teacher's role in creating the right educational environment and making decisions on his own were intermediate, with an arithmetic average of 3.90 with a standard deviation of 0.87.

The most important paragraphs are:
• If the students don't work, it could indicate that the job is not fun.
• Math is my favorite subject to teach.
• I'm not good enough at math.

Trust and math enjoyment: Feeling confident and having fun while teaching or learning mathematics is a favorite subject.

In order to achieve results, arithmetic averages and standard deviations of trust and enjoyment in mathematics have been extracted: Feeling confident and enjoying while teaching or learning mathematics is the preferred subject, as shown in Table 5.

Table 5

Arithmetic Averages and Standard Deviations of the Field of Confidence and Enjoyment in Mathematics: Feeling confident and having fun while teaching or learning math is my favorite subject.

Paragraph	Arithmetic Average	standard deviation	Grade
Offering rewards is a good strategy to motivate students to complete math tasks	4.69	1.24	high
The effort must be one of the primary considerations when marking students.	4.31	1.31	medium
Total grade	4.59	1.01	high

From the data in the table, trust and enjoyment in mathematics: The feeling of confidence and enjoyment while teaching or learning mathematics is a favorite subject came to a high degree, with an arithmetic average of 4.59 with a standard deviation of 1.01.
The most important paragraphs are offering rewards is a good strategy to motivate students to complete math tasks.

The relationship between mathematics and everyday life is close versus the separation of mathematics from everyday life.

In order to achieve results, the arithmetic averages and standard deviations of the close relationship between mathematics and daily life have been extracted as opposed to the separation of mathematics from everyday life, as shown in Table 6.

Table 6:

Arithmetic averages and standard deviations of the field of close relationship between mathematics and everyday life versus separation of mathematics from everyday life.

Paragraph	Arithmetic Average	standard deviation	Grade
My interest in everyday life situations (such as sewing, carpentry and finance) requires me to use math to solve problems.	4.43	1.42	high
I understand math better when it's connected with outdoor school activities.	4.18	1.21	medium
Total grade	4.49	1.04	medium

From the data given in the table, the close relationship between mathematics and daily life versus the separation of mathematics from daily life came to an average of 4.49 with a standard deviation of 1.04.

What is the relationship between beliefs and attitudes about mathematics and achievement?

To achieve the results, the value of the Pearson correlation coefficient (r) has been calculated and the statistical indication of the responses of the study sample members between belief variables and trends in mathematics and between educational achievement and schedule (6) shows this:

Table 6:

Pearson Correlation Coefficient and Statistical Connotation between Variables of Beliefs and Trends in Mathematics and Educational Achievement.

variables	Value of the correlation parameter	statistical significance
Beliefs and trends about mathematics Achievement	0.501	0.000

The results of the above table show that the Pearson self-proficiency correlation factor for students was (0.501), and the statistical connotation level was (0.000), a statistical function value, i.e. there is an average positive relationship between beliefs and trends about mathematics and educational achievement, i.e. the higher beliefs and trends about mathematics, the higher the student's educational achievement.

Discussion

The results were expected about the beliefs and attitudes about math students and their relationship to their achievement in mathematics, so that there is a group of students who like and enjoy math, as well as working to pursue the class more often than others. There is a tendency towards math and math, as opposed to a group of other students who do not like math. The results show that the beliefs and trends of

the students in the south of the country are moderate. Qatina and Al-Shara (2021) stated that students' beliefs are conducive to students' behavior and acceptance of the surrounding environment, as teachers focus and direct their students' thinking and communication towards how they study mathematics differently.

It has also been shown that the field of self-confidence among students about attitudes and beliefs in mathematics is moderate. According to the researcher, students need to be cared for by the teacher in order to gain mastery of educational skills.

There are many factors that influence students' attitudes towards mathematics. Teachers, parents, peers, as well as the school environment, all have an impact on the individual attitude. It turns out that teachers, colleagues and positive parental support will help to create positive attitudes and beliefs about mathematics and thus help to curb negative attitudes and beliefs (Giles, Byrd, Bendolph, 2016).

The results also showed that mathematics as a constant body of knowledge throughout human life came to a high degree. According to the researcher, mathematics and especially basic skills are needed in most stages of one's life. In many daily transactions, students devise ways to help them understand the subject of mathematics, so this result was demonstrated by the need for mathematics in everyday life. External stimulation versus internal motivation and the importance of the teacher's role in creating the right educational environment and making decisions on his own have been shown to be moderate. According to the researcher, this result is due to the different responses of students to the stimulus factor.

Beliefs and attitudes about mathematics show an important influence on an individual's decisions about the amount and nature of mathematics one teaches in the future. To express differently, students' careers related to mathematics are likely to be influenced by their feelings, feelings, and beliefs towards mathematics. Thus, behavioral combinations either direct students to study mathematics fields or drive students away from jobs that require moderate math competencies, so the main goal for all teachers must be to teach learners with strong self-beliefs in mathematics and positive attitudes towards mathematics. Thus, there has been a significant shift in the study of the contributions of emotional variables, such as self-competence, treatments and disposal, to cognitive skills (Kabissi, 2015).

It is also revealed that trust and enjoyment in mathematics, the feeling of confidence and pleasure while teaching or learning mathematics as a favorite subject came to a high degree. The researcher considers that the subject of mathematics is enjoyed by students when mastering it, especially since there are many of its skills that provoke thought at its highest levels, so this result has emerged.

The improvement of mathematical beliefs is an important benefit to the development of mathematical prowess in students. When ideas are well understood and meaningful, students tend to develop themselves positively. They also increased their confidence in their abilities to learn and understand mathematics.

There is a strong impact of students' beliefs about mathematics that affected their achievement. The demand for an understanding of the importance of mathematics, math's nature, math pleasure in learning it increases its understanding of its fundamentals, which helps to achieve and the master learning skills. It also contributes to raise the level of mathematical prowess among students and results in positive beliefs about learning mathematics (Kepner & Huinker, 2012).

It has also been shown that the close relationship between mathematics and everyday life versus the separation of mathematics from everyday life came to an average degree. According to the researcher, there are many places in mathematics that are related to everyday life, so this result has emerged.

It has been shown that there is a positive relationship between beliefs and attitudes about mathematics and educational achievement, that is, the higher the beliefs and trends about mathematics, the higher the educational attainment of students. According to Karjanto, 2017, students' attitude towards mathematics is an important factor in influencing students' achievement in mathematics.

According to the researcher, the subject of mathematics evokes the highest levels of thinking in students. A student who is proficient in mathematical skills has the ability to think in the right direction, thereby increasing his or her level of achievement.

(Kim, Sihn, Mitchell, 2014) indicated that teachers' beliefs influence both class practices and students' learning opportunities. It has also been shown that what a teacher thinks is the best way to teach mathematics or to organize students in a lesson, is what he or she will do in a classroom. The studies emphasize the importance of beliefs and their impact on teaching performance, and that their impact is reflected in pupils' level and trends towards mathematics, as primary-level attitudes towards mathematics and academic achievement are more easily influenced by their teachers than by secondary-level students.

Summary of results

- The results showed that the beliefs and attitudes of students in the south of the country were moderate.
- The field of self-confidence among students about attitudes and beliefs in mathematics came in a medium degree.
- Mathematics as a constant body of knowledge throughout human life has come up with a high degree of knowledge.
- External stimulus versus internal motivation and the importance of the teacher's role in creating the right educational environment and making decisions on his own are moderate.
- Confidence and enjoyment in math: Feeling confident and having fun while teaching or learning math is a favorite subject came to a high degree.
- The close relationship between mathematics and everyday life versus the separation of mathematics from everyday life came with an average degree.
- There is a positive relationship between beliefs and attitudes about mathematics and educational achievement, that is, the higher the beliefs and trends about mathematics, the higher the educational attainment of students.

Recommendations:

- The teacher works on various methods during math class to overcome the boredom that can affect some students.
- The teacher should give many examples of mathematical laws in order to enhance students' understanding of mathematics.
- Research focused on the beliefs and trends of mathematics among students and their relationship to the motivation of students towards learning

• Train students to use the logical sequence to solve mathematical issues in order to reach the solution in an orderly, error-free manner, especially when applying laws.
• The teacher works to increase students' confidence in math subjects and motivates them to practice mathematical issues.

Appendix

Questionnaire form: Please put a circle around the number indicating the degree of your acceptance in the following terms.

		Strongly disagree					Strongly agree
1	Mathematical ability is something that remains relatively constant throughout a person's life.	1	2	3	4	5	6
2	Students who really understand mathematics get the right answer quickly.	1	2	3	4	5	6
3	When a student makes a particular error in front of the rest of the students, it is preferable to ask another student to do the job.	1	2	3	4	5	6
4	To understand math, students need to work independently in their tasks.	1	2	3	4	5	6
5	Offering rewards is a good strategy to motivate students to complete math tasks.	1	2	3	4	5	6
6	Students without correct answers need to be trained on other issues.	1	2	3	4	5	6
7	There's usually one way to solve the mathematical problem.	1	2	3	4	5	6
8	My interest in everyday life situations (such as sewing, carpentry and finance) requires me to use math to solve problems	1	2	3	4	5	6
9	I feel confident because I understand math.	1	2	3	4	5	6
10	I understand math better when it's tied to other things I care about outside school.	1	2	3	4	5	6
11	The effort must be one of the primary considerations when grading the students.	1	2	3	4	5	6
12	Some people have a talent for math,	1	2	3	4	5	6

	while others don't.						
13	I can improve my math skills, but I can't change my basic ability.	1	2	3	4	5	6
14	All students can be good at math if they work harder.	1	2	3	4	5	6
15	In mathematics, you can be creative and discover things by yourself.		2	3	4	5	6
16	The best way to understand math is to do a lot of exercises.	1	2	3	4	5	6
17	The more students enjoy doing math exercises , the more they learn.	1	2	3	4	5	6
18	When my answer to a mathematical question is different from someone else's, I usually assume that my answer is wrong.	1	2	3	4	5	6
19	I don't enjoy doing math.	1	2	3	4	5	6
20	When I learn math, I often find it difficult to explain my answers.	1	2	3	4	5	6
21	In mathematics, answers are either true or wrong.	1	2	3	4	5	6
22	Individuals have a specific mathematical capacity where they can't do much to change it.	1	2	3	4	5	6
23	In mathematics, there's always some students who don't understand the subject, no matter how much they try.	1	2	3	4	5	6
24	Students who finish math tasks quickly understand better than those who take longer time.	1	2	3	4	5	6
25	Students who provide correct answers have a better understanding of mathematical concepts.	1	2	3	4	5	6

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The Educational and Geometric Psychological Impact Of Origami On Sixth Graders.

1. Introduction

Teaching mathematics in general depends on traditional learning in most schools, as it hinders the acquisition of the skills and mathematical concepts behind the processes they use when solving a mathematical problem or question, and thus students have difficulty understanding the properties of the concepts they have learned and linking them with other concepts.

Therefore, the present study comes to show the importance of teaching mathematics to overcome such problems and difficulties, which shows the importance of multiple representations in mathematical and geometrical learning, and the importance of multiple examples in the educational process, which depends on learning through origami. Contributes to student activity in the learning process as it contributes to the identification of learning processes. Learn, discover and build information by ensuring their active participation with appropriate tools and activities.

Thus, the aim of the present study is: The present study is designed to know the effect of origami's educational and geometrical interaction on sixth graders.

The results indicate that learning through paper folding, i.e. origami, contributes to the development and improvement of students' educational skills more than traditional learning.

2. Literature review

2.1 Representations in Mathematical teaching

Mathematics, which is taught as a core and weighted course the rough out the years of education from elementary to high school, is considered by students as an abstract and difficult course to understand, it allows them to memorize it directly and thus efforts are made only to improve it. As most teachers say, the definition of succeeding in mathematics is the ability to use formulas and their rules and methods instantly correctly, and to do the calculation in the right way today. Therefore, when mathematics is taught in traditional teaching processes, the information is prepared, presented and followed by solutions with individual and correct answers that are required to the use of what is learned.

In such an educational environment, it is difficult for students to acquire the skills and attainment that the mathematics curriculum expects of them. So, many students are unaware of the mathematical concepts behind the processes they use when solving a mathematical problem or question and what mathematics actually means; Hence students think of learning mathematics as performing actions using meaningless formulas and symbols and try to learn mathematics by routine learning. As a result, students have difficulty grasping the characteristics of the concepts they have learned and relating them to other concepts (Omer, 2020).

Therefore, mathematics must be taught in order to overcome such problems. If students are meant to learn a mathematical concept intentionally and hesitantly, they should be allowed to ask questions about the idea, exchange opinions with others, and perform activities. As is well known, students learn best through practice and experience; by choosing the right toolkit and materials, classroom

environments should be designed to ensure that students are active in the learning process (Turkosy & Taslidere, 2016).

In other words, the teacher needs to prepare appropriate learning environments that will be effective in the students' learning process and help them become familiar with the learning processes and the discovery and construction of information by ensuring their active participation (Akpinar, 2010).

When teachers select and use appropriate materials, that will help students embody concepts while learning mathematical concepts that are abstract in nature, (Teyfur, 2011) by creating effective learning environments through the use of appropriate tools and activities so that curriculum objectives can be more easily achieved.

Manual activities that students do by themselves by actively participating in them during the course allow them to learn better concepts, as well as use models, tools and mathematical materials to enable students to take a more active role in the math teaching process.

Thus, the use of learning environments allows different teaching materials for students to clearly examine previously explored concepts for their ideas, explore some new features of the idea, discuss and present their own meaningful information enabling students to achieve more and more memorable learning by providing tangible learning results (Bozkurt & Polat, 2011).

It is important and necessary to make concrete use of the material as much as possible in teaching new concepts, and assessments to be made when teaching mathematics in primary and secondary schools (MEB, 2018), which helps students realize the basic properties of a concept and improve their imagination and scientific ideas.

2.2 Origami

(For paper folding) it is the ancient art of paper folding; Traditional origami usually involves only straight folds on a flat (square) piece of paper so that tearing, cutting or gluing will not be allowed. After folding the origami a scalable surface is created that can develop into a flat plane (isometric with a flat surface), and like that; some of the activity of paper binders around the world is related to engineering. Starting with a flat initial piece of paper, its folding allows the design of patterns (flat or non-flat) related to geometry and / or art. The folding action itself involves the flat sheet as a particular mechanism, the small portion of the thickness above the volume of the paper allows it to bend along the fold lines and not stretch the fabric inside the plane. Depending on the application, the mechanical one can attach the flat sheet model to the film without bending stiffness and high tensile stiffness.

However, significant distortions occur along the fold lines that can be considered as axes between groups of individual pieces of paper that have no folds; Much progress in origami leads to flat folded models, although there are three-dimensional models available (Dureisseix, 2012).

2.2.1 Origami development and paper folding

Before World War II there were many folding traditions that may have common roots but in which they develop completely independently. The oldest documented tradition of paper folding is the Japanese tradition in Germany, Friedrich Probel - the founder of the kindergarten, promoted folding exercises in his activities for children. Thus, the first man to create the paper folding design is known as the Adolf Branch painter who created a two-layer model of a horse and rode it in the early 19th century.

The horse and raven model begins at the same folding stages called the windmill base, so that the windmill base itself begins by folding all the corners to the center and back one; this law form is called "Fold Blinz".

In the 1950s, Akira Yoshizawa developed a number of basic new forms and a new technique for creating pieces of origami by wetting paper, called wet folding.

This was accompanied by the invention of a marking system for origami folding sequences plus Yoshizawa arrows, as a result; the system became known as Yoshizawa-RandlettSystem and is the most common form today for transmitting two-dimensional origami instructions. This new marking allows sharing of more complex folding sequences.

By 1964, it already contained instructions marked by Yoshizawa while origami practice and the term spread around the world through printed publications and special interest groups. Only in the 1980s did public awareness of origami rise (Weidner, 2018).

2.2.2 Origami are two main turning points during its development.

The first is the introduction of the common suspension system, and the second is the application of mathematics to what was the traditional art of paper folding so that origami artist Akira Yoshizawin proposed the oldest marking system in 1954. It was further modified by Randelt and Harbin in 1961, and is known as the Yoshizawa system -Randlet is still the official blogging system of the origami community.

Fold lines or geometric patterns within paper such as Florida in a sheet of paper can further define the wrinkle pattern by wrinkles, vertices and face. The fold is the line along which the fold occurs, the vertex is the meeting point of the number of wrinkles and the face is the areas restricted in wrinkles. Head rank is the number of folds closest to the head; the fold is a fold with the angle of fold assigned as a deviation from the drop in the case of a cut between the sheet and a plane perpendicular to the fold (Meloni, Cai, Zhang, & Lee, 2021).

(Lang, 2017) In short, by looking at the paper from the same face of the reference plane always where it stands, two types of folds can be identified: a mountain fold if convex and a valley fold if a cave (angle between 0 degrees and 180 degrees). The Yoshizawa-Randlettnotation system represented mountain folds as ridgelines and valley folds as dashed lines; but for complex patterns.

It has been shown that origami can be applied to solve mathematical problems such as quadratic, cube, quadratic, pentagonal equations with rational coefficients, triangulation and cube multiplication.

Thus, mathematics has been widely applied in the process of designing and optimizing origami structures, it is worth noting that the mathematical models adopted during the previous design process often negate the effect of realistic properties such as capacity or thickness of a given material.

The main two reasons why such characteristics are omitted are firstly; the characteristics are simply unknown at an early stage of the planning process. Secondly: omissions can help expand design options.

Given the construction process, local design changes become necessary to adopt appropriate coupling solutions that match the initial wrinkle pattern. Once applied in a homogeneous material such as paper, origami can be described as compatible mechanisms for achieving movement through elastic deformations of wrinkles or sides. In particular; because they are fabricated into two-dimensional shapes, they can be considered as evolving lamination mechanisms and equal layout mechanisms can also be achieved using rigid panels and rotary hinges (Meloni, Cai, Zhang, & Lee, 2021).

2.3 The effect of origamis on geometry and mathematical concepts

Therefore, it is more used to build three-dimensional geometric shapes, origami can contribute to understanding the concepts of geometry (Wares, 2016).

It enables students to realize concrete mathematical concepts and improve their mathematical ideas.

This way, that the use of origami in education will influence the significant contributions to the

development of children's motor, mental and creative abilities in origami activities in which students participate personally. So that origami can ensure its realization in the senses field (attention and stimulation) and the psychomotor field too (requiring eye and muscle coordination) for the student, as well as in the cognitive realm of learning (MEB, 2018).

It is stated that the use of origami in mathematics teaching would increase student involvement from cognitive, emotional, and psychomotor aspects and so they could learn mathematics more easily. You can clearly see that different geometric shapes are formed even if you fold a piece and open the paper we are dealing with. The folds and knots formed when making the origami represent the different elements (side, corner, edge, surface ...) of the same shape. It allows using origami in teaching geometrical topics; a visual presentation of some concepts, features, and relationships without measurement tools such as a meter, ruler, and spur; because origami also provides visual evidence for purposeful support and conservative learning in teaching mathematical achievement (Omer, 2020).

2.3.1 Symmetry

Symmetry is an important aspect of origami in geometry. For different types of paper, constructions are grouped or classified according to types of symmetry. So that translations, rotations and satisfactions are all connected to each other in symmetry because they are both isometric; so, they become the creation of a number of other identical shapes that preserve space, angle and distance. Thus classifying origami constructions by symmetry is also a way of presenting art from a mathematical point of view and can be easily used in class when symmetrical shapes are sometimes referred to as reflexive symmetry; In addition a line of symmetry on one side that will fit the other side in a similar way.

The origami can be divided by reference to rotational symmetry and thus produce symmetry by rotating clockwise or counterclockwise; in mathematical terms, transition symmetry is the “smoothing” of a shape in any direction, as long as the shape remains the same (Hook & Paul, 2013).

2.3.2 Use of technology

Computers can be used to explore origami at a deeper level, allowing for the creation of complex volumes and numbers that would otherwise not be possible to build. There are many computer programs, such as TreeMaker, that help create complex origami designs using geometric algorithms (Hook & Paul, 2013).

2.3.3 Euclidean geometry

(Ben-Lulu & Ben-Ari, 2020) added that the basic structure of Euclidean geometry is: Angle, copy part line, copy angle, construct perpendicular to line from point A not to line, and construct perpendicular to line from point to line. So that all these can be applied in origami structures; in way that the origami power comes from placing two points on two lines, and it turns out that it allows constructions that cannot be performed using a ruler or a compass, especially constructions that require calculation of the cube roots.

2.4 Origami in Israel

Since 1993, Israeli artist Miri Golan has used origami as a tool for Israeli and Palestinian children to recognize each other as equals.

Golan, founder and director of the Israeli Origami Center, founded Folding Together and oversees its Israeli component, the non-profit organization that brings children from East and West Jerusalem; who would not otherwise meet, together creating origami works (Weiss, 2018).

2.5. Purpose, research question and hypothesis

2.5.1 Research Objective:

The present study was designed to perceive the impact of origami-educational-geometrical interaction on sixth-graders.

2.5.2 Research question:

How does origami develop the geometric cognitive perception for sixth graders?

2.5.3 Research hypothesis:

Origami learning contributes to the development of effective learning and the construction of more conceptual mathematical knowledge than traditional learning.

3. Methodology

3.1 Study Design

The research set-up is a quantitative demonstration.

3.2 Study population

The study population is sixth-grade students from an elementary school in state-Arab education**.**

3.3 Study participants

The participants in the study are 30 sixth-grade students from an elementary school in the northern district of the country from the Arab sector. The research-related questions presented to the students were supervised by the teachers supervising my training in the field of education, and were approved accordingly**.**

3.4 Research tools

- Questionnaire of 10 questions in geometry.
- An educational lesson using origami
- Statistical plot SPSS according to model T.

3.5 The research procedure

- Initially, 10 geometrical questions will be handed out to show students' abilities that are dependent on traditional learning.
- Then students will be taught the origami method.
- Eventually, the questionnaire will be distributed by itself, and the students will solve it, which depends on the origami learning method.
- Accordingly, the scores are entered into the SPSS statistical program according to model T, so that it shows the difference in scores and hence; the difference between traditional learning and origami learning is collected.

3.6 Research variables

3.6.1 Independent variable

• Geometrical studies

3.6.2 Dependent variable

• Origami - Learning by folding paper

3.7 Data Processing and Analysis

The data dependent on the questionnaire were processed and reviewed by the teachers supervising my training as a teacher, which clarifies the questions in the questionnaire, and is therefore approved.

So the results of the questionnaire were analyzed using the parameter "" using the SPSS statistical program, which showed that learning through origami improves higher educational skills more than traditional learning and this, is what the research is based on.

4. Results

In this chapter, the researcher will present the results of the study, as the study included 30 sixth-grade students in an elementary school in the north of the country.

Table 1: Students who participated in the study are presented by gender.

Gender	Students number	Percentages %
Male	14	**46.6%**
Female	16	**53.3%**
Total	30	**100%**

The questionnaire questions are intended to show the possibility of identifying the objects learned in sixth grade on the subject of Objects in terms of knowing the shape, their name, and knowledge of how to create the shape, the difference between the sizes of the geometric shapes ... and so on.
Therefore, the results of the questions were classified in terms of the answer into two possibilities (which are: agree or disagree), expressing the importance of knowledge or lack of knowledge. This is according to the questions presented to the students; the contents of the questions are in the sense that I can, I know, or I agree, and therefore represent the positive aspects of learning.
At the beginning, the first questionnaire was presented: the questionnaire was distributed based on the students' educational knowledge through classroom learning (traditional learning); so the student got to know the models through the supply bag that came with the geometrical book, which contains brushes for the models.
Then, a geometrical lesson is taught based on the art of origami; the questionnaire was then presented to students again to show the difference between traditional learning and origami art.
Thereby, the results showed the following:

Table 2: Explains the importance of educational perception

The statement	average	Standard deviation	minimum	מקסימום
Traditional learning	1.23	0.93168	Agree (1)	Disagree (2)
Learning through the art of origami		0.20423	Disagree (2)	Agree (1)

Table 3: Shows the differences between the levels of imitation learning and the level of origami learning using the results of the questionnaire.

	Learning through the art of origami $N = 30$	**Traditional learning** $N = 30$	$t(29)$
Average	1.86	1.23	-6.652^{**}
SD	0.93168	0.20423	

$^{**}\, p < 0.001$

As a result, the results table shows that the more origami in the teaching process in geometry, the greater the mathematical perception of students, and therefore the origami learning is better than traditional learning.

Therefore, the results indicate support for the hypothesis, since the results showed that:

$\{t\ (-6.652) = , p < 0.001\}$

This shows the differences between the means so that the average level of origami learning (M = 1.86, SD = 0.93168) is higher than the average level of traditional learning (M = 1.23, SD = 0.20423).

Hence the hypothesis was achieved: origami learning contributes to the development of effective learning and the construction of more conceptual mathematical knowledge than traditional learning.

5. Discussion

The discussion in this chapter depends on the results that the researcher has reached in addition to the theoretical material written in the theoretical background and thus his relevance or opposition to the results.

By referring to the results and that a very large percentage of students do not learn mathematical geometry using multiple methods or tangible tools that allow students to relate to analytical perception; in addition to the higher skills presented by the Bloom scale, the results showed that the traditional learning in we use in schools, that is dependent on teaching books. Thus, showing the abstract idea of the student. It was found that the students suffer from a lack of understanding of the content and education. The results showed that 76.66% of the students lack full understanding; (Omer, 2020) stressed that students in the educational environment find it difficult to acquire the skills and achievements that the mathematics curriculum expects of them. This is why many students do not understand the mathematical concepts behind the actions they use when solving a mathematical problem and what mathematics actually mean, and for this reason, students think that learning mathematics is to deal with meaningless formulas and symbols, and trying to learn mathematics through routine learning. As a result, students have difficulty internalizing features of the concepts they have learned and relating them to other concepts.

Thus, the researcher reached at presenting the educational lesson to figures, which depend on the organic figure, by changing the results to 83.33% in favor of organic learning, which represents the importance of learning using several tools and representations in conceptual development of the educational process; which is consistent with the theoretical material. Thus (Teyfur, 2011) confirmed that the appropriate educational materials will help students embody concepts while learning abstract mathematical concepts by nature, by creating effective learning environments through appropriate tools and activities.

This way it is easier to achieve the objectives of the curriculum. Subsequently, manual activities in learning environments for different materials allow students to explicitly examine previously discovered concepts for their ideas, explore some new features of ideas, discuss and present their own meaningful information, enabling students to achieve more and more memorable learning by providing concrete learning outcomes (Bozkurt & Polat, 2011). It helps students realize the basic characteristics of the idea and improve their imagination and scientific ideas (MEB, 2018).

So that it will be used more for building your own three-dimensional geometric shapes, which origami contributes to the understanding of geometrical concepts (Wares, 2016) so as to teach a class in sixth grade using figures that express three-dimensional objects; This origami provided visual evidence for purposeful support and conservative learning in teaching mathematics, in agreement with (Omer, 2020).

Validity and reliability

The means of validity and reliability required for the quantitative research method were taken in this study, since it covered an area of sixth grade students from an extensive area from the elementary school State-Arab for education (15 different areas). It also contained male and female students and students from different sectors.

Thirty students from 15 schools that are located in different areas were selected by simple random sampling for research.

It was also ensured that the students participating answered any question regardless of their current achievement level in order to achieve internal validity during the data collection application.

It should be noted that the questionnaire was reviewed based on comments from professionals.

In addition, for the purpose of external validity, the findings were presented in accordance with the research question.

6. Summary

The traditional learning that results from studying the book and its results are nothing but abstract concepts that the student does not understand. They contribute to his despair and isolation from an attractive learning and represent the educational process of the passive teacher who wants to complete the educational curriculum. Thus, this method affects the student negatively, contributes to delay in the process of thinking and intellectual development and does not contribute to the achieving goals of the Bloom scale goals in educational skills, and therefore it represents the lower skills of Bloom scale, which depends on purely pictorial understanding.

On that account, teachers must treat education with everything new. Origami is not considered a new subject, as it has been discovered since ancient times. However, the teaching process in schools in Israel through origami is a modern educational method that rests on its goals on the higher concepts and skills on the Bloom scale.

This enables students to realize concrete mathematical concepts and improve their mathematical

thinking and ideas. so that the use of origami in mathematics and geometrical education in general has an impact on significant contributions to children's motor, mental and creative abilities in origami activities in which students personally participate, and psychomotor (which requires eye-muscle coordination) as well as in the field of cognitive learning.

Thus, the use of origami in mathematics teaching increases student participation from the cognitive, emotional and psychomotor aspects, and thereby they can learn mathematics more easily, products when making origami representing the various elements (side, corner, corner, edge, surface ...) in the same way.

These imagine some concepts, features and relationships without measuring tools such as abacus, ruler and catalyst, so this origami also provides visual evidence for purposeful support and conservative learning in teaching mathematics, especially geometry.

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8. Appendices

8.1 Appendix 1: The Student Questionnaire

Dear Student: Answer the questions according to your knowledge of geometrics in the subjects you have studied.

By placing a circle on the answer that seems right to you.

Questions	I agree	I disagree
1. I love the geometry subject.	(1)	(2)
2. I participate in educational events in geometry.	(1)	(2)
3. I can identify objects by their different names.	(1)	(2)
4. I can classify geometric shapes by: surface, angles, polygon...	(1)	(2)
5. I can distinguish between polyhedrons.	(1)	(2)
6. I draw three-dimensional models.	(1)	(2)
7. I call the stereotype according to the rule.	(1)	(2)
8. I can distinguish between the triple pyramid, the square pyramid, the pentagonal pyramid ...	(1)	(2)
9. I can distinguish between a cube and a box.	(1)	(2)
10. I built a three-dimensional model.	(1)	(2)

Definitions of Ratio And Proportionality Terms And Their Relationship To Cognitive And Meta-Cognitive Orientation In The Proportional Thinking Of Preparatory Level Students

Abstract:

The subject of the research was selected by the researcher's experience in mathematics teaching and by the fact that research continued with many mathematics teachers in finding that students had to be aware of proportion and proportionality. The researcher worked on a form showing the extent to which students in junior high were able to recognize the definitions of ratio and proportionality terms and their relationship to cognitive and above-cognitive attitudes in the proportional thinking of elementary level students. (Torre, 2013) indicated that most students must graduate from school knowing relative thinking. Therefore, students must be able to distinguish between proportional and non-proportional attitudes and use the appropriate method for each situation. (Misnasanti, Suwanto, 2017) noticed that the existence of gaps nowadays in identifying those elements directly is related to the ability to use ratios. Thus, applying relative logic is more complex than often thought and the way the concept of conceived relative thinking is more complicated.

In this research, I will expand the idea through a form that answers the following question: What are the advantages of definitions of ratio and probability terms that are appropriate and what is their relationship to cognitive and above-cognitive trends in student proportional thinking? The results were there was moderate degree among all students in the proficiency of definitions of ratio and proportionality terms and their relation to cognitive and above-cognitive orientation in proportional thinking in students at the preparatory level.
As for verbal math questions and proportional representation of fracture, ninth grade students have the ability to solve those questions more than others do.
Finding the missing number requires higher skill ability, which was beyond seventh and eighth grade levels, so we found that ninth grad students had the ability to solve problems.
With regard to meta-cognitive exercises, ninth grade students had the ability to master them more than others because these kinds of questions need to be worked out by students with some effort.

Keywords:
Ratio, proportionality, cognitive orientation, meta-cognitive orientation, proportional thinking.

Introduction:

The problem of the study is revealed through the gaps nowadays that identify those elements in addition to the ability to use ratios and apply relative logic. This sounds more complicated than often thought because of the way in which the concept of relative thinking is indirectly implied by the tasks that have been included in relevant research and in mathematical textbooks. We can assume that relative logic is traditionally synonymous with the ability to solve the appropriate lost value (Misnasanti, Suwanto, 2017). This ability is the key element that justifies the inclusion of an aspect of analog thinking in the interpretation of relative logic, from very early on the existence of a relationship between ratios and measurements by indicating that the ratio is a special case of

measurement. In fact, both ratios and measurements require students to think about relationships (Refaie, 2017).

The subject of ratios and proportionality is an important central area in mathematics education and learning. The aim is to give students the concepts, generalizations, skills and means of thinking about the subject of proportion and proportionality, and to address and apply them in all other courses, whether on mathematics or on physics, geography, technology, etc., which makes it necessary for daily life. The proportions were widely used to solve the problems of everyday life (Refaie, 2017). Therefore, in mathematics and science, if relative logic is not understood conceptually and algorithmically, it becomes difficult to transmit and use it in everyday life. Therefore, relative thinking plays an important role in student mathematical development because it forms the backbone of mathematics curricula and includes important and interrelated ideas such as multiplication, division, fractions, decimal fractions, ratios, percentages and linear functions. It takes time, a variety of situations and opportunities to build their understanding in multiple ways. (Classroom Educator, 2012)

The ratio (Atabas, 2013) is a comparison of two quantities while the rate is a comparison of two quantities with the opposite measures. For example of this is a ratio of 3 girls to 4 boys, and a rate of 4 miles in 5 hours. Even with the distinction between ratio and rate, there is no agreement to call the same idea a common term.

Proportionality is a description between two quantities. These are problem solving and calculation activities in areas that include scope, probability, percent, rate, trigonometry, equivalence, measurement, and flying shape engineering (Misnasanti, Suwanto, 2017).

Cognitive orientation is a set of higher skills that manage thought activities when an individual is involved in a situation of solving a problem or making a decision (Kahil, 2015).

Proportional thinking (J, 2013) means "a form of mathematical thinking that is related to the concepts of ratio and proportionality (the notion of ratio and proportionality, peripheral proportionality and inverse proportionality, proportional division) and their applications in mathematics, other sciences and working life."

Research was chosen to examine the relationships between a definition of ratio terms and their proportionality and their relationship to cognitive orientations in student proportional thinking.

Student assistance is important because students consider it very difficult, and it is the basis for a wide range of mathematical concepts. Students find it difficult to understand ratios and proportionality because of their previous lack of understanding that extends to later years and the ability to recognize multiple comparisons and relationships between quantities, so there are difficulties for students in this subject.

In order to achieve the research objectives, a test is held to recognize the strategies of how students deal with problem relativity. The test consists of a set of questions and was intended to obtain information about the students' previous knowledge, and their strategies for solving the relative problem (Lukito, Nasument, 2015).

A set of hypotheses has been formulated:

The concept of proportion and proportionality.

- Strategies for metacognition issues defined in proportion.
- Comparison of ratios.
- Finding the missing dimension in verbal matters.
- Determining proportionality.
- Proportional representation as fractions.

• Finding the missing dimension.
• Recognition of the notion of ratio in verbal matters.
• Metacognition proportion.

Theoretical background:

1) The concept of ratio and proportionality

The concept of ratio and proportionality is the relationship between two measured amounts, which are said to be proportional if the change is related to the change of one another by a fixed ratio. Two discounted amounts are proportional when the increase of one by a fixed ratio or number is related to the increase of the other by a fixed ratio or number. The two amounts are inversely proportional when the increase is related to the decrease of the other by a fixed ratio or number. The ratio being the comparison of two numbers or a fixed number. (Misnasanti, Suwanto, 2017).

2) Concept and types of thinking

Thinking is a set of mental processes that represent the imagination, the imaginary image, the understanding, the reflection on ideas and decision-making. It is a series of invisible and intangible mental activities that are relevant to the brain, in which the brain, when exposed to the excitement of what is received from one of the senses, or more of the sensations. The result of thinking represents the sum of the forms and processes of mind performed by the mind. (Refaie, 2017).

Mathematical thinking is a mental activity in mathematics. It comprises the following nine methods: extrapolation, extrapolation, generalization, formality, mathematical proof, symbol expression, visual perception, relational thinking, probabilistic thinking, when confronted with a problematic situation for which a solution is sought (Cetin & Ertekin, 2011).

Mathematical thinking also involves different types of thinking, which vary depending on the mathematical theme .There is algebraic, probabilistic, statistical, geometric, proportional and many others. These types may overlap; requiring learners to be able to practice mathematical thinking of different kinds, especially since the interdependence of its subjects, the dependence of each on others, and the relevance of many of its subjects characterize mathematics to the reality of living life (Makdadi, 2017).

Proportional thinking is a way of thinking. It involves feeling and sense of quantitative relationships, comparison of proportions and fragmentation of information stored and needed for each context. It also represents the ability to understand, translate and solve issues associated with different proportional situations using beat, and relative and comparative thinking (classroom Educator, 2012).

A study of Makdadi (2017) showed a sample of 523 Female students from the scientific and literary secondary schools of the State Schools of Education and Education Departments of Luwayi Al-Tawayyah and Al-Mu'ayyah and Bani Abid Brigade, if at all. Of the female students, 25.05% were classified at first proportional levels of thinking. (Very low) (60.04%) Female students rated at first proportional levels of thinking (Weak), (14.53%) Female students rated at First Proportional Thinking Levels (average), (0.38%) of female students were classified in the first (empowered) levels of proportional thinking. The level of proportional thinking of female students is concentrated in the second (weak) level.

Jarradat (2013) conducted a study of the first secondary students in Saudi Arabia to uncover the relationship between the level of proportional thinking and the level of probabilistic thinking of the students. The results revealed a statistically significant relationship between the ability to think proportional and the ability to think probabilistic to students.

3) **Proportional thinking components**:

1.Relative thinking:

It's based on understanding the relationships between the different factors in the situations or problem facing the individual and the mathematical issue that has a number of elements. if the pupil is properly aware of the relationship between them, it leads him to the right solution (Refaie, 2017).

2.Units and unitizing:

It represents the concepts and representation of numbers and numbers systems (including conversion between numbers), including the properties of integer numbers and relative numbers, and the relevant aspects of non-proportional numbers, as well as quantities and units that refer to phenomena such as time and money, weight, temperature, distance, area, size and derivative quantities and their numerical description (Mclntosh, 2013).

3.Partitioning:

This part of represents the student's process of deconstructing the parts so that these parts together represent the whole. This is shown by the combination of fractures so that all fractures represent an integer number. The division lies at the heart of the understanding of the relative number, as students divide a whole number into a number of equal parts (Refaie, 2017).

4.Attending to quantities and change:

Quantity is the most widespread and important mathematical aspect so that we can participate in and interact with our world. This concept includes quantifying the characteristics of objects, relationships, attitudes and entities in the world, understanding the different representations of such quantities, and judging quantitative interpretations and proofs. The link to the quantification of the world includes an understanding of benchmarks, numbers, amounts, units, indicators, relative size, trends and digital patterns.

5.Ratio sense:

Students skilled in mathematics are able to make sense of proportion and unit rates in the context of real-world attitudes, and persevere when choosing and using appropriate representations of given contexts. The development of a percentage of students requires attention to fractional representations as a means of arranging and equalizing ratios in the context of content that illustrates the use of ratios. There are four types of ratios that are important in solving proportional problems: Part, Whole part, associated groups, and well-known metrics. Students always need to make sure that they describe relationships more than just processing sets of numbers (Refaie, 2017).

6.Rational numbers interpretations:

Relative numbers are numbers that are found in the form of a two-digit ratio. The relative number is a fraction consisting of a commutation. To illustrate the comparison between the relative numbers and how the relative numbers are arranged by explaining the comparative lesson of the relative numbers and their order, the student must know the mechanism of dealing with the relative numbers correctly, where many arithmetic processes can be done on the relative numbers (Ortiz 2015).

4) Levels of proportional thinking:

(Ortiz, 2015) states that there are four levels of proportional thinking:

a. Below level one: This level depends on guesses and the use of sight to estimate certain things. This level of thinking is so disproportionate that the connection between the two amounts is not accurate.

b. Level one: This level is More comprehensive than the above. It depends on the dimension of the images and the strategies through which the sense of situations that are related to

comparisons is relied upon. This level of thinking is indicative but not formal in proportional situations.

c. Level two: Inference depends on many skills from equidistant breakdowns, metrics and strategies that express the relative aspect. At this level the inference is quantum.

d. Level 3: At this level, the arithmetic operations of a multiplication and division are used in order to reach the appropriate proportionality that expresses the relations which bind equal fractions.

5) Teacher's role in teaching proportion and proportionality:

To help students develop their thinking, they need educational opportunities and expertise to develop their conceptual knowledge of proportionality. So, they are able to distinguish situations that require proportional reflection. The role of the teacher in the development of a series of tasks is highlighted during the curriculum for the development of student capacity. There is a set of requirements for the teacher to perform while teaching students the subject of proportion and proportionality. For example, linking the difference between fracture units and rate units, students are strengthened in order to increase their motivation to extract proportions and create proportional relationships (Hitton et al., 2013).

6) Cognitive Trends in Proportional Thinking

Proportional thinking is a concept and skill that plays a role in many of the mathematical subjects studied by the student. It is not just a conserved procedure or algorithm that is applied, it includes a conceptual understanding of proportional relationships. Proportional thinking requires a genuine understanding of the concepts of ratio and proportionality, and requires the ability to use concepts appropriately to solve and evaluate different situations of issues. It needs a higher thinking skills and the ability to distinguish between summation and multiplication comparisons. Proportional thinking also distinguishes between peripheral and reverse proportionality. With proportional thinking, students need to develop strategies, do high-level cognitive tasks to have the abilities beyond the perceived cognition to observe and judge the reliability of their thinking without direct instructions. (Putarek, 2019).

Research method

Research question: What are the advantages of ratio definitions and what are their relation to cognitive metacognitive trends in student proportional thinking?

Research method

Quantitative method is used in this research. Ratio is tracked and adapted to the cognitive and metacognitive orientation of students through forms that are distributed to students at the junior high level. Results recognize the stages of relative thinking in a clear and understandable way.

The research form consisted of an article examining ratio terms and their relevance to cognitive and meta-cognitive orientations. It discussed levels of proportional thinking. The form has 9 questions in ratio which cover all levels of thinking.

The form is modified to suit the students. The form tested the relevance and motivation of each student.

1	Define the concept of ratio and proportionality	Cognitive examination
2	A 9-year-old's boy is 1.23 meters tall. How tall would the boy be at the age of 18?	Metacognitive exercise

3	In eighth grade 15 boys and 10 girls * What is the ratio between boys and girls? *What is the ratio between the number of boys and the number of all class students?	Comparison of ratios
4	In a dairy factory, you need 10 liters of milk to produce 2 kg of butter. How many liters of milk you need to produce 6 kg of butter?	Do verbal math exercise
5	In a building, the fire system controls 9 out of 10 fires. How many fires can the system control if there are 20 fire? A: 9 B:10 C:18 D:20	Comparative excersises
6	Write (T) in front of the correct proportion: 2/5, 4/5 ( ) 1/3, 3/6 ( ) 3:2 , 9:6 ( )	proportional representation of fraction
7	(2,4,16) ------- (6:3·8) (1,3,6) ------- (6:4 ·9) (72, 64, 37) ------- (6:36·8)	Identifying numerical similarity
8	A chocolate cake for 3persons needs 120 grams of chocolate, 9 large spoons of cream, 3 eggs, 4 large spoons of coffee, 4 large spoons of sugar. If we want to make a cake for four people instead of three. How much sugar do we need	Identification of the notion of ratio in verbal questions.
9	To paint a 4 cm square image, we need an 8 mm in real one. How much color do we need to paint the magnifying image into a square of a 12 cm of each side?	Metacognitive exercise

Research population and samples:

- Research population: preparatory school in the South that was founded in 1944.
- Research samples: The sample consisted of 55 students from lower secondary schools in the Arab region. The form was applied to them in the subject of mathematics during the 2021 school year.

Research procedure:

The form was distributed in 2021 to a preparatory school. 55 students from seventh to ninth grades participated in the. The form included 9 questions, which were presented to them as a test. There was enough time for the students to solve the test according to the age group.

Results:

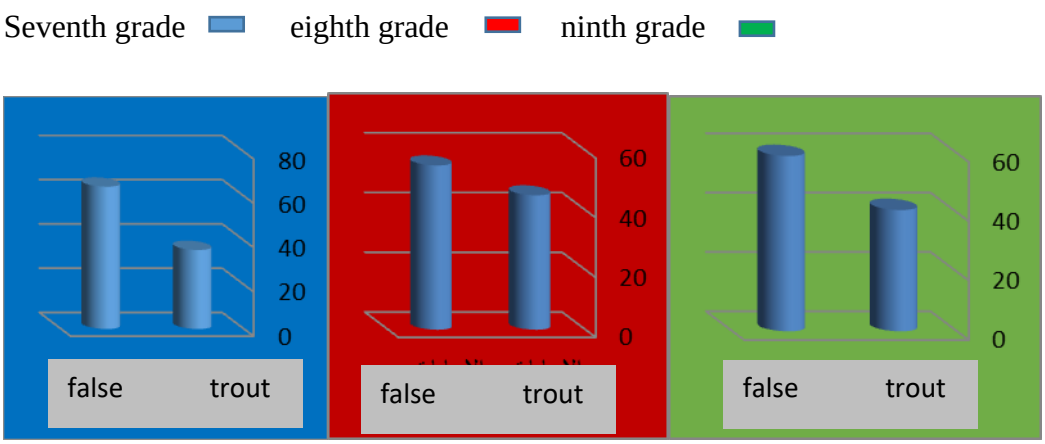
1. Do cognitive and meta-cognitive attitudes in proportional thinking of preparatory students influence the notion of proportion and proportionality.

To answer the previous question, the response ratios were calculated to the question that: Define the concept of proportion and proportionality?

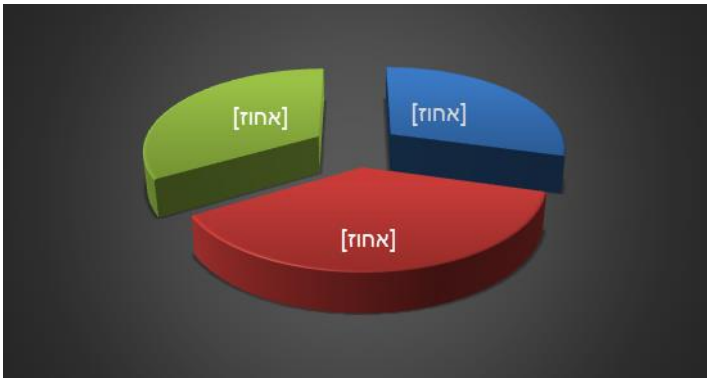
	Seventh grade	
Percentage of the correct answers		35.7%
Arithmetic Averages		0.714
	Eighth grade	
Percentage of the correct answers		45.0 %
Arithmetic Averages		.900
	Ninth grade	
Percentage of the correct answers		40.9%
Arithmetic Averages		0.817

The percentage of the seventh grade answer was 35.7%. The percentage of the eighth grade was 45.0%. The ninth grade percent was 40.9%. The answers of the students varied according to their age. Their perspective on the interpretation of the question varied because the majority of the students knew proportionality incorrectly.

The following is a graph of the answers percentage:



The following chart compares the answers of preparatory level students:



From the above graph, it is clear that the effect of cognitive and meta-cognitive attitudes in proportional thinking of preparatory students on the concept of ratio and proportionality in eighth grade was 37%the highest, while it was 34% for ninth grade and 29% for seventh grade.

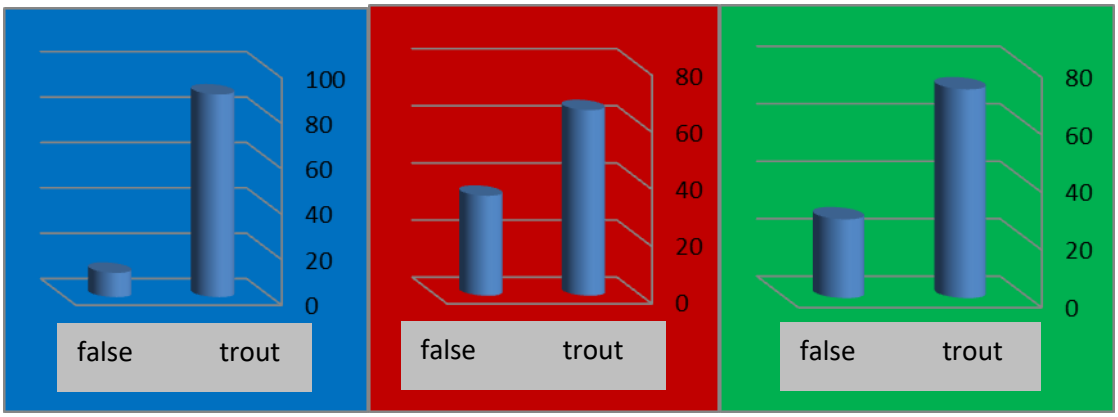
2. Is there is an influence of cognitive and meta-cognitive attitudes in the proportional thinking of students on strategies for solving meta-cognitive issues in proportion?

To answer the previous question, the response ratios were calculated about the question: If the 9-year-old boy is 1.23 meters tall, how tall will be at the age of 18?

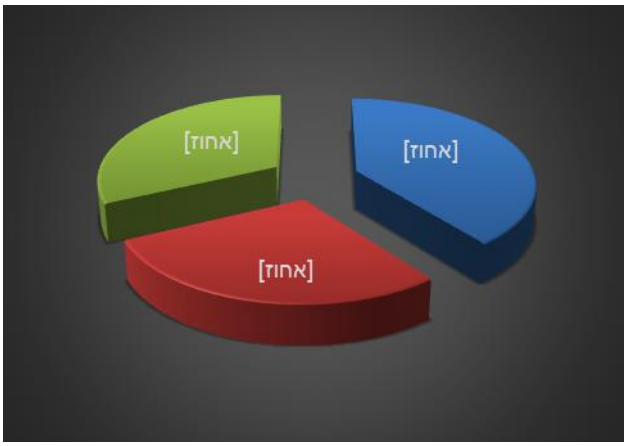
	Seventh grade	
Percentage of the correct answers		89.3%
Arithmetic Averages		1.78
	Eighth grade	
Percentage of the correct answers		65.0%
Arithmetic Averages		1.30

	Ninth grade	
Percentage of the correct answers		72.6%
Arithmetic Averages		1.45

The percentage of students who answered correctly in seventh grade was 89.3%. The percentage of eighth grade students were 65.0% and ninth grade was 72.6%.
The following graph illustrates each class by the correct answers.



The following graph compares the student's answers in the three levels:



The above graph clearly indicates that the influence of cognitive and meta-cognitive attitudes in the proportional thinking of preparatory students of the seventh grade was 39%. The ninth grade was 32% and the eighth grade was 29%.

3. Is there is an influence of cognitive and meta-cognitive attitudes in proportional thinking of students on the comparison of ratios?

To answer the previous question, the ratios have been calculated for the following questions:

- What is the ratio of boys to girls?
- What is the ratio of boys to the whole class?

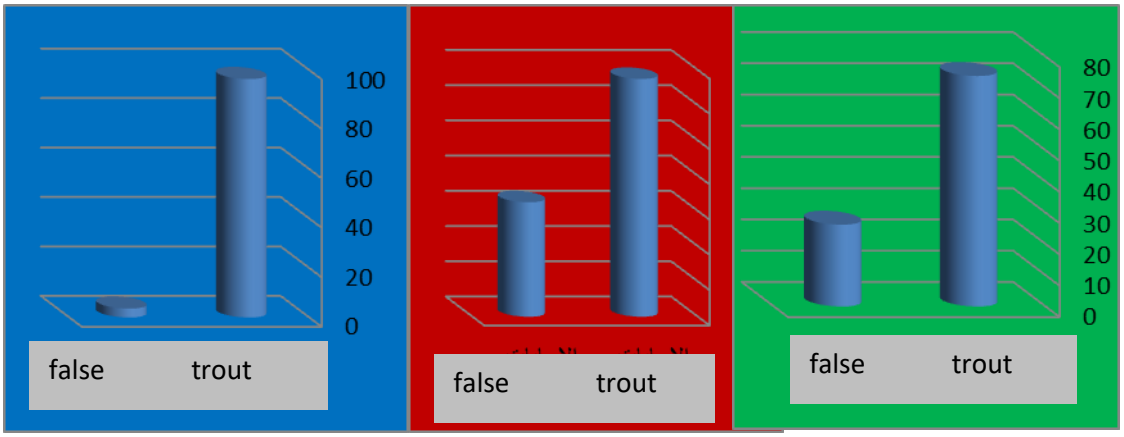
	Seventh grade	
Percentage of the correct answers		96.4%

Arithmetic Averages		1.92
	Eighth grade	
Percentage of the correct answers		67.5%
Arithmetic Averages		1.35
	Ninth grade	
Percentage of the correct answers		37.8%
Arithmetic Averages		1.47

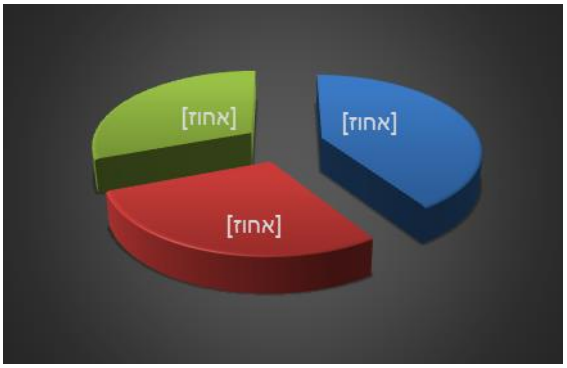
One explanation of the students' answer is misunderstanding of the question. They thought that they should answer according to the class they are in. Some students complained and said it was difficult to answer.

The percentage of correct answers in seventh grade was 96.4%, in ninth grade it was 73.8% and in eighth grade was 67.5%.

The following graph indicates the answers of each class:



The following chart compares student's answers of preparatory level:



The above chart showed the effect of cognitive and meta-cognitive attitudes in relativistic thinking of preparatory students. The seventh grade ratio was 41%, which was the highest, compared with ninth grade (31%) and eighth grade (28%).

4. Is there an influence of cognitive and meta-cognitive attitudes in the proportional thinking of students on finding the missing dimension in verbal matters?

To answer the previous question, the response ratios were calculated to the following question:

In a dairy factory, you need 10 liters of milk to produce 2 kg of butter, so how many liters of milk do you need to produce 6 kg of butter?

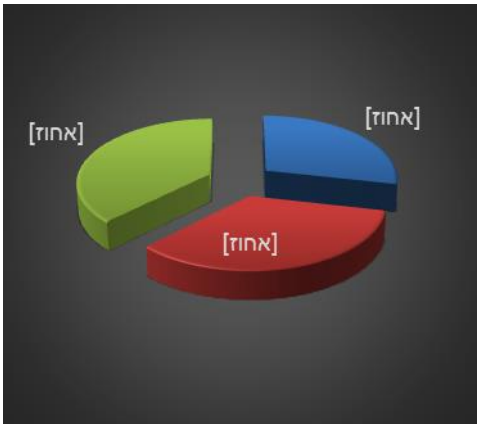
	Seventh grade	

Percentage of the correct answers		60.7%
Arithmetic Averages		1.21
	Eighth grade	
Percentage of the correct answers		72.5%
Arithmetic Averages		1.45
	Ninth grade	
Percentage of the correct answers		80.0%
Arithmetic Averages		1.59

The answers showed that the 7th grade had 60.7 % correct answer. The 8th grade had 72.5 % correct answer and the 9th grade had 80% correct answers.

The following graph shows the correct answers of each class:

The following chart compares the students' answers of each level:



From the above chart, we notice that the effect of cognitive and meta-cognitive trends in proportional thinking of preparatory level students of finding the missing dimension was 38% for the ninth grade, while it was 34% in eighth grade and 28% in the seventh grade.

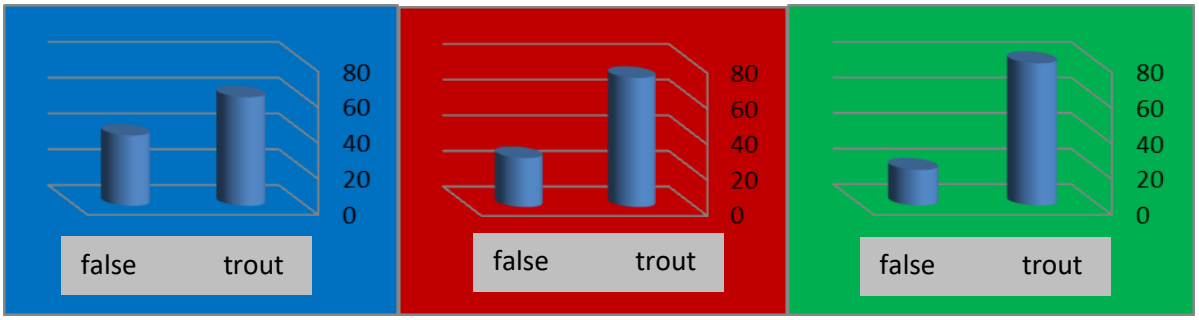
5. Do cognitive and meta-cognitive attitudes in the proportional thinking of students influence the determination of proportionality?

To answer the previous question, the response ratios were calculated to the following question: The fire control system in a house controls nine out of every 10 fires. How many fires can be controlled from the same house of if there are 20 fires?

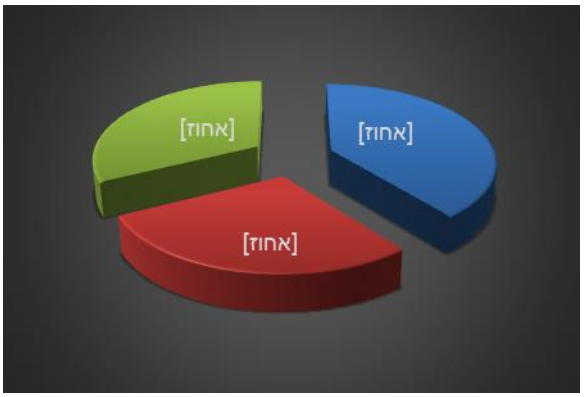
	Seventh grade		
Percentage of the correct answers		100%	
Arithmetic Averages		2.00	
	Eighth grade		
Percentage of the correct answers		72.5	
Arithmetic Averages		1.45	
	Ninth grade		
Percentage of the correct answers		82.4	
Arithmetic Averages		1.64	

Explanations have been given to students with similar examples. This kind of question, which is aimed at determining proportionality, has monitored students' potential in this kind of question. The seventh class percentage of correct answer was 100%, the ninth was 82.4%, and the eighth grade was 72.5%.

The following graph illustrates the correct answers of each class:



The following chart compares the student's answers of each level:



We note from the chart that the effect of cognitive and meta-cognitive attitudes in the proportional thinking of students in the seventh grade was 39%, which is the highest. The next was the ninth grade that was 32%, and finally is the eighth grade, 29%.

6. Do cognitive and meta-cognitive attitudes of proportional thinking have an influence on fractions concept of the preparatory level students?

To answer the above question, students' answers were calculated for the following question:

Write (T) in front of the correct answer:

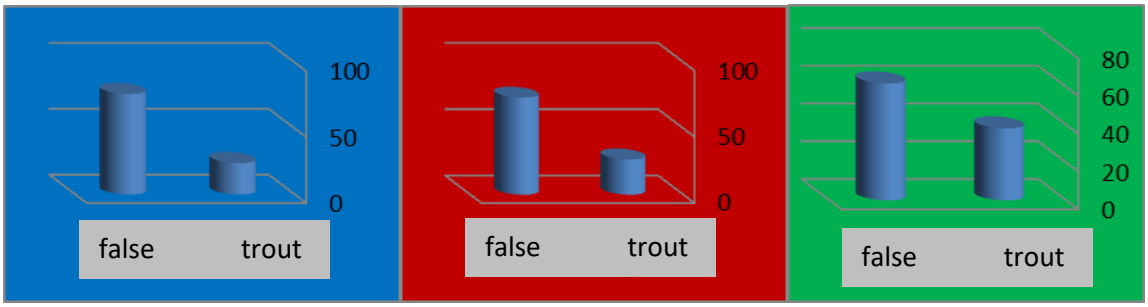
2/5, 4/5 ( )

1/3, 3/6 ( )

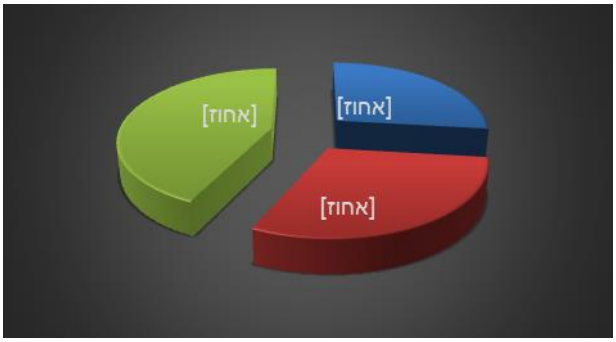
3:2, 9:6 ( )

	Seventh grade	
Percentage of the correct answers		23.8%
Arithmetic Averages		0.71
	Eighth grade	
Percentage of the correct answers		26.7%
Arithmetic Averages		0.8
	Ninth grade	
Percentage of the correct answers		38.1%
Arithmetic Averages		1.14

It is clear that seventh grade had the highest correct answers. The percent was 71%. The ninth grade percent was 38.1%, and the percentage of correct answers for class 9 was 26.7%. That is, the student proficiency to solve questions about fractional representation was problematic.
The following graph illustrates the correct answers of each class:



The following chart compares the student's answers of each level:



We note from the chart that the effect of cognitive and meta-cognitive attitudes in proportional thinking of preparatory level students on proportional representation of fractions in ninth grade was 43%, while 30% for eighth grade and 27% for seventh grade.

7. Do cognitive and meta-cognitive attitudes of proportional thinking have an influence on students concept when answering finding the missing dimension?

To examine the previous question, we calculated the answers of the following question**:**

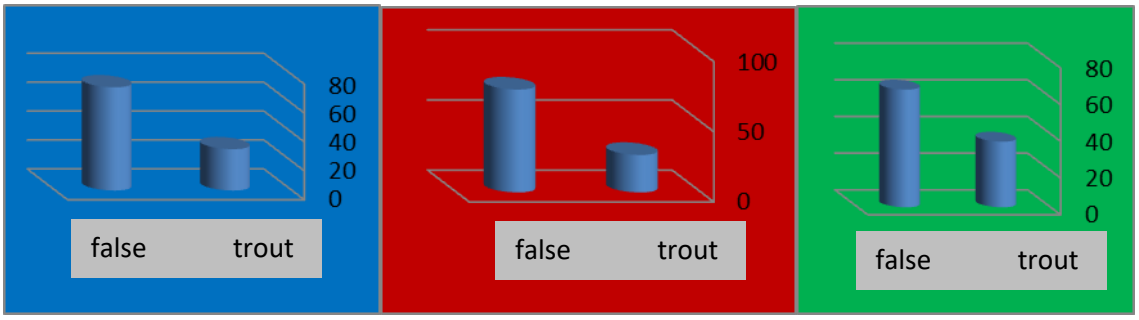
6:3 · 8 _____ (2, 4, 16)
6:4 · 9 _____ (1, 3, 6)
6:36 ·8 _____ (37, 64, 72)

	Seventh grade	
Percentage of the correct answers		28.6%
Arithmetic Averages		0.85
	Eighth grade	
Percentage of the correct		26.7%

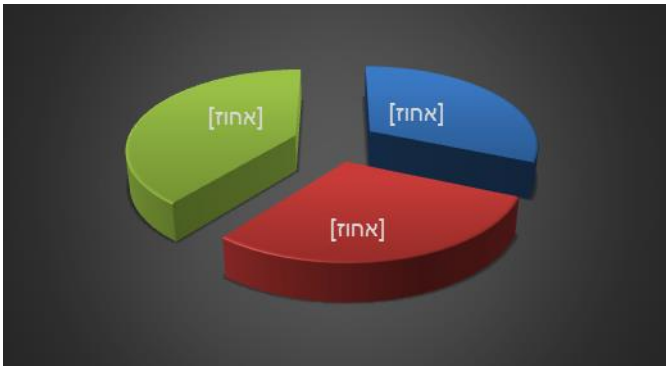
answers		
Arithmetic Averages		0.80
	Ninth grade	
Percentage of the correct answers		35.8%
Arithmetic Averages		1.07

The results as shown above: Ninth grade was 35.8%, seventh grade was 28.6% and eighth grade was 26.7%.

The following graph illustrates the correct answers of each class:



The following chart compares the students answers of each level:



We note from the chart that the effect of cognitive and meta-cognitive attitudes in proportional thinking of students on finding the missing dimension in ninth grade was 39% that is more than the seventh grade 32%. Eighth grade percent is 29%.

8. Do cognitive and meta-cognitive attitudes of the proportional thinking of elementary level students affect the perception of ratio in verbal math questions?

to answer the above question, The ratios response had been calculated to the following question:

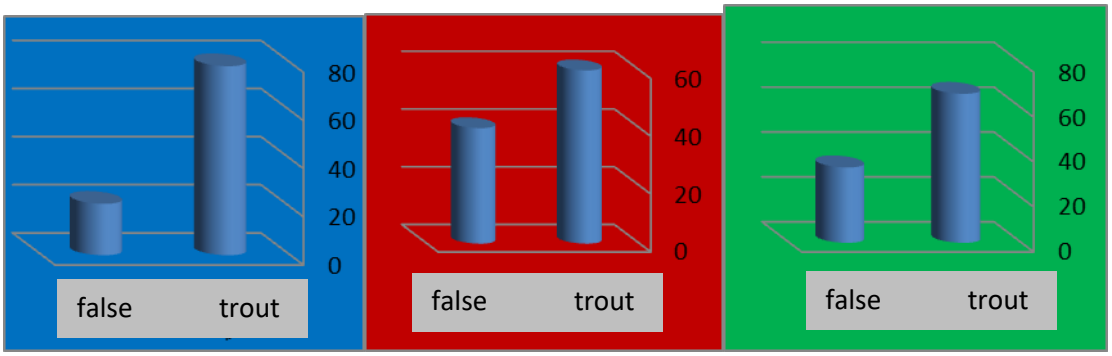
a chocolate cake needs 120 grams of chocolate, 9 large spoons of cream, 3 eggs, 4 large spoons of coffee, and 4 large spoons of sugar for three people . If we want to make a cake for four people

instead of three. How much sugar do we need?

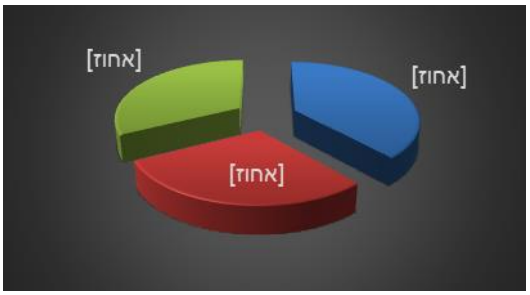
	Seventh grade	
Percentage of the correct answers		78.6%
Arithmetic Averages		1.57
	Eighth grade	
Percentage of the correct answers		60.0%
Arithmetic Averages		1.20
	Ninth grade	
Percentage of the correct answers		66.4%
Arithmetic Averages		1.32

For some students, the proficiency of this type of question in the 7th grade was 78.6% correct, 9th grade was 66.4% and 8th grade was 60%.

The following graph illustrates the correct answers of each class:



The following chart compares the students' answers of each level:



We note from the chart above that the effect of cognitive and meta-cognitive attitudes of proportional thinking of preparatory level students on the perception of ratio in verbal math questions of seventh grade was 38% higher, while 33% was for ninth grade, and 29% was for eighth grade.

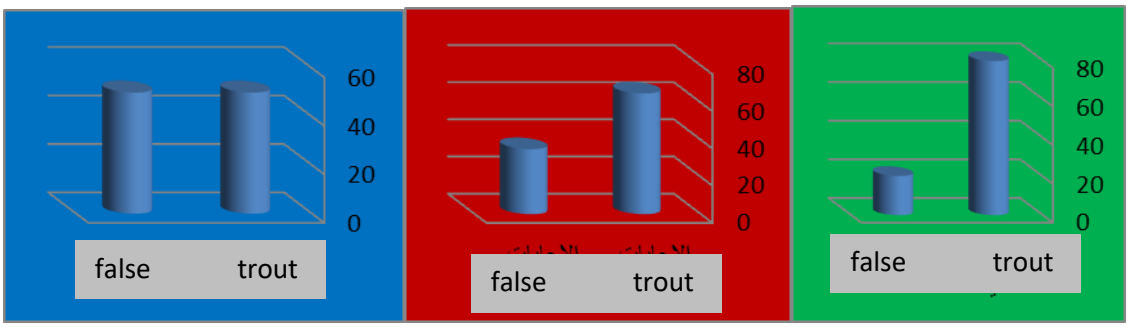
9. Do cognitive and meta-cognitive attitudes of the proportional thinking of elementary students affect meta-cognitive issues in proportion?

To answer the previous question, the ratios responses were calculated to answer the following question: 8 mm is required to paint a 4 cm square image. How much paint do we need to paint the magnified image of a 12 cm square?

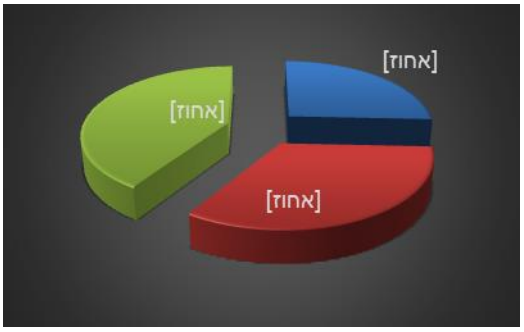
	Seventh grade	
Percentage of the correct answers		50.0%
Arithmetic Averages		1.0
	Eighth grade	
Percentage of the correct answers		65.0%
Arithmetic Averages		1.30
	Ninth grade	
Percentage of the correct answers		79.7%
Arithmetic Averages		1.59

The percentage of students answers of this question of the ninth was 79.7%. The eighth grade answers percent was 65.0%. The seventh grade answers percent was 50.0%.

The following graph illustrates the correct answers of each class:



The following chart compares the students' answers of each level:



We note from the chart that the effect of cognitive and meta-cognitive attitudes of the proportional thinking of students on meta-cognitive issues of the ninth grade was 41%, which is higher than eighth grade 33% and seventh grade 26%.

Discussion

Results of this study indicates that students have good understanding of the concept of proportion and proportionality. There is a convergence of students in the proficiency of that concept, because this subject is taught at various stages at school. Students of 7th, 8th, and 9th grades study the subject of proportion and proportionality and have a moderate understanding of those concepts. This is due to difference in environmental factors and intelligence level of students as well.

The strategies of math problem solving vary from student to another. For example, seventh grade students have the capacity to master these strategies more than other students. This is because seventh grade students have the most motivation towards learning. They can also be controlled and directed towards the strategies used to solve these problems than eighth and ninth graders because they have gone through a higher level of learning.

As comparison of ratios is concerned, seventh grade students have the ability to understand this concept because the lesson is done in a simplified way compared to ninth and eighth grade students.

Regarding the verbal math questions and the proportional representation of fracture, ninth grade students were able to solve the questions more than others. This is because they were able to read and understand the meaning of the questions. On the other hand, concerning the subject of determining descent, seventh grade students have the ability to master it more than other students.

Finding the missing number requires a higher skill capacity that was difficult for grade 7 and grade 8th to answer and easy for 9th grade student. It also revealed that the concept of ratio was more advanced in grade 7th students than others.

With regard to meta-cognitive math exercises, ninth grade students had the ability to master them more than others because these kinds of exercises need to be worked out by students.
Finally, there was a moderate degree for all students of the proficiency of definitions of ratio and proportionality terms and their relation to cognitive and meta-cognitive orientation in the proportional thinking of preparatory level students. The percentage ranged between 55.4% to 63% of all students.
Makdadi study (2017) showed that 25.05% of female students were rated for the first proportional thinking as (Very Low), 60.04% were rated as (Weak), 14.53% were rated as (Intermediate) and 0.38% were rated as (very good).
It is clear that the level of proportional thinking of female students is concentrated in the second level (weak), while a Garadat study (2013) shows a statistically relevant relationship between the ability proportional thinking and the probability thinking.
There is an intermediate degree among all students in the proficiency of definitions of ratio and proportionality terms and their relation to cognitive and meta-cognitive orientation in proportional thinking of students at the preparatory level.
The strategies for resolving math problems vary among students. Seventh grade students had the ability to master those strategies and the concept of ratio.
As for verbal questions and proportional representation of fracture, ninth grade students were able to solve the questions more than others.
Finding missing number and meta-cognitive questions also requires higher skill ability, which was beyond the seventh and eighth grade ability. This is explaining why ninth grade students succeeded in solving the questions easily.
Regarding meta-cognitive exercises, ninth grade students had the ability to master them more than others because these kinds of questions needed more efforts from students.

Recommendations:

From the results, I recommend the following:

- To pay more attention to the development of proportional thinking and to make more research about the levels and development of proportional thinking in different categories of students.
- Teachers should provide an appropriate classroom environment that allows students to exchange views and encourages them to have the right answers by understanding of proportionality subject. Answers should be discussed logically.
- To develop students' levels of proportional thinking and suggest special training programs that contribute to the development of those levels.

Appendix

A. Math test on ratios and proportions:

1. Define the concept of proportion and proportion?
   Answer: ----------

2. If a 9-year-old is 1.23 meters tall, his 18th birthday will be his height?
   Answer: ----------

3. In the eighth grade, 15 boys and 10 girls:

i. What is the ratio between the numbers of boys to the number of girls?

Answer: ----------

ii. What is the ratio between the number of children to the number of all students in the class?

Answer: ----------

4. In a dairy factory, it takes 10 liters of milk to produce 2 kg of butter

How many liters of milk itself would you need to produce 6 kg of butter?

Answer: ----------

5. The fire control system in a building controls 9 out of 10 fires, the number of fires that can be controlled from the house of 20 fires in the same system is:

a. 9
b. 10
c. 18
d. 20

6. Put a circle in front of the two ratios that represent the proportion

a. 2/5, 4/5
b. 1/3, 3/6
c. 9:6, 3:2

7. Calculate the following:

a. 6:3 x 8
b. 6:4 x 9
c. 6:36 x 8

8. Description of Chocolate Cake for Three Persons 120 grams of chocolate, 9 tablespoons of cream, 3 eggs, 4 tablespoons of coffee, 4 tablespoons of sugar. If we wanted to make a cake for four people instead of three. How much sugar do we need?

Answer: ----------

9. 8 mm is required to paint a 4 cm square picture, how much color do we need to paint the enlarged image into a square with a side of 12 cm?

Answer: ----------

B. Statistical analysis:

I. Right versus wrong questions at every grade

	Seventh grade		Eighth grade		Ninth grade	
question 1						
	Correct answers	35.7	Correct answers	45	correct answers	40.9

	Wrong answers	64.3	Wrong answers	55	wrong answers	59.1
question 2						
	Correct answers	89.3	Correct answers	65	correct answers	72.6
	Wrong answers	10.7	Wrong answers	35	wrong answers	27.4
question 3						
	Correct answers	96.4	Correct answers	67.5	correct answers	73.8
	Wrong answers	3.6	Wrong answers	32.5	wrong answers	26.2
question 4						
	Correct answers	60.7	Correct answers	72.5	correct answers	80
	Wrong answers	39.3	Wrong answers	27.5	wrong answers	20
question 5						
	Correct answers	100	Correct answers	72.5	correct answers	82.4
	Wrong answers	0	Wrong answers	27.5	wrong answers	17.6
question 6						
	Correct	23.8	Correct	26.7	correct	38.1

	answers		answers		answers	
	Wrong answers	76.2	Wrong answers	73.3	wrong answers	61.9
question 7						
	Correct answers	28.6	Correct answers	26.7	correct answers	35.8
	Wrong answers	71.4	Wrong answers	73.3	wrong answers	64.2
question 8						
	Correct answers	78.6	Correct answers	60	correct answers	66.4
	Wrong answers	21.4	Wrong answers	40	wrong answers	33.6
question 9						
	Correct answers	50	Correct answers	65	correct answers	79.7
	Wrong answers	50	Wrong answers	35	wrong answers	20.3

II. Percentage of right versus wrong questions to all grade:

	q1	q2	q3	q4	q5	q6	q7	q8	q9	Final mark	
arithmetic average	0.714286	1.785714	1.928571	1.214286	2	0.714286	0.857143	1.571429	1	11.78571	Seventh grade

Ratio	35.7%	89.3%	96.4%	60.7%	100.0 %	23.8%	28.6%	78.6%	50.0%	58.9%	62.2 %
arithmetic average	0.9	1.3	1.35	1.45	1.45	0.8	0.8	1.2	1.3	10.55	Eighth grade
Ratio	45.0%	65.0%	67.5%	72.5%	72.5%	26.7%	26.7%	60.0%	65.0%	52.8%	55.4 %
arithmetic average	0.817857	1.451 19	1.476 786	1.599 405	1.647 024	1.144 444	1.073 016	1.328 571	1.594 048	12.02 565	Ninth grade

III. The average and percentages in 7th grade:

	q1	q2	q3	q4	q5	q6	q7	q8	q9	sum	
Pupil 1	2	2	2	2	2	3	3	2	2	20	7th
Pupil 2	1	2	2	1	2	0	0	2	2	12	7th
Pupil 3	1	2	2	1	2	0	0	2	0	10	7th
Pupil 4	2	2	2	2	2	2	3	2	2	19	7th
Pupil 5	1	1	2	1	2	2	1	2	2	14	7th
Pupil 6	0	2	2	1	2	0	0	2	0	9	7th
Pupil 7	1	2	2	2	2	2	3	2	2	18	7th
Pupil 8	0	2	2	1	2	0	0	2	0	9	7th
Pupil 9	0	2	2	1	2	0	0	0	0	7	7th
Pupil 10	2	1	2	2	2	2	3	2	2	18	7th
Pupil 11	0	2	2	1	2	0	0	2	0	9	7th
Pupil 12	0	2	2	1	2	0	0	0	0	7	7th
Pupil 13	1	2	2	1	2	2	1	2	2	15	7th
Pupil 14	0	1	1	1	2	0	0	0	0	5	7th
Pupil 15	1	2	2	1	2	0	1	2	2	13	7th
Average	0.714286	1.785714	1.928571	1.214286	2	0.714286	0.857143	1.571429	1	11.78571	7th
Ratio	35.7%	89.3%	96.4%	60.7%	100.0%	23.8%	28.6%	78.6%	50.0%	58.9%	62.2%

IV. The average and percentages in 8th grade

	q1	q2	q3	q4	q5	q6	q7	q8	q9	sum	
Pupil 1	2	2	2	2	2	3	3	2	2	20	8th
Pupil 2	2	2	2	2	2	2	3	2	2	19	8th
Pupil 3	2	2	2	2	2	2	2	2	2	18	8th
Pupil 4	2	2	2	2	2	1	1	2	2	16	8th
Pupil 5	0	1	1	2	1	0	0	1	2	8	8th
Pupil 6	0	1	1	1	1	0	0	1	1	6	8th
Pupil 7	1	2	2	2	2	1	0	2	2	14	8th
Pupil 8	0	1	1	1	1	0	0	0	1	5	8th
Pupil 9	1	2	2	2	2	1	1	2	2	15	8th
Pupil 10	0	1	1	1	1	0	0	0	0	4	8th
Pupil 11	0	0	0	1	1	0	0	0	0	2	8th
Pupil 12	1	2	2	2	2	0	0	2	2	13	8th
Pupil 13	1	2	2	2	2	1	1	2	2	15	8th
Pupil 14	0	0	1	1	1	0	0	0	0	3	8th
Pupil 15	0	0	0	0	1	0	0	0	0	1	8th
Pupil 16	2	2	2	2	2	2	3	2	2	19	8th
Pupil 17	0	0	0	0	0	0	0	0	0	0	8th
Pupil 18	2	2	2	2	2	1	1	2	2	16	8th
Pupil 19	0	0	0	0	0	0	0	0	0	0	8th
Pupil 20	2	2	2	2	2	2	1	2	2	17	8th
Average	0.9	1.3	1.35	1.45	1.45	0.8	0.8	1.2	1.3	10.55	8th
Ratio	45.0%	65.0%	67.5%	72.5%	72.5%	26.7%	26.7%	60.0%	65.0%	52.8%	55.4%

V. The average and percentages in 9th grade:

	q1	q2	q3	q4	q5	q6	q7	q8	q9	sum	
Pupil 1	2	2	2	2	2	2	2	2	2	16	9th
Pupil 2	1	2	2	2	2	2	1	2	2	16	9th
Pupil 3	1	2	2	2	2	1	1	2	2	15	9th
Pupil 4	1	2	2	2	2	2	2	2	2	17	9th
Pupil 5	1	2	2	2	2	2	1	2	2	16	9th
Pupil 6	0	2	2	2	2	1	1	1	2	13	9th
Pupil 7	0	1	1	2	2	1	1	1	2	11	9th
Pupil 8	2	2	2	2	2	3	3	2	2	20	9th
Pupil 9	0	1	1	2	2	1	1	1	2	11	9th
Pupil 10	1	2	2	2	2	1	1	1	2	14	9th
Pupil 11	0	0	0	1	1	0	0	0	0	2	9th
Pupil 12	1	2	2	2	2	2	2	2	2	17	9th
Pupil 13	0	2	2	2	2	1	1	1	2	13	9th
Pupil 14	0	1	1	1	2	1	1	1	2	10	9th
Pupil 15	2	2	2	2	2	3	3	2	2	20	9^{th}
Pupil 16	0	1	1	1	2	1	1	1	2	10	9th
Pupil 17	1	2	2	2	2	2	1	2	2	16	9th

Pupil 18	0	1	1	1	1	1	1	1	2	9	9th
Pupil 19	2	2	2	2	2	2	2	2	2	18	9th
Pupil 20	0	1	1	1	1	1	1	1	1	8	9th
Average	0.817857	1.45119	1.476786	1.599405	1.647024	1.144444	1.073016	1.328571	1.594048	12.02565	9th
Ratio	40.9%	72.6%	73.8%	80.0%	82.4%	38.1%	35.8%	66.4%	79.7%	60.1%	63.0%

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The impact of using real life situations in solving linear equations by seventh grade students

Abstract

The purpose of this study was to investigate the impact of using real life situations in solving linear equations for the seventh grade students. Integrated approach (qualitative and quantitative) methods were utilized and 20 average students from seventh grade deliberately participated in this study. Research methods consists of two parts. The first part includes two survey forms that examined the procedural errors of the students' answers, as well as some observations of four activities done by the students. The four activities are adding similar algebraic terms, quantity comparison, and quantity comparison and finding the missing value, and solving linear equations. In the first stage, Form (A) was passed to students and followed by the intervention teaching tools. Then students' reactions and feelings were observed. In the final stage, Form (B) was passed to students and results of the four activities were analyzed. The second part of the research includes two surveys forms that examine the mistakes done by students in solving real life problems as well as some observations of some students who dealt with analyzing real life problems. In the first stage, Form (A) was passed and followed by the intervention teaching tools. Then students' reactions and feelings were observed. In the final stage, Form (A) was passed to students and results of life problems were analyzed.

The results of this study showed that the concept of linear equations developed as the following order: First, the concept of adding and subtracting similar algebraic, then the concept of quantity comparison and finally the concept of equality in linear equations. The results suggested that real- life situations were an important element in understanding math tasks, and moreover, it helped students overcome their mistakes and difficulties and developed conceptual knowledge of math subjects.

The results also indicated that the intervention of teaching tools had a positive impact on the students, who were also able to correct their procedural errors. Results of the t- test indicated that there were statistical differences on form A and form B. In the light of the findings, the researcher recommended an advanced mathematics curriculum for the middle level in light of life skills. He also suggests using technology to broaden student perception and develop imagination in solving linear equations in light of the life situation around us.

Introduction

In algebra, an equation can be defined as a mathematical statement consisting of an equal symbol between two algebraic expressions that have the same value. The algebraic expression on the left is called the left side of the equation and the algebraic expression on the right is called the right side of the equation. The variable in a given equation is a letter that represents an unknown numerical value that we want to find. Solving the equation is a set of all the numbers you place (instead of unknown) in the equation creates correct solving. that is, the value of the expression on the left side is equal to the value of the expression on the right side. Algebraic equations in general and linear equations in particular are considered gatekeepers between school mathematics, higher education, employment, and a subject that breaks the boundaries between concrete and extrapolative mathematics as mathematics is considered abstract and deductive subject. (Knuth,Mcneil Alibali,Stephens;2007).

Algebraic expressions and learning the procedures on which they operate is very important in the field of math. Lately, there are more and more voices that claim to go far in this field. Instead of focusing on skills and treatments performed on algebraic expressions, one should focus on attitudes, which will stimulate the need to deal with them, and give context and meaning to learning the necessary mathematical skills. For example, finding the legitimacy and generalization of structures, using mathematical models to represent and understand quantitative relationships, and searching for the changing phenomena in different contexts. There are also claims to focus on mathematical processes in learning, for example: Thinking, forming hypotheses, doing research, linking different representations of mathematical concepts, formulating mathematical discourse, and choosing appropriate tools, etc. ((Alibali,2007). In traditional curriculum, algebraic equations are presented very quickly, and the result is that equations are solved without understanding the symbols. During learning process, time must be taken into consideration to develop the concept of equations and There is a need to link them to life issues and to the cognitive skills particularly in learning linear equation. linear equation requires Comparison, naming quantities, quantity measures and use of related symbols. Comparison involves the perception of some concepts like; big-small, one thing - many things, a few - many, more – less. Naming quantities includes knowing the names of numbers in order. Quantity measures includes matching the number with its symbol and matching the written symbol with the number of objects. Students learn the concepts of linear equations better when first learning the sense concept, then the semi-sense concept, and finally the concrete concepts all in sequence. This means at the beginning, learning concepts using real things (sense concept). Next, real objects are represented by drawings or symbols (semi-sense concept). At the end, numbers are used instead of drawings or symbols (concrete concepts).

Mathematics is considered one of the most important subjects of study to which life issues are directly related, from the simple processes that students practice in their daily lives, such as selling and buying, to the general life connections they face to the higher processes of problem-solving and decision-making. Therefore, there is an absolute need to concentrate on words problems in math and focus on the conceptual meaning of equations and their relevance to reality. This can encourage students to understand symbols and solve equations. (Faiz Mina 1994 and 64-66).

Many students face problems and difficulties when solving equations with one variable. Therefore, it is very important to know and understand the problems and difficulties that students face when learning equations at once. This understanding may help us to create learning program deals with linear equations with one variable. Thus, the purpose of this work is to study the impact of word problems in solving linear equations with one variable to the seventh students in The Triangle in Israel. (Abdelkader Khalid 2013)

Theoretical Background:

In this chapter, I will review the theoretical background of the study, which includes the theoretical framework of the study and previous studies. the theoretical framework contains linear equations, student difficulties and word problems.

3.1 linear equations

"Equation" is the equal of two algebraic expressions in which one or more variables appear in one of them. As with any equality, the two expressions are separated by the sign "=." A linear equation is an equation in which all variables are of the first degree, i.e. appear without base of a power. A variable is a symbol with a non-constant numerical value. Algebraic expression is a set of variables that have

algebraic processes between them. There are different definitions of first-degree equations that appear in this definition. A first-degree equation has one variable- an equation that appears in one expression is at least one variable equation. This variable is always first -degree and the equation is not considered a high degree equation. (Kramarski, B.2004).

3.2 Student difficulties in solving linear equations:

Solving equations is an essential part of student mathematical task as part of the middle school curriculum. This subject is an important part of algebra studies especially for the teachers of math subjects. Linear equations are of a compositional nature, that is, from the simple to the difficult forms. The results and theories are derived from postulates by taking indicative steps governed by the laws of logic. The difficulties of learning linear equation require looking at the nature of the laws on which this subject is based and lies as symbolic language, so efforts are being made to teach students to solve issues in practical way, regardless students' mental abilities. When studying linear equation, many students have difficulties with word problems. This is because they are unable to translate verbal words into written phrases, which suggest that they may not have understood the meaning of written phrases and verbal phrases. (Abdelkader 2013)

"what's the equation?" (Yerushalmy & Chazan 2008) replied that in the standard learning approach, the equation has many meanings: It can be defined as "any numbers," which is a comparison of algebraic expressions so that if numbers are placed in the place of variables, we get an argument that compares two numbers - sometimes true, sometimes wrong .

3.3 Strategies for Solving Linear Equations

The code system in mathematics allows the mathematician to achieve the level of abstraction required to solve general problems. The use of letters to distinguish variables and teachers is the basis of scientific language. Algebraic equations represent a set of equations of the same algebraic expression, as well as general forms of quantum relations between the two parties. For example, the formula $y = 3x + b$ represents a set of linear functions with the same inclination. The development of the symbol system in mathematics in general and algebra in particular is of great importance. Symbol practice is considered the basis for understanding algebraic analysis and other fields. The development of mathematical symbols that began in algebra revolutionized this field, and today it is impossible to think of mathematics without variables and criteria (Tall, Lima, & Healy, 2014). When solving linear equations and algebraic equations, first students should treat the sign of the equation as an equality between two expressions (Kieran (2006)) and not as instructions for the process (McNeil et al. ،2006 Hattikudur ،McNeil & Stephens ،2007). Second, students should be able to understand and analysis the usage of symbols on which the equations are based (Huntley, Marcus, Kahan & Miller, 2007). Third, students should understand that expressions on either side of an equal sign have the same character, but can act on the variable as an entity rather than a number" (Andrews and Ohman, 2019).

The study of equation solutions is evaluated according to multiple strategies and their relative effectiveness (Little-Johnson & Star, 2007; Star & Seifert،2006).

When a strategy is defined here as a step-by-step problem-solving procedure. First, the main feature of personality is the knowledge of multiple strategies. It refers to recognition and knowledge of more than one solution. Learning about a number of solution strategies allows learning from educational interventions. Second, knowledge of the effectiveness of the strategy is an essential feature of problem-

solving experience and is also a key common mechanism for learning development (Andrews and Öhman, 2019). Mastering multiple strategies and the relative effectiveness of strategies makes it possible to best deal with problems while understanding the field better (Little-Johnson & Star, 2007)

a. Cognitive skills of linear equation learning:

The cognitive skills required to learn mathematics in general and linear equation in particular is the comparison, naming quantities, quantity measures and the use of quantum symbols. For comparison, it involves understanding the concepts of big - small, one thing - many things, few - many, many more - less. Naming quantities includes knowing the names of numbers in order and calculating things. The use of quantum symbols involves linking the number's name to its written symbol, and matching the written symbol to the number of the objects. Measurement of quantities includes the basic concepts of vacuum and fluids (empty-full), weight (light-heavy), length (short-long), time (before-after) and heat (hot-cold).

b. from sensory to abstract:

Students learn the concepts of linear equations in the best way when education is carried out sequentially from the sensory, the semi-sensory, and finally the abstract. that means teaching concepts using real things at first, then real objects are represented by drawings or symbols in the semi-sensory stage. In the final stage, figures are used instead of drawings or symbols.

c. Learning mathematical vocabulary in linear equations:

Students should learn mathematical vocabulary and phrases when solving linear equations.

d. Learning rules:

Learning a linear equation becomes easier if the student knows the basic rules and concepts. For example, the student must know that the equation consists of equality between two linear equations and so on.

e. Training students to learning skills:

Students should also learn to generalize skills into multiple situations. Students are known to experience great difficulties in transmitting the effect of training. Generalization does not occur without effective training. In general, skills generalization training requires an emphasis on:

- Enhancing motivation to learning and help students to master skills
- discussing the importance of learning with students and applying various skills with adequate examples periodically.

f. Development of problem solving skills:

The skill of problem solving must be given priority in teaching concepts and math calculations of linear equation. In general, this requires the teacher to help the student to look for situations similar to the current problem and to use similarities by applying concepts and skills in both conditions.

g. Develop a positive attitude towards linear equation learning

It is worthy to say that students' attitudes, motivation and beliefs regarding mathematics and linear equation learning have a significant impact on their learning. Students often develop negative attitudes and lack of motivation to learn because of past failure experiences. Students' participation in goal-setting, the use of skills analysis and taking into account their past experience are key methods of stimulating motivation and increasing success.

h. Following progress and providing feedback:

Scientific research provides significant evidence of the positive impact of tracking the student's level of progress in learning math concepts and providing immediate and corrective feedback. These methods improve accuracy and learning, leading to the development of student achievement.

i. Provide sufficient opportunities for the student to practice and review:

It is difficult for students to master the concepts and math calculations of the linear equation without providing them with sufficient opportunities to exercise and review. Teachers should diversify the methods and materials used. Teachers can use and apply life activities during education. In her article, Perles, k. 2010, noted several strategies that would provide teachers with opportunities to help students, stating that there are many strategies that we can use to help students who are unable to understand mathematical concepts. For example, we can encourage them to imagine questions and connect them to everyday life. We can also help them integrate what they learn into actual life situations. These strategies can help students to make the concept of linear equation more "real" in their minds. They encourage students to solve problems of the linear equation on graph paper or on the computer, which can help them maintain the correct order of numbers. We must also leave space for students on the working paper or exam to do their math, as well as make sure that the working papers are clear and arranged. In addition, we should teach students ways, strategies, and hints to help them remember information, as well as giving them a preview of the information that will be taught before teaching process starts. This will help students prepare psychologically for the information that will be learned.

Ama Spector (Ireland, 2007) indicated that the strategies were similar to that of Pearls. She noted that we should avoid moving the student on higher-level tasks before the easiest levels were fully understood. We should give him clear guidance and support when exercising a strategy. In addition, we should encourage him to discuss and explain to support the development of thinking in mathematics, and display the conditions of mathematics and symbols on the walls using special colors for different tasks. (Thornton et al. 49, 48 thornton.et.al) suggests the following tips that a teacher should use to minimize the difficulties of learning the linear equation:

- Teacher should praise the good things a student performs and avoid correcting the mistakes until the student gains self-confidence.
- Teacher should Involve students in problem solving and make them aware of their progress to help them discover ways to evaluate themselves.
- Teacher should provide feedback to reduce unwanted methods and create a more positive attitude towards math learning.
- Give some time for students to speak and thus develop math skills.

3.4 Real life situations

They are a set of integrated skills related to knowledge acquired by the learner. They are also the values and attitudes that make the learner capable of taking responsibility and dealing with the demands of daily life at various personal, social and functional levels with the highest possible creative interaction with his/her society and problems. It is also a set of behaviors and mental, social and subjective abilities that students deliberately acquire after going through systematic mathematical experience, helping them to exercise daily life effectively and adapting scientifically, socially, intellectually and culturally to the society. (Ali, 2014)

Life skills in mathematics:

Mathematics is one of the most important subjects of study to which life issues are directly related, from the simple processes that students practice in their daily lives, such as selling and buying, to the general life connections they face to the higher processes of problem solving and decision-making.

The subject of mathematics is characterized by its ability to achieve the life-related goals that students acquire as they learn mathematics. Math interferes with the details of our daily life, which are simple and complex. In simple things, the time and the rest of the money are known after buying something, and complex things, such as organizing a home budget, and sports accounts are used for cooking, driving and sewing. Mathematics plays an important role in many hobbies and sports. It is a basic requirement for all members of society because it is used in all activities of everyday life in the market, factory, farm, home and business. It is a set of skills and tools that help students successfully interact with everyday life situations and challenges of society in order to achieve happiness and gain benefit in the field of work and decision making. mathematical life issues are those skills that help an individual interact positively with the problems of his or her daily life with confidence by making appropriate decisions and developing positive relationships with others. " According to the researcher, math-related life skills are the set of behaviors and mental, social and subjective abilities that a student intentionally acquires after undergoing systematic experience. Mathematics help individuals to practice daily life effectively and to adapt scientifically, socially, intellectually and culturally to the society. (Majdi Aziz 2000)

The importance of life skills in teaching:

Recently, schools have interested in the need to teach these skills and integrate them into the curriculum. Many schools have adopted a stable education to develop the life skills of learners at different levels of education. The human future is dependent on the advancement of education and the development of its concepts. (Majdi Aziz 2000). The importance of life issues as follows:

- Learning life issues is one of the main goals of contemporary education and one of the new tasks of a teacher in the twenty-first century.
- Life issues seek to help learners interact with society in particular and with life in general.
- Life issues are diverse, covering all aspects of behavior, education and emotion, and depend primarily on the form and nature of the relationship between learner and society.
- Life issues achieve education goals by preparing people for life. They represent the most important output of human learning.
- Life issues help to manage one's life, adapt to one's self, live with the changes that have occurred, and with the demands of life.
- Makes the individual able to take social responsibility and solve the problems facing him or her, and meet the challenges of his or her time.
- Life issues bring self-confidence to an individual and help him or her to act effectively in different situations and to interact socially using active methods of communication with others.
- It relates to the personality of the learner and develops his/her roles in society and in the world of work in addition to his or her citizenship, universality, and social personality.

3.5 Using real-life skills in teaching mathematical terminology

Life issues in mathematics should include communication and communication skills, problem-solving and decision-making skills, personal and social skills, time management skills and skills for job

market. One of the general criteria in mathematics education and learning is to focus on the development of true understanding of mathematical concepts and processes so that education is done through real attitudes, problem solving, and various applications of mathematics in situations related to the life of the learner.

Life issues are numerous and diverse. The most important issues are social interaction skills, self-confidence, hobby practice, language communication skills, cognitive skills, and information handling skills, data handling skills, billing, and taxation, personal budget, reading skills, research, problem solving and scientific thinking. The life skills associated with mathematics are problem-solving, decision-making, leadership and cooperation with groups. (Zulkardi, 2013).

Real-life skills associated with mathematics and mathematics can achieve them are:

- Academic Skills: they include understanding, application, observation, ranking, and equivalence, analysis of results, research, and problem solving, recording of ideas, organization of information, self-learning and thinking.
- Social Skills: they include cooperation, participation in-group activities, correct oral speech, written expression, questions, and presentation of written reports to others, correct discussion, expression of opinion, tolerance and persuasion of others.
- Personal Skills: They include accuracy, order, hygiene, proper reading, writing reports, responsibility, self-esteem and choice.

Real-life skills related to mathematics:

- Problem solving skills: the ability to seek a solution to an issue through a number of successive steps.
- High thinking skills: the ability to analyze information and experiences in an objective manner, to distinguish and correct the factors affecting them with flexibility, to link causes and results, and to generate new ideas about things and attitudes.
- Social communication skills: the ability to communicate with members of society, friends and family to maintain social relations between the individual and the persons surrounding him or her by sharing the ideas, beliefs, customs and traditions prevailing in society.
- Personal self-skills: the ability to develop an individual's personality, independence, self-control and potential in various emotional, social and mental aspects.
- Time management skill: It is the ability to plan a range of actions associated with certain goals on time.
- Decision-making skills: the ability to reach a sound decision on a situation or problem after information is collected. (Faiz Mina 1994) (Majdi Aziz 2000)

The study

4.1 Importance of the study

The importance of the current study is that it provides math teachers with new methods and strategies for teaching linear equations in addition to ways to overcome the errors that students may have in the subject of linear equations.

4.2 Aim of the study

The current study aims to examine the impact of the use of life issues in solving linear equations in seventh grade students.

4.3 Research Question:
What is the impact of using life issues on solving the linear equations of seventh grade students?

4.4 Research methodology

4.4.1 Research type:

The current study relies on the integrated approach: A qualitative approach based on qualitative data shown in the form of views of the fact that the study requires the ability of the researcher to link all views of the students with a view to producing results, and the quantitative approach, where the change that occurs before and after the process of learning is examined. It is also an integrated approach based on data collection and analysis and conclusions from scientific research curricula (M. It's Khaled Shahab. (2018). Methods and methods of scientific research).

4.4.2 Population and sampling

The study was conducted in one of the Arab schools in the triangle of the Israeli Ministry of Knowledge. 40 teachers and approximately 900 students in the first semester (2021) participated in this study. The students were selected depending on their achievement level according to the research procedures. The educational knowledge of the students is to prepare the guidelines at a good level of attainment.

4.4.3 Research tools:

Section 1:
(a) observations: The study was based on three audio and video observations of three students doing four tasks in the three classes documented by the educational unit.

(b)Survey: It contains eight questions of written linear equations, so that each of the two questions of the same level is gradually divided from easy to difficult. So I passed form (A) before passing the educational task, and form (B) after (the completion of the educational task.

goal	**Form (B) questions**	**Form (A) questions**
Adding equal expressions, identifying the problem accurately	$x + 2x = 6 + 3$	$x + 5x = 24 + 6$
Adding equal expressions, analyzing the problem	$7x - 2x = 20$	$x + 3 = 8$
Adding and subtracting equal expressions. Suggest solutions to the problem	$x + 6 = 10$	$x + 19 = 22$
Adding and subtracting equal boundaries. Choosing the suitable solution.	$7x = 2x - 10$	$6x = 3x + 9$
Multiplication and	$2x = 110$	$4x = 20$

division of like terms. Solving problems with ordered steps.		
Multiplication and division of equal expressions. Evaluation of the solutions.	$0.5x - 5 = 20$	$0.5x + 2 = 34$
Using the law of expansion. Developing suggested solutions	$3(x-2)+4=3$	$24 = -(x+5) - 17$
Using the law of expansion. Reviewing new situations based on solved problems.	$2(10x+2) - 6(x+2) = -36$	$-(x+15) + 3(x-6) = -1 - 2$

Section 2:

(a) observations : The study was based on three observations recorded in audio and video of three students doing tasks in two classes that were documented by the educational unit.

(b) Survey form: It contains two questions of linear equations. each of the two questions is gradually divided from easy to the most difficult levels I passed a survey form (A) before passing the educational task, and a survey form (B) after the completion of the educational task.

Survey form (A)	**Survey form (B)**	**goal**
Ajwad has some money from his parents as a present on his 13th birthday. He bought 1/4 of the money CDs paid 200 shekels for clothes. He has got 100 shekels left to save. How much better did he get from his parents on his birthday?	Suhad bought two shirts for the same price and one trousers. The trousers are 50 more than one shirt. Suhad paid 350shekels. How much did she pay for one trousers?	Turning linguistic concepts into mathematical concepts
Two friends came out at the same hour in one direction from the two places between them, 14 km, one of them walked at a constant speed of 3 km/h to an hour and his friend walked at a constant speed of 4 km/h to an hour. How many hours do they meet?	Majid bought 5 books, a pen and 3 paper packages. The price of the pen is half the price of one book. The price of a paper package is 3 times more than a book. The total amount paid by Majid is 90shekels. What is the price of the book, the pen, and the paper packages?	Developing problem-solving skills in mathematics and daily life.

4.4.4 Data analysis

The observations were analyzed in two phases. in the first phase I tracked the students' acts before and during their learning exercise. For the form (A), a T-test was conducted to examine the change in students before and after learning.

4.4.5 Research procedures

The survey form was distributed to all students before and after the intervention unit. In the first stage, form (A) was passed to students followed by the intervention unit. The activities are done by students in sequence. First, the fruit activity, second "buying problems " activity, third "scale" activity for section (1). In addition "scale" activity is done by students in section (2) and then I closely monitored the behavior and emotion of the students at the school during the observations. I recorded the observations on the subject of the research. The students were not informed of the objectives of the research during the educational unit. A t the last stage, the form (B) was distributed followed with form (A) before the second intervention unit. Then the intervention unit was passed in prepared environment for the class and I closely monitored the behavior and emotions of the students at the school during the observations, and I recorded the observations on the subject of the research**.**

4.4.6 Intervention unit:

The Unit will address four tasks related to the subject of linear equations. As each task begins with a realistic situation and problems close to the student world, the exchange of concepts is presented, and students use a variety of symbols to provide information and to pass on a particular meaning to linear equations. Everyday life tools have been used to allow students to define concepts as clearly as they are. These tools help students to achieve the desired goals and contributes to building a new knowledge and discovering concepts that they have never dealt with in terms of the procedural solution of equations.

First activity: add and subtract the terms of algebraic expressions (fruits). Put apples, bananas and oranges on the school table, give a symbol of each fruit type.

Students were asked to collect fruit of the same type together. The minus number refers to eating the fruit.

Answer the following:

$$3x + 4x = ?$$

Next stage:

Second question:
$4y + 2x + 6y + x = ?$

Students were not able to collect two types of fruit together.

We conclude that when dealing with algebraic expressions, we add and subtract like terms together.

Table (1): fruit activity

task	**Task goals**	**contents**
Addition of one type of fruit	Addition of algebraic like terms	Passing one fruit. Monitoring Students thinking.
Addition of two types of fruit	Addition of algebraic different terms	Passing two types of fruits. Monitoring students thinking.

Second activity:

Promote quantities and equations comparisons. (Scale activity)

Quantity comparison. Imaginary activity has been prepared to provide students with opportunities to invent the variables and solve the equations system. Students learn how to find the values of groups and elements when the values are known.

Three scales were drawn. The first scale has ten bananas on the left and two pineapples on the right. The second scale has one pineapple on the left and one apple and two bananas on the right. The third scale has one apple on the left. Students were asked how many bananas should be on the right of the third scale?. Compare the three scales.

(Van Reeuwiljk, m .2001)

Table of fruit task (2)

task	**Task goals**	**contents**
If we maintain the concept of equality, we get the answer to the last part.	Defining the concept of equality and equivalence between two parties	The way students think about how effectively to come up with the right, answer has been tracked through analysis and comparative quantities.

Third activity: clothes

task	Task goals	contents
Section one: Buying problem activity (Van Reeuwiljk,m.2001)	Students should be able to collect like terms and link reality with equations	Two images were brought in, one containing a trousers and two sunglasses, the other three trousers and one sunglass, each with the same sum of money. The price is NIS 250. Students were asked to determine which one is more expensive than the other? Then there's a discussion about how it

		relates to equations.
Section two purchasing problem activity (Van Reuwiljk,m.2001)	Students should be able to collect like terms.	Students have been asked to determine the price of a blouse and the price of a drink? The teacher is observing their answers The first group is at 44 shekels and the second is at 30 shekels.

Fourth activity: turning equations into life issues (word problems)

Table (3) of scale activity:

task	**Task goals**	**contents**
Scale and vegetables	-Determining the meaning of the variable in the linear equation. - Deep thought in the concept of linear equation. -collecting and adding like terms	The students were given an algebraic equivalent and were asked to turn it into a word problem question from life using scales and vegetables.

Fifth activity: doing word problems from life

task	**Task goals**	**contents**
Word problems	-Deep thinking of word problems in realistic way -Developing the ability to identify the variable and analyze word problems.	Students were given word problems and were asked to analyze them and try to solve them in the appropriate way.

Results

In this chapter, we will look at the stages of evolution of the concept of linear equations in which students go through with activities that contain the concepts of equations. We will focus on their ideas during this stage. First, we will present their earlier ideas and concepts of linear equations and then we will present their ideas beyond the learning process. We will also highlight the stages of evolution of the concept of algebraic terms and the evolution of the concept of equality in the linear equations of students during the learning process through observations.

5.1 Addition and subtraction of algebraic like terms (fruit activity).

Activity description: This activity includes Addition and subtraction of algebraic like terms through fruits activity. In the first question, students were asked to collect three pills of apples with 4 pills of apples. In the second question, students were asked to four bananas with two apples and two bananas with one apple. (*x*) Symbol is for apple and (*y*) symbol is for banana. Students thinking process is observed and worksheet was passed to students at the end.

Developing the concept of algebraic addition of like- terms:

Developing the concept of algebraic addition of like- terms as follows: Salma was able to collect the same type of fruits. Nagham couldn't collect the different types of fruits (10 bananas and 3apples), this indicates that she couldn't collect different types of fruits, when moving from sensory to abstract, students could link addition concept. Layan expressed the 10y +*x* the scale helped her to answer. Nagham could understand that for every 2 pineapples there is 10 bananas that is, there is 5 bananas for each pineapple, she used a sensory method to get the correct answer. Asma could get the same concept, she was able to understand that when 5 bananas equal to two bananas and one apple then 3 bananas =one apple.

5.2 Comparing quantities: fruit activity (section 2):

Activity description: there were 3 scales drawn on papers. Student had to compare the quantity in each scale pan to achieve balance. The first question is; how many bananas do we need for one apple to keep the scale balanced? The first scale had two pineapple pills, which have the weight of 10 bananas. The second scale had one pineapple in one pan and one apple and two bananas in the other pan. The third scale had one apple in one pan and students were asked how many bananas should be in the other pan? The second question, two pineapples were placed on one pan of the scale, and on the other pan there were four apples. In the second stage, two apples were put in one pan and six bananas in the other pan. In the last stage, students were asked how many bananas do we need to keep the scale balanced?

Students then start thinking about how many bananas should be put to keep the scale balanced. In the second question, how many bananas should be to keep the scale balanced? During discussions, students compared their answers and they were able to develop the concept of quantitative comparison.

Development of quantity comparison concept:

The development of a comparative concept of quantities is demonstrated by Nagham and Salma when they got the correct answers by analyzing and comparing the quantities. In this section, we could notice the perfect awareness of quantity comparison concept through Layan and Nagham.

5.3 Algebraic like-terms: (clothes)

Activity description: This activity motivates students to compare quantities and collect like-terms by working out on worksheet. Questions were asked: what is more expensive, the trousers or the sunglass? In the second question, students were asked for the price of both a blouse and a glass of juice. The researched followed their thinking and analysis of the questions.

The stage of developing quantity comparison concept:

Some students did not have an apparent perception of the quantity comparison_concept between two groups or parties. For example, Saeed and Rana showed difficulty in this kind of questions. This may be due to a lack of understanding of the activity from the beginning.

In this section, students were aware of quantity comparison concept. Taking into consideration individual differences, we can notice that Saeed had been able to link the everyday problem with the deep lack of understanding. Mohammad had also solved the problem according to the daily concept. Rana was able to know the prices. These were examples of the development of quantity comparison concept.

Students showed full awareness of comparing. Some students had different thinking and answered correct answers because they considered the questions easy.

5.4 Turning equations into word problems :(scale activity)

Activity description: worksheet was given to students to solve equations by drawing a balance and writing the following expressions on them on each side or by swapping symbols with a drawing like fruit types. The researcher followed the students' solution strategies before presenting Form B to them.

Development of equality concept of linear equations:

Students couldn't understand the right concept of equality. For example, Jana (8) couldn't understand the meaning of equality correctly and the aim of scale activity. She had answered as a robot without understanding the real goal behind the activity. Whereas we can notice a trial by Saeed (13) to understand the content of the activity. Another examples are (35), Saeed (40), and Nagham (43). They all analyzed equality concept of linear equations.

5.5 Analyzing real-life activity:

Activity description: In the analysis of real-life activity, I observed the students during the activity. I could notice Haya who tried to analyze the without using previous math information. Another example is from Samir (25) who had the same analysis and got the correct answer.

Analyzing parts of the worksheet:

Purchasing problems task:

name	analysis	worksheet
Rana	The task was solved by drawing and was closer to linear equations.	
Mohammad	The task was solved through life thinking. The student did not use linear diagrams or	

	equations.	

Scale task:

Name	analysis	worksheet
Saeed	He could solve word problem with hesitation to procedural solution.	
Jana	She could link the equation concept with scale task successfully. She didn't need procedural solution	

5.6 Student results of linear equations:

Results indicate that there are significant differences form (A) and form (B). The T-test was done and the standard rates and standard deviations of the research samples were calculated. The student mean in form (B) was higher than form (A) Form (B) was (M=85, V=82) and form (A) was (M = 55.7, V = 70.075).

The stages of development are first, the analysis of the data of the question. Then Students are trying to think of ways to solve the problem. They imagined the questions then turned it into real. Answers analysis varied among students. Haya add ages and reduced them to reach a solution until she had 20. Samir (13) based on a quantitative comparative system and came up with the answer, that is, students do not necessarily need to move to the abstract to solve verbal issues.

Results of analysis of questions related to life issues

The results indicate that there were significant differences form (A) and form (B). The T-test was done and the standard deviations of the research samples were calculated. The student mean in form (B) was higher than form (A), where it was (M = 68.5, V = 41.244) in form (A), and (M=86, V=30.9) in form (B).

Results

This study aimed to examine the impact of real life situations on solving linear equations. Students' methods of solving linear equations have been analyzed by learning word problems, developing the concept of addition and subtraction of like-terms of algebraic expressions, developing the concept of quantity comparison and then, developing the concept of equality in linear equations. Before, during and after learning word problems, Students' feelings were analyzed. Student's feelings were analyzed by T-test results.

According to the results, students went through three stages: The first stage was the development of the concept of algebraic like-terms. The second stage, students developed quantity comparison concept. At this point, students discovered the cause of the mistakes they had before and they acquired the new knowledge students skipped the error by delving deeper into a quantitative comparative concept. In the last stage, students developed the concept of equality for linear equations with joy and confidence.

The drawbacks of the new method were that it took more time than a procedural solution. It depended on the operation of thought and the dimensions of people being computer machines that solve what they do not understand, even if the solution is true. They found the solution of linear equations by drawing and escaping from routine and boredom in schools. Even though a few students complained that, the method was tiring because it forced them to think, they became used to start creative thinking. The most important use of thinking abilities was to follow our predecessors' learning opportunities to detect error, which helps the teacher to correct easily.

Recommendations

Based on research results and discussions, I recommend giving students opportunities to discover new learning skills, and to link the previous information they had gained to real-life situations. These skills should be applicable to mathematics in general, and to linear equations in particular without the teacher's intervention or guidance. We also recommend that teachers should pay attention to the emotional aspect of students during learning process because it is the best evidence of the student's understanding. We also recommend paying more attention to advanced mathematics curricula for the intermediate level in the light of life skills. It is important to consider problem-solving skills in math and provide problem-solving from life to gain better understanding for students in all levels.

Technology can be used as illustrative tools, such as the representation of a student's imagination by drawing on a computer and the development of computerized games based on the concept of linear equations, which contributes to overcoming difficulties, eliminating negative emotions and turning them into positive ones.

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The Impact of the Use of Mathematical Problem Solving on the Development of Creative Thinking Skills for Prep School Students in Arab Schools in Israel

Abstract

Mathematics occupies a central place among the different sciences; it can be described as the backbone of these sciences. Mathematics, from many specialists' point of view, is an important tool for organizing experiences, and understanding the environment in which we live; in addition to that, solving the problems of the world needs innovative and intelligent solutions to achieve the desired progress for the global civilization. Problem-solving models usually combine training on the steps of problem-solving and creative thinking. The current research aims to examine the impact of the use of mathematical problem-solving on the development of creative thinking skills for prep school students in Arab schools in northern Israel. The researcher used the experimental approach, and designed a control group and an experimental group with pre- and post-tests. The research sample consisted of 80 prep school students in Arab schools in northern Israel, and the result was that there are statistically significant differences (at the $\alpha \leq 0.05$ level) between the average scores of students in the experimental group and the control group in the post-application of the creative thinking test in favor of the experimental group. The researcher concludes with recommendations to invest in developing students ' creative thinking. The importance of the current research stems from the importance of developing students' mental abilities, developing their self-education abilities, and acquiring creative thinking skills; because knowledge alone does not replace thinking, and cannot be utilized without the support of creative thinking.

Introduction

The goals of teaching mathematics have gone through many different stages. In the past the goal of teaching mathematics was to focus on the accuracy and speed in performing calculations. But the technological developments have reduced the importance of this goal since a small calculator can perform all these operations more accurately and quickly. Therefore, the goals of teaching mathematics have changed to focus on understanding and perceiving the meaning, and this requires a focus on understanding mathematics as an independent, interconnected subject with its own fundamentals, problems and self-pleasures.

While this goal may be sufficient to create a plenty of theoretical mathematicians, it may not be an excuse to overburden pupils with many subjects of mathematics, the primary goal of education as a whole is to prepare the individual to become a useful member for himself/ herself and his/ her community (Abd Algani, 2019).

The important question here is: How does mathematics contribute to this goal? The continuing and growing problems facing humanity require rapid and growing development in the methods of solving them.

Therefore, mathematics helps to prepare a useful individual by developing his/her ability to solve the problems of the renewed life with all their types and times.

The importance of solving mathematical problems in school comes from the fact that it is the primary objective of teaching and learning process. Knowledge, skills, concepts, mathematical generalizations and even all other school subjects are not only goals by themselves, but also they are means and tools that help the individual to solve his/her real problems (Abd Algani, 2018).

In addition, problem solving is the natural way to practice thinking in general, there is no mathematics without thinking and there is no thinking without problems.

So the objectives of teaching mathematics focus on developing understanding, meaning and skills alongside with the basic processes, which contribute to rapid scientific development which result endless problems in one's life (Algani & Eshan, 2019).

It is considered the main goal of problem solving in mathematics is to train students on some ways and methods that help them to solve problems in general.

The school mathematics Study Group in the USA (SMSG) has developed the following set of problem solving goals:

- Provide the student with different types of strategies that help him/her to solve problems.
- Develop the flexibility of student in the way of processing and initiating problem solving.
- Develop some methods to apply geometric representations in the production of new information about the problem.
- Develop some skills in scheduling and organizing the given information and derivatives to take advantage in the solution.
- Deepen the student's understanding of the problem by accustoming him/her to the work of numerical estimates based as in the light of the problem posed

From the above, the importance of problem-solving methods is marked in the following points:

- Help student to discover new concepts.
- Teach student how to develop the concept to use it in solving a new problem.
- Accustom student to critical scientific thinking.
- Help to join and match mathematical concepts.
- Develop some of the student's mental abilities such as visualization, abstraction, analysis, and synthesis.
- Stimulate student's curiosity and discovery.
- Develop student's ability to analyze situations and make decisions.

Mathematics also is one of the study materials that aims to develop creativity and creative thinking. Creativity is not achieved out of the blue; it must be preceded by a problem that challenges the mind, so mathematics can be taken as a field for the development of creativity and creative thinking. Its structural nature allows more than one logical conclusion to the same given introductions, and its connotation structure gives some flexibility in the organization of content. Moreover, mathematics is rich in problem situations for which students can find for each situation multiple and diverse solutions, and its study teaches the student to employ objective criticism of the situation. This will provide the student with some of the basic capabilities for the creative process. Creative thinking in mathematics can be learned as a skill, and then developed with more training, since each learner possesses some degree of thinking (Abd Algani, 2018; Abd Algani, 2019; Mufti, 1995).

Mathematics represents an important field of education since it reveals the capabilities of creative thinking and its development for learners in all grades. Mathematics is not just a collection of facts and information, but mainly a way and style of thinking to face mental problems; therefore, successful teaching of mathematics affords learners the capabilities and methods of creative thinking. (Abd Algani, 2018; Aladdin & Abdel, 2003)

Mathematical creative thinking as a science is different from creative thinking as a study subject. Creative thinking as a science seems obvious when the learner solves the mathematical problem in an

independent way, not previously known to him, but creative thinking in mathematics as a study subject appears if the learner knows that many mathematical questions can be solved in more than one way, and this itself is the essence of creative thinking (Abd Algani & Eshan, 2019; Roshka, 1989).

Creative Thinking Skills

A review of most common tests of creative thinking, that Torrance (1966) and Guilford (1967) tests indicate the most important skills and abilities of creative thinking that researchers have tried to measure, that are:

1. Fluency

Fluency refers to the ability to produce as many ideas and solutions to a problem as possible. Fluency in mathematics means the learners' ability to give several different solutions to a particular topic or issue. It means accustoming pupils to give several different solutions to a particular topic, issue or obstacle, so that they have the ability to recall the largest number of ideas when exposed to a particular mathematical or geometric problem, and then choose the solution or idea that the pupil finds most convincing. Fluency is divided into sub-aspects: verbal fluency, fluency of thoughts and fluency of expression (Abd Algani, 2018).

a. Verbal Fluency

The verbal fluency of mathematics may not be as important as in languages, for instance. We mean the speed of the individual to think and to provide words, or mathematical synonyms, or their imperfections, and generate them in a certain format, or the ability of an individual to produce as many mathematical vocabularies as possible within a given specification in a certain period of time (Abd Algani, 2018; Austin, 1988).

- Write as many attempts as possible to solve the following question:

$y = -x^2 + 4x - 7$

- A man who is now (71) years old and his son is (33) years, how many years ago was the father three times the age of his son?

The answer…….. years.

1) 14 2) 11 3) 15 4) 21

- List the largest number of objects around us whose size can be calculated?

b. Fluency of Ideas

Fluency of ideas is the individual's ability to give as many mathematical ideas as possible associated with a certain perceived situation, for example (Davis, 1981):

- Mention all the consequences of doubling the population of Israel.
- Write down as many results as possible for doubling the length of the day to 48 hours.
- Every line has to be the same sum, find the value of y (see figure 1),

17			y
13	**15**		
	10	**11**	**17**

	y		**14**

Figure 1: Find the value of y

c. Fluency of Shapes (expression):

Fluency of shapes refers to the ability to change shapes with simple additions, and the ability to quickly draw a number of examples and preferences or adjustments in response to a particular visual stimulus. Examples (Brousseau, 1991):

1. Example: What can be shaped from the following forms (see figure 2)?

Figure 2: What can be shaped from the following forms?

In the previous example, the student should draw whatever s/he wants to draw, geometric or non-geometric shapes, and the more the answer or the shape s/he draws is meaningful and unique, the more it indicates his/her innovative abilities.

2. We want to turn the triangle into various drawings that express objects or things. What additions can you add for that (see figure 3)?

Figure 3: The Triangle

3. This is an example of one of the students' solutions (see figure 4):

Figure 4: This is an example of one of the student solutions

2. Flexibility

Flexibility is the ability to vary the mathematical answers and solutions. Flexibility in mathematics means asking learners to mention as many as possible properties of a drawn geometric figure. Here we can notice the development of the student's thinking, and the flexibility that s/he shows in the production of the greatest number of ideas to achieve the presented mathematical situation. One kind of flexibility is that the student can change the way of research, and stop searching in a particular way or narrate preconceived ideas. Another a kind of flexibility is that the student must be aware of the things s/he is looking for, maybe more important than the things s/he needs (Abd Algani, 2018; Abd Algani et al, 2019). Forms of Flexibility:

- **Automatic Flexibility**: It is the speed of the individual to produce as many diverse ideas as possible associated with a problem, and according to this ability the individual tends to automatic initiative in these situations, and does not just respond (Al-Khalili, 2005).
- **Adaptive Flexibility**: It means finding a solution to a problem or facing any situation in the light of the feedback that comes from that situation (Al-Taati, 2004).

The researcher believes that flexibility is the individual's ability to give multiple and different inputs and ideas to solve a problem. Examples of Flexibility (RAMA[1], 2017):

❖ Mention the uses of the caliper ruler for (student, tailor, carpenter, blacksmith …….)

❖ Think of all the ways you can design to weigh very light objects.

❖ If there were six people at a party and everyone wanted to shake hands with the others only once, how many times did they shake hands at this party?

a) 36 b) 18 c) 15 d) 12

[1] National Authority for Measurement and Evaluation in Education in Israel.

3. Originality

Originality is the ability to produce mathematical ideas unfamiliar to one's colleagues. Originality in mathematics means the ability to produce authentic responses, i.e., responses not commonly repeated among the colleagues of the person who comes up with these responses. It can be measured in mathematics by asking the learner to give several different solutions to the same mathematical situation, such as giving more than one method to solve a given geometric exercise, or solving an algebraic question by more than one method (Abd Algani & Haj, 2020). For example, (Crrouse, 1987):

In this figure (5), AB, CD are two diameters of the circle perpendicular, M, N two points, and MX, NK, NG, MV, are columns on AB, CD as shown.

To prove that $GK = XV$, the traditional solutions are either:

- Application of triangles $\Delta XEG \cong \Delta EGK$
- Application of Pythagorean theory.

4. Elaboration:

Elaboration means the ability to give many details or make new additions to an idea, problem or mathematical question to develop or enrich it. With this skill, more precise details of the case are discovered or identified and highlighted. For examples (Davis, 1981):

❖ Ahmed bought 10 pens …….

Add what you want to the question so that it can be solved using a process of:

a) addition b) subtraction c) multiplication d) division

❖ In each item there is a set of triads and there is an adjective to achieve, except one triad has not achieved it. Draw a circle around the irregular triad, and write down what is the adjective: (4, 2, 4), (5, 1, 4), (2, 5, 4), (5, 3, 2), (2, 3, 5), (2, 2, 6).

5. Sensitivity to Problems

Sensitivity to problems means vigilance to what is in the mind when solving or researching a particular mathematical situation and being attentive to anything new or every change in the path for researching the problem or solving it. Problem sensitivity means awareness of problems, needs, or weaknesses in the educational situation (Abd Algani, 2019). Sensitivity to problems in mathematics means that some pupils are faster than others in noticing the problem, checking its presence in the situation, and linking the data to their previous experiences. For examples (Brousseau, 1991):

❖ Khalid bought 6 books, 9 notebooks and 7 pens for 15 NIS. If the price of one pen is one NIS. Can you help Khalid to know the price of one book? How?

❖ Notice the outputs of the examples and write down the output of example four?

$11 \cdot 11 = 4$

$22 \cdot 22 = 16$

$33 \cdot 33 = 36$

$44 \cdot 44 = ?$

a) 0 b) 16 c) 48 d) 64

The correct answer is b.

❖ Multiple-Choice

Example: Which number, when it is squared, decreases? The answer is ……

a) negative integer
b) positive integer
c) number 1

d) any fraction in which the numerator is less than the denominator

The correct answer is d because:

For example, if we take the number $\frac{1}{2}$ and square it, it becomes $\frac{1}{4}$, which is less. while negative numbers and positive numbers increase when squared, and number 1 remains the same.

Factors affecting creative thinking

We cane summarize the factors that affect the creative thinking in the following chart (figure 6):

Figure 6: Factors affecting creative thinking

1. Personal Factors

There are some factors (Abd Algani & Eshan, 2019):

❖ **Self-Assessment:**

Self-assessment means that the individual has a sense of self-confidence, knows well how to evaluate it (high, medium, or low rating), and how an individual sees himself from his personal perspective.

❖ **Psychological Security and Freedom:**

Psychological security is a feeling of reassurance that means lack of fear, absence of anxiety and having self-confidence, while the opposite is called psychological insecurity, which means constant anxiety, lack of confidence and severe phobia from others.

❖ **Experience Acquisition (Openness to experience):**

Experience acquisition relates to many interests and is influenced by imagination, insightful vision, previous knowledge and the acquisition of various experiences.

2. Environmental Factors

Environmental factors refer to lack of proper place, overcrowding, lack of support from colleagues, lack of material support and socialization in a bossy family.

❖ **Educational Patterns:**

Educational factors refer to the diverse teaching methods and the ways used by an individual in learning, or the teacher in education, as well as the place where the learning process takes place.

❖ **Economic Level**:

A person may not pass through the process of learning, going to university, completing high school, or experience society rejection and criticism for creative ideas, with the lack of alternatives and the lack of appropriate reinforcement for the creators (Al-Ayasr, 2013).

❖ **Cultural Level:**

This refers to the environment surrounding the person, when all people around him are not educated, or do not have the cultural background that appreciates the importance of education. This cultural poverty creates a kind of frustration for the learner. Family is considered the first cell and the basic building block in the building of society, and the place where the individual receives his/her life lessons. It has an impact on the formation of personality and behavior, so the family plays a big role in the development or suppression of the child's creative abilities. For example, a domineering father who imposes his opinions and does not allow to his children to express their opinions, negatively affects the personality of the children and damages their self-confidence, and serves to suppress the

creative abilities of the individual (Abu Latifa, 2009; Abd Algani & Eshan, 2019; Abd Algani & Haj, 2020).

Personal Stimuli:

Personal stimuli are within the person, giving him/her the motivation to reach the goal s/he wants (Algani, 2019).

Obstacles of Creative Thinking

Several references have indicated that there are many and varied obstacles that stand in the way of the development of creative thinking skills and effective thinking, and perhaps the first step that teachers, coaches and parents should pay their attention to is identifying these obstacles; so that they can be effectively overcome them when applying an educational or training program aimed to develop creative thinking skills (Treffinger & Isaksen 1985; Abd Algani, 2018). Obstacles of creative thinking were classified into two main groups – personal obstacles and situational obstacles, which we summarize below:

1. Personal Obstacles

- **Poor self-esteem:**

Poor self-esteem is an important factor in creative thinking, because poor self-esteem leads to fear of failure, risk avoidance, and unsafe consequences situations.

- **Tendency to Conformity**

The tendency to comply with the prevailing norms hinders the use of all sensory inputs, and limits the possibilities of imagination and expectation, and thus sets limits on creative thinking.

- **Excessive Enthusiasm**

A strong desire for success and an overzealous enthusiasm for achievements lead to a rush of results before the situation matures, perhaps jumping to a late stage in the creative process without exhausting the prerequisites that may take more time. For example, (Austin, 1988):

❖ Use numbers from 1 to 9; write one number in each circle so that you get a total of 23 in each direction (see figure 7).

- **Saturation**

Saturation means reaching a state of overexposure that may result in a loss of awareness of the merits of the status quo, or inaccuracy of views. Saturation is an anti-incubation state or a phased storage of an idea or problem, for example (Austin, 1988):

Use the numbers $\{0, 1, 3, 5, 6\}$ to solve the following code:

		A	***A***	***C***
	×		***A***	***C***
	N	***M***	***7***	***C***
N	***W***	***W***	***C***	**0**

N N 7 2 C

- **Stereotypical Thinking:**

Stereotypical thinking is a form of traditional thinking, restricted to habits; Isaksen and Treffinger (1985) considered it the most prominent obstacle to creative thinking. To illustrate the impact of this obstacle, De Bono gives a symbolic example:

❖ A dog used to walk a long way to get the bone his owner put it in the same location behind a fence (see the figure 8). Since the first successful attempt to reach the bone was achieved by taking this long road, the dog held on to it, and it became a habit he did it automatically. If the dog could be guided to this obstacle, he would be able to abandon his habit and find the shortest way to reach his goal.

Figure 8

Another example:

You enter a room with two ropes hanging from the ceiling, and you are asked to tie the two ropes together. There are some tools on a table in the corner of the room, including a hammer, pliers and scissors. You hold the end of one of the ropes and walk towards the other, but you quickly realize that you cannot reach the end of the other rope. You try to extend the range you can reach with the hammer, but it doesn't work. What can you do to solve the problem?

The solution: This problem can be solved using the available tools in an unconventional way. If you attach the hammer to the end of one of the ropes and wave it like a pendulum, you will be able to hold it in the middle of the room, and with your other hand the end of other the rope, so you have used the weight of the tool to get the rope closer to you rather than trying to pull or lengthen it. People often fail to come up with this solution because they rarely think of new uses other than those of the traditional uses for tools or materials available, Duncker (1945) and (Isaken & Treffinger, 1985) explained this failure by the tendency of individuals to stick to the familiar uses of things, and described this tendency by the terms "inertia" or "functional constancy".

- **Insensitivity or a Feeling of Helplessness**

One of the necessary characteristics of the process of creative thinking is vigilance and a delicate sensitivity to problems. When the sensitivity is weakened by lack of excitement or lack of challenge, the person becomes more inclined to stay in the circle of reactions to what is happening around him, giving up the initiative to explore the dimensions of the problem and to find solutions (Isaken & Treffinger, 1985).

- **Haste and Improbability of Ambiguity**

This trait is related to the desire to find an answer to the problem by taking the first opportunity, without understanding all aspects of the problem, and without working to develop several alternatives or solutions to it, and then choosing the best one. One of the problems associated with this trait is the unpredictability and evasion of complex or ambiguous situations, and escaping from facing it. Postponement of judgment is also an important characteristic of creative thinking; for example, when brainstorming is practiced, judgment is allowed only after every possible opportunity to generate ideas has been exhausted (Abd Algani, 2018).

- **Transfer Habit**

When certain mental patterns and structures that have been effective in dealing with new and diverse situations are entrenched, other, more effective strategies are often ignored, and some killer phrases that summarize this obstacle include: "We've always been doing this successfully," or: "We've always been solving the problem this way".

2. Situational Obstacles

Situational obstacles to creative thinking mean those related to the situation itself, or to prevailing social or cultural aspects. The most important of these obstacles are:

- **Resistance to Change**

There is a general tendency to resist new ideas, and to maintain the status quo by many means for fear of their repercussions on the security and stability of the individual, there are those who believe that modern experience poses a threat to their gains and conditions, and therefore, they respond by using 'deadly' phrases to any new idea (Brousseau, 1991), such as:

- It's not going to work in statement questions.
- This idea of solving the question is very long.

For example, three consecutive natural numbers totaling 300. What are they?

Since the quotient of 300 by 3 is 100. There are three possibilities:

100,101,102

99,100,101

98,99,100

The second possibility is the correct answer.

- **Imbalance between Competition and Cooperation**

There is a need to combine the spirit of competition and the spirit of cooperation for both the individual and the group to achieve new achievements, and excessive consideration of either of them may cause loss of contact with the real problem or progress in solving it; therefore, balance between them is a condition of productive or creative thinking (Coxeter, 1986).

Example for the fifth grade students[2]:

The lengths of the sides of this rectangle are 2 cm and 6 cm (see figure 9):

Indicate the polygon whose perimeter is equal to the perimeter of the rectangle

Figure 9

Comparison between Creative Thinking and Critical Thinking

Perhaps it is not possible to distinguish between creative thinking and critical thinking for the simple reason that any good thinking involves an assessment of quality and the production of what can be described as novelty. It is difficult for the brain to be preoccupied with a complex thinking process without the support of another complex thinking process (Abd Algani, 2018).

But the outcomes of thinking vary depending on the type of task, and whether it requires creative or critical thinking. Creative thinking must include internal critical thinking.

How critical thinking is involved in creative thinking:

1- Self-criticism (for a person): For example, a student criticizes himself for a mistake he made when answering the question.

2- External criticism: It comes from other people for a mistake in one's answer/solution.

For example (Austin, 1998): A student solved the following equation: $x^2 - x + 1 = 0$

[2] Ministry of Education in Israel, Proved Book for 9Th grade.

And from the equation $x^2 - x = -1$ and by analysis a common divisor

$x^2 = x - 1 \quad (2)$

$x \cdot (x - 1) = -1$

we compensate for the $(x - 1)$ of the equation (2) so

$x \cdot x^2 = -1$

$x^3 = -1$

$x = -1$

When verifying by compensation by the original equation, the solution does not verify, where is the error in which the student falls in?

The correct solution: The mistake lies in the step $x^2 = x - 1$ where this step becomes a requirement to be $(x - 1)$ positive quantity which means x is more than 1.

Trends of Creative Thinking

There are many trends and theories that explain creativity, and the most prominent are (Al-Ayasrah, 2013; Abd Algani, 2018):

❖ **Behavioral Trend**: adopted by Skinner, who defined creative thinking as the kind of thinking that is reinforced or substantiated, leading to the possibility of continuity. However, if it does not receive the required reinforcement, this thinking will diminish.

❖ **Cognitive Trend:** focuses on creative thinking results through the interaction and organization of past and new experiences, while providing a certain maturity, an exciting environment for the individual, and effective training in connectivity and logic.

For example (Edwards, 1979): If a student told to you, I can prove that $5 = 7$ and gave you the following proof:

$1^5 = 1$ as well as $1^7 = 1$ no matter how high the forces = 1

That is $1^5 = 1^7$ because the two results are equal.

And there's a rule in mathematics: if the bases are equal, the exponents are equal, and vice versa. So $5 = 7$ What's wrong with this proof? (The error is that the rule has a complement.)

a) the two quantities are not equal b) 5, 7 are odd numbers

c) the rectangle is less in perimeter d) if the basis is greater than 1

❖ **Clairvoyance Trend**: This trend in interpretation of creativity was adopted by the German scientist Fertimer, who assumed that creative thinking is clairvoyant and intuitive thinking, so the creative idea is the one in which the problem is formulated and the individual suddenly arrives at the solution by active mental processes, where the situation is treated with a new treatment (Saada, 2015; Abd Algani, 2019).

***** Intuition is the formation and verification of mathematical guesses.

For example, *(*Edwards, 1979): Find the result of dividing (1122) by (11) without performing the division operation:

a)120 b) 12 c)102 d) 1002

The correct answer is (c).

The Levels of Creative Thinking

Researchers' views on the topic of creative thinking differed. Tuarns attempted to resolve differences between those views, and proposed five levels of thinking, which are (Tashman, 2010; Abd Algani, 2019; Abd Algani & Eshan 2020; Al-Ayasrah, 2013; Austin, 1988):

❖ **Creative Expressions**: This level refers to the development of unique ideas, regardless of their type.

For example, (Edwards, 1979): Find uncompleted square roots: It is known that the square root of the number 9 is 3, but what about the roots of uncompleted squares? To find their value, it is necessary to estimate their approximate value, for example: Find the root of the number 85?

❖ **Productive creativity:** In this level there are strong indications of the availability of certain restrictions that regulate the free performance of individuals.

For example (Edwards, 1979): How do you prove that the sum of the angles of a triangle equals 180^0? Mention 4 different ways to prove that? What is the simplest of these ways?

❖ **Regenerative Creativity**: This level represents the individuals' ability to penetrate intellectual principles, and includes substantial improvements through modifications incorporated in new starting point's skills and concepts.

For example (Hoffman, 1988): Is $(x+y)^2 = x^2 + y^2$ true for every real number x ,y?

❖ **Innovative Creativity**: It refers to the proficiency in using materials.

For example (Hoffman, 1988): Prove that $\frac{n(n+1)}{2}$ is a natural number for every natural number n?

❖ **Innovative Creativity**: This level includes principles and assumptions, and it is considered the highest degree of creativity

Two numbers x, y square sum of 41 expressed this by symbols

The answer: $x^2 + y^2 = 41$ (Hoffman, 1988).

Modern methods that teachers apply to develop creative thinking in mathematics (Abd Algani, 2018):

- Encourage the learner to think in a collective way in order to get as many ideas as possible from the discussion with the group.
- Accept the suggested ideas and help the learner to modify and develop them.*
- Help the learner assume answers and test them to reach the right solution
- Do not provide ready-made solutions for the problems or ready-made proofs for theorems.
- Give questions that require deep thinking and are open ended.
- Encourage the pupil to produce something new from his/her imagination and invention.

Problem of Research

From all of the above, we can deduce the research question as follows:

What is the impact of the use of mathematical problem-solving on the development of creative thinking skills among prep school students in Arab schools in northern Israel?

The following research hypotheses can be derived:

1. There are statistically significant differences at the level of the $\alpha \leq 0.05$ function between the average scores of students in the experimental group and the control group in the post application of the creative thinking test on the fluency skill in favor of the experimental group.
2. There are statistically significant differences at the level of the $\alpha \leq 0.05$ function between the average scores of students in the experimental group and the control group in the post application of the creative thinking test on the flexibility skill in favor of the experimental group.
3 . There are statistically significant differences at the level of the $\alpha \leq 0.05$ function between the average scores of students in the experimental group and the control group in the post application of the creative thinking test on the originality skill in favor of the experimental group.
4. There are statistically significant differences at the level of the $\alpha \leq 0.05$ function between the average scores of students in the experimental group and the control group in the post application of the creative thinking test as a whole in favor of the experimental group.

Methods

This chapter discusses the procedures followed in the implementation of the study, the study community and sample, the preparation of the study tool, the statistical methods used, and ensuring its reliability and stability.

Study Procedure

The researcher used the experimental method, which is defined as a method that studies a current phenomenon while inserting changes in one of the factors and monitoring the results of the change. (Al-Aga, Al-Ostath, 2020). The study design was a control group and an experimental group with pre- and post-tests. The independent variable in the study was "solving mathematical problems" and its effect on the dependent variable "creative thinking skills".

Study Community

The study community consists of all preparatory school students in northern Israel, numbering 26,600 students for the 2019-2020 academic year.

Study Sample

The sample was selected from different Arab preparatory schools in northern Israel during the first semester of the 2019-2020 school year. The researcher divided the study sample into two groups: the experimental group (40 students) and the control group (40 students), as presented in Table 1.

School	Class	Experimental / Control Group	Number of the students
Arab prep schools from northern Israel	E	Experimental	**40**
	C	Control	**40**
Total			**80**

Table 1: The Sample

Teacher's Guide

The teacher's guide is considered a monitor and assistant in the implementation of lessons without problems and flops. It provides directions and guidance that help the teacher to facilitate the educational process and its progress in the right direction. It has been prepared according to the following steps:

- **Guide aim:** To provide a comprehensive presentation of the role of the teacher in applying the steps of solving mathematical problems in order to achieve the educational goals of the unit. It also helps the teacher to develop creative thinking skills in mathematics in general and in the unit of algebraic fractions in particular for prep school students according to the curriculum of Israeli Ministry of Education.

- **Guide Content**: It consists of the unit of algebraic fractions and solving equations for the preparatory stage according to the Israeli Ministry of Education curriculum in mathematics, as shown in Table 2:

No.	Subject
1	**Algebraic fractions**
2	**Simplifying algebraic fractions**
3	**Addition of algebraic fractions**
4	**Subtracting algebraic fractions**
5	**Multiplying algebraic fractions**
6	**Dividing algebraic fractions**
7	**Solving algebraic equations**

Table 2: Guide Content

The guide was written according to the following:

1. The objectives of each subject are formulated in a behavioral way, so that the teacher can measure the achievement of class goals and student performance.
2. Tools and educational means: the researcher prepared the means that suit the nature of the educational situation according to student's needs.
3. Assessment and evaluation: To assess students' understanding of the educational materials.

Study Tool

Creative Thinking Test: The test consisted of 12 questions, to identify and evaluate thinking skills. The objective of the test was to measure the extent to which the prep school students possess creative thinking skills. The researcher prepared the test items according to previous studies, and placed emphasis on examining the following:

- **Fluency**: Refers to the ability to give as many answers as possible to the mathematical problem in a specified period of time.
- **Flexibility**: Means the ability to generate varied thoughts in solving problems.
- **Originality**: Refers to the students' ability to find unique solutions for the group s/he belongs to.

The test was prepared in its initial form with written instructions, and then presented to a competent committee in the field of mathematics including teachers in the field and experts in evaluation and language. The final form of the test was amended according to the recommendations of the expert committee. The test was given to an exploratory sample to determine the level and time required to solve it and the difficulties that it may include. The time required for the test was 120 minutes. The researcher checked the tests, and determined the stability of the test using the alpha Cronbach equation. The result was alpha Cronbach's α=0.63, which is an indicator of the test's validity.

Equivalence of Two Study Groups

The researcher confirms the equivalence of the experimental group and the control group using the following variables:

1. **Mathematical achievement**: Through students' achievements in previous exams, as presented in Table 3:

Group	*Number*	*Mean*	*SD*	*T(79)*
Experimental	40	66.93	16.9	**0.43**
Control	40	65.5	18.48	

Table 3: Mathematical Achievement

2. **Cultural, economic and social level**: The experimental and control groups were from the same schools and from a close socio-economic and cultural environment.

Results

The current study aims to reveal the impact of the use of mathematical problem-solving on the development of creative thinking skills for prep school students in Arab schools in northern Israel. To achieve this goal, the researcher's applied his creative thinking test to the study students. And after the application was completed, data was collected to examine the validity of study hypotheses.

First Hypothesis: The first hypothesis states that there are statistically significant differences at $\alpha \leq 0.05$ between the average scores of the students in the experimental group and the control group in the post application of the creative thinking test in the skill of fluency in favor of the experimental group.

In order to test this hypothesis, a t-test was used to calculate the significance of differences between two independent groups to identify the impact of the use of problem-solving in the development of creative thinking skills for prep school students in Arab schools in northern Israel.

Table 4 shows the results:

Group	**Number of Students**	**Arithmetic Mean**	**Standard Deviation**	**T-test**	η^2
Experimental	40	37.86	13.55	11.52	**0.62**
Control	40	12.98	1.8		

Table 4: First Hypothesis Results

This confirms the obvious impact of the use of mathematical problem-solving on the development of fluency; and also confirms the first hypothesis.

Second Hypothesis: The second hypothesis states that there are statistically significant differences at $\alpha \leq 0.05$ between the average scores of the students in the experimental group and the control group in the post application of the creative thinking test in the flexibility skill in favor of the experimental group.

In order to test this hypothesis, a t–test was used to calculate the significance of differences between two independent groups to identify the impact of the use of problem-solving in the development of creative thinking skills (flexibility) among prep school students in Arab schools in northern Israel.
Table 5 shows the results:

Group	Number of Students	Arithmetic Mean	Standard Deviation	T-test	η^2
Experimental	40	27.16	8.33	11.21	**0.6**
Control	40	12.38	0.54		

Table 5: Second Hypothesis' Results

This confirms the obvious impact of the use of mathematical problem-solving on the development of flexibility, and thus corroborates the second hypothesis too.

Third Hypothesis: the third hypothesis states that there are statistically significant differences at $\alpha \leq 0.05$ between the average scores of the students in the experimental group and the control group in the post application of the creative thinking test in originality skill in favor of the experimental group.
In order to test this hypothesis, a t-test was used to calculate the significance of differences between two independent groups to identify the impact of the use of problem-solving in the development of creative thinking skills (originality) among prep school students in Arab schools in northern Israel.
Table 6 shows the results:

Group	Number of Students	Arithmetic Mean	Standard Deviation	T-test	η^2
Experimental	40	65	12.88	8.53	**0.47**
Control	40	29.5	2.89		

Table 6: Third Hypothesis Results

This confirms the obvious impact of the use of mathematical problem-solving on the development of originality, and consequently confirms the third hypothesis.

Fourth Hypothesis' Results: The fourth hypothesis states that there are statistically significant differences at $\alpha \leq 0.05$ between the average scores of students in the experimental group and the control group in the post application of the creative thinking test as a whole in favor of the experimental group.

To test this hypothesis, a t-test was used to calculate the significance of the differences between two independent groups to identify the impact of the use of problem-solving in the development of creative thinking skills in general among prep school students in Arab schools in northern Israel.
Table 7 depicts the results:

Group	Number of Students	Arithmetic Mean	Standard Deviation	T-test	η^2

Experimental	40	78	10.18	9.43	**0.52**
Control	40	56.6	6.47		

Table 7: Fourth Hypothesis Results

This confirms the obvious impact of the use of mathematical problem-solving on the creative thinking test as a whole, and substantiates the fourth hypothesis.

Discussion and Conclusion

The results of the first hypothesis, whose results found an effect for the use of mathematical problem-solving between the average results of students in the experimental group and the average of the students of control group in favor of the experimental group, coincide with the results of Abu Athrah (2010) and Mustafa (2009), regarding the use of some strategies that work on the development of creative thinking skills, including fluency in the field of mathematics, and this can be explained by the following reasons:

1. The use of mathematical problem-solving gives the students an opportunity to solve life problems related to the reality of their lives, which improve the students' fluency of thinking.
2. Mathematical problem-solving helps students to apply knowledge in new life situations and increase their connection to this knowledge, leading them to improve their performance.
3. The use of mathematical problem-solving improves students' handling of life problems compared to the control group students.
4. Mathematical problem-solving increases students' awareness of the importance of studying mathematics in solving daily life problems, prompting students to develop their creative thinking.

The results of the second hypothesis, which found an effect for the use of mathematical problem-solving between the average results of the students of the experimental group and the average of the students of the control group in favor of the experimental group, are consistent with the results of Abd algani (2018; 2019), Abu thrah (2010), Giordano (2003), Mann (2005) and Rosa (2000), in the use of some strategies that develop creative thinking skills, including flexibility, in the field of mathematics. This can be explained by the following reasons:

1. Solving mathematical problems allows students to take organized steps that greatly contribute to the development of their ability to express and participate effectively, resulting in the development of students' flexibility in producing ideas.
2. The use of solving mathematical problems gives the issue a vital character by accustoming students to formulate the issue in their own language, to draw an appropriate diagram of it, and to explain it with a model or sensory means. The diversity in the means of presentation of objects and life situations, and the use of symbols, increase students' creativity.
3. Solving mathematical problems is concerned with students' understanding of the topics and problems posed, which develops a spirit of creativity, makes them abler and skilled in dealing with life and its problems, and expands their life experiences and links them to what they had learned at school.
4. The use of mathematical problem-solving made students able to solve unfamiliar and more complex problems with more confidence and mental flexibility compared to the control group students.

The results of the third hypothesis, which found an effect for the use of mathematical problem-solving between the average results of the students of the experimental group and the average of the students of the control group in favor of the experimental group, are consistent with the results of the studies of Abd algani (2018; 2019), Abu thrah (2010), Giordano (2003), Mann (2005) and Rosa (2000), in the use of some strategies that develop creative thinking skills including originality, in the field of mathematics. This can be explained by the following reasons:

1. The use of mathematical problem-solving helps to develop the aesthetic sense of mathematics, to appreciate its importance in real life, and develops a positive inclination towards it, which led to an originality in students' thinking when solving life problems.
2. Mathematical problem-solving is used to ask meaningful questions, and gives enough time to think about the answer and clarify the meaning of each question, so that students learn how to address any problem they face by themselves.
3. The use of mathematical problem-solving allows students to appreciate reasonable answers, and to use them inversely towards the data, which contributed to the formation of their own issues or problems, which increased their authenticity.

The results of the forth hypothesis, which found an effect in the use of mathematical problem-solving between the average results of the students of the experimental group and the average of the students of the control group in favor of the experimental group, are consistent with the results of the studies of Abd algani (2018; 2019), Abu thrah (2010), Giordano (2003), Mann (2005) and Rosa (2000), in the use of some strategies that develop creative thinking skills as a whole in the field of mathematics. This can be explained through the following reasons:

1. The diversity of activities and life problems leads to a rise in creativity among students.
2. Solving mathematical problems with their multiple, progressive and interrelated steps broadens students' perception, and their inclusion in the steps has helped them to develop their creative thinking.
3. Solving mathematical problems increases students' understanding of the problems posed, which developed their fluency of solutions, flexibility of entrances, and originality of solving them, which developed their creative thinking.

We can conclude that the diversity of activities led better understanding of the material, which in turn led to conceptual learning among students and to more creative thinking among students. All of the above can be summarized in the Abd Algani, Hibi and Abo Al-Haija model (see figure 10):

Figure 10: Abd Algani, Hibi and Abo Al-Haija Model

Recommendations

In light of the results of the study the researcher recommends:

1) To use mathematical modeling in the mathematics curriculum to show the role of mathematical knowledge in solving real-life problems.

2) To train students in the faculties of education and teacher training colleges on how to use modeling and mathematical problem-solving in solving life problems.

3) Teachers should work to discover students' abilities and inclinations, develop their curiosity, and work to develop these abilities in the right direction.

4) The authors of the math curriculum should boost teacher's attention to the importance of mathematical problem-solving, to increase the student's motivation to study mathematics.

5) There should be a specialized team to select problems and activities that develop creativity, and to include them in the math curriculum in an appropriate manner that takes into account students' individual differences.

6) Apply gradualness in posing problems in the curriculum, so that there are problems solved mentally; some need paper and pen and some need calculators in order to develop creativity in students.

7) To focus on organizing the content of the mathematics curriculum in the preparatory stage according to mathematical problem-solving.

8) To prepare guides for teachers to teach the mathematics curriculum at the preparatory stage using mathematical problem-solving.

Proposals for Future Research:

In the light of the objectives of the current study and its results, we can propose the following future studies and research:

1. Study the impact of the use of mathematical modeling in teaching other subjects at other educational stages.
2. Study the impact of the use of mathematical modeling on the development of visual thinking skills among primary school students.
3. Study the effectiveness of training programs for teachers to use mathematical modeling in teaching different school subjects.
4. Study and identify the awareness of workers in the educational field concerning the importance of mathematical modeling.

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The connection between parenting style and the achievements in mathematics and discipline of high school students from the Arab society

Abstract

The present study examines the relationship between the four main parenting styles and students' achievement and discipline at school. The four examined parenting styles are: the authoritarian, the authoritative, the permissive and the uninvolved. The main research question: Is there any relationship between parenting style and student achievement in mathematics and discipline at school? The study focused on high school students from Arab society. Questionnaires regarding parenting style were given to 50 parents from three high schools, a private one and two governmental. Subsequently, achievement and discipline questionnaires were given to teachers working in the same schools. The findings of the study revealed a positive relationship between the authoritative parenting style and the students 'achievements in mathematics, and a positive relationship between the authoritative parenting style and the students' discipline. In addition, the study revealed a positive relationship between authoritarian parenting style and student achievement in mathematics, and a positive relationship between authoritarian parenting style and student discipline. The study also revealed a negative relationship between the permissive parenting style and student achievement in mathematics, and a negative relationship between the permissive parenting style and student discipline. Furthermore, the findings show a negative relationship between uninvolved parenting style and student achievement in mathematics, and a negative relationship between uninvolved parenting style and student discipline. Hence, the main research conclusion is that the authoritative parenting style is the best and most effective of the four parenting styles, this is because students who are raised according to this style have the best achievements in mathematics and discipline. In contrast, the findings show that the uninvolved parenting style is the worst style, because of the negative relationship between it and the student achievement in mathematics and discipline.

Keywords: parenting style; Academic achievement in mathematics; Student discipline; High School Students; Arab society

1. Introduction

Parenting style can set goals and boundaries for children, besides giving mental, emotional and financial support. The combination of support and goal setting lead children to future success (Inam, Nomaan & Abiodullah, 2016).

This study focuses on the relationship between parenting styles and their impact on student achievement in mathematics and discipline at school. This issue is considered important because it can raise people's awareness about towards the way they should educate their children. It sheds light on the importance of supervising children and the significance of intervention and provides the appropriate response in everything related to the child's life.

The research literature emphasizes that parenting style has a very high impact on the child's future and his success at school and in life, in general. Authoritative parents who get involved in their children's lives, give them the needed support and encouragement, are parents who will most likely see their children succeed in the future. Authoritative parents give their children autonomy since being young, so they develop early and become more successful in the future. Parents who punish their children for every

mistake the make are supervising parents, yet these acts may come back to haunt those parents. Beyond the other, there are parents who give their children everything they ask for, but do not supervise them. At the same time, there are parents who are not involved at all in their children's educational process (Inam, Nomaan & Abiodullah, 2016).

Hence, the aim of the present study is to examine how parenting style affects student achievement in mathematics at school as well as their discipline. Therefore, the main research question is: Is there any connection between parenting style and student achievement in mathematics and discipline in the Arab society?

2. Literature Review

2.1 Parenting style

Parenting style is a psychological structure that represents the standards and strategies parents set and use to raise their children. The quality of raising children can be very vital and much more important than the amount of time parents spend with their children. For example, parents can spend the whole afternoon with their children, but at the same time they can be involved in other different activities like browsing on their smartphones; consequently, they will not show enough care towards their children. Hence, it can be said that parenting style is the way parents respond to their children's needs and the way they ask them to do things. Today, there are lots of studies that deal with parenting styles, and theories that describe the best parenting style for raising children (Huang & Gove, 2015).

Children go through a lot of different stages during their life, therefore parents have to create a parenting style considering a number of factors that develop over time, with the development of children's personalities. During infancy, parents try to adjust to a new lifestyle after the birth of their baby. Psychologists differentiate between the relationship between parents towards children and the relationship between children towards parents. Children's relationship with their parents is a relationship of dependence and affinity, while parents' relationship with their children is called connection. During infancy and early childhood, parents must determine a particular parenting style according to which they will raise their baby. But then, in adolescence, parents have to make changes in their parenting style because they need new adjustments to their child's new personality, which will require much more freedom. In fact, parents always face such challenges throughout raising their children (Kuppens & Ceulemans, 2019). The child's mood and the parents' culture have a high impact on the parenting style that the child can accept. Likewise, adherence to education plays a large part in the subject.

Previous studies on parenting and child's development have shown that parents who provide their children with proper independence, control and nurturing raise children who exhibit a higher level of social ability. Showing the children love in addition to caring and affection encourage both the child physically and mentally. During the 1980s, researchers were able to understand how different parenting styles affect a child's development during life (Kuppens & Ceulemans, 2019).

2.2 Theories of child rearing

Previously written child-rearing theories are the source, or the basis, for the parenting-style theories that this paper discusses. This section presents a small portion of the most common and dominant theories that have historically been related to the topic of child rearing and from which parenting styles were subsequently derived.

In the early 17th century, two philosophers wrote two different books which specifically deal with raising children. John Locke's book "*Some Thoughts Concerning Education*", written in 1693, is a major starting point in the pedagogical field. In his book, Locke emphasizes the importance of experience for the child's development. Locke recommends that the child develops the physical habits first. In 1762, the philosopher Jean-Jacques Rousseau published a book on education entitled: "Emile, or on Education." In his book, Rousseau suggested that the education a child should receive should be much less related to books, and more dependent on the child's interaction with the world around him. Hence, it can be seen that both philosophers have two different approaches to raising children. While John Locke pays more attention to the children's physical ability and skills, Jean-Jacques Rousseau is more concerned with the slow-paced parenting style. Russo prefers the child to understand his environment at his own pace without parental pressure (Masud, Thurasamy & Ahmad, 2015).

A theory close to Piaget's theory is that of Eric Erickson. According to the theory, the child develops in eight stages, during life. To move on to the next level, the child must go through the previous level. Moving from stage to stage is done by solving a problem related to the stage in which the child exists. According to the theory, the child has to face a crisis related to the stage he is in, solve the problem and then progresses to the next stage of development in life. Hence, the role of parents is to choose a parenting style that will expose their children to as many dilemmas as possible that will help children develop their abilities at the stage they are at (Chen, 2015).

According to Frank Furedi's theory, parents' actions are less influential on the children than the people think. According to his theory, governments always try to guide parents in the way they should raise their children. They make parents care about their children and look for certain effective ways to raise them. But in fact, children have the desire and ability to succeed in any situation. According to Furedi, development is a natural thing that is going to happen during life, and parental intervention can sometimes delay children's development, especially if parents are always intervening in anything related to their children (Chen, 2015).

Another important theory on the subject of raising children is Jean Piaget's "The theory of cognitive development". This theory describes how children interpret the world around them. According to Piaget, children think differently from adults. According to the theory, at each stage of life the children think differently, and the children's cognitive thinking develops according to the age of the child. This theory has contributed much to the field of child rearing, and continues to this day to influence parents and teachers (Gralewski & Jankowska, 2020).

2.3 Baumrind's parenting typology

According to Sarwar (2016), Diana Baumerind is a researcher who has dealt with the subject of classifying parenting styles. Her research is known as Baumrind's Parenting Typology. In her research, she examined the difference between the way parents raise their children in the context of the following:

1) Reactive versus non-reactive parents
2) Demanding parents versus non-demanding parents

Parental responsiveness refers to learning in which parents respond to their children's needs in a supportive and accepting way. Demandingness refers to the rules that parents set for their children's behavior, their expectations of their children to obey the rules and the level of punishment expected if the children break the rules (Sarwar, 2016). Hence, Baumrind has identified three main and dominant parenting styles that most parents adopt and raise children according to:

1) Authoritative parenting style
2) Authoritarian parenting style
3) Permissive parenting style

Baumerind believed that parents should not punish, but they should not also be permissive. Instead, they should set rules for their children that should not be broken, but at the same time they should show their children their love. The researcher adds that parents' stress can affect parenting style in that the style will not be stable enough and consequently results in poor communication with the children. Stress can lead to less supervision, setting incomprehensible rules or in some cases, failure in setting rules. In addition, stress can cause parents to be responsive instead of being involved parents, i.e., parents who react after things have already happened, instead of being involved in everything related to their children's lives. Hence, parents should pay attention to the fact that stress is highly harmful to raising children, therefore they are required to keep their passive emotions away from their children as much as possible (Sarwar, 2016).

After a more in-depth study of parenting styles it was found that there is a fourth common parenting style just like the other three parenting styles called: uninvolved Parenting Style (Garcia & Serra, 2019).

2.4 Parenting Styles

2.4.1 Authoritative parenting style

According to this parenting style, parents are both reactive and demanding. This parenting style is characterized by the fact that it puts the child at the center, and thus the expectations from the child are very high, i.e., children should reach adulthood very quickly. Although this style position high expectations from children, specifically in showing maturity, still parents who raise their children according to this parenting style show forgiveness when the child does not meet their expectations. Parents who raise their children according to this parenting style encourage their children to be independent, but they also set boundaries for their children's actions. Parents do not rule out negotiations with their children, and they try to be warm and caring (Kim et al., 2018). Parents who use this style are less controlling than parents who use the authoritarian style, thus giving their children more freedom. As a result, they allow their children to take their own decisions according to their own judgment. Children raised according to this style are independent children who usually trust themselves. This style is born when the parents are reactive and demanding (Doinita & Maria, 2015).

Parents who raise their children according to this parenting style expect mature and independent behavior from their children. Punishment for misconduct is a stable punishment that matches the size of the offense the child committed. There is also consistency in the punishment, so that the punishment is not arbitrary or violent. In many cases, parents have a conversation with their child and analyze the case with him/her in a way that will allow him/her to see the mistake he has made. In some cases, it helps the child understand and change his/her behavior. The result of this parenting style, children tend to be more successful, loved by the people around them, more generous and able to make decisions independently (Radcliff et al., 2018).

2.4.2 Authoritarian parenting style

Under this parenting style, parents are demanding but unresponsive. Authoritarian parents are restrictive and severely punishing. In addition, parents make their children obey the rules they have set without any explanation as to why these rules should be followed. This style puts the status of the family at the center

and not the child's. Punishment such as shouting and corporal punishment are the most common forms of punishment that characterize the authoritarian parenting style. The purpose of this punishment is to teach the child how to behave and how to grow up in a rude atmosphere after adulthood. Furthermore, this punishment prepares children for the negative reactions of society they might encounter in the future, such as anger and aggression (Jadon & Tripathi, 2017; Friendson, 2016).

Despite this, it cannot be argued that this parenting style is not successful all over the world. In fact, this parenting style is culture-dependent. In Asian and Eastern countries this parenting style is successful, as can be seen in countries like China and Japan that raise their children according to the authoritarian parenting style. One explanation for this phenomenon is that parents and adults in these countries are figures who receive more respect than adults in Western countries (Rauf & Ahmed, 2017).

2.4.3 Permissive parenting style

According to this parenting style, parents are responsive but not demanding, they have no demands from their children. This parenting style is characterized by parents being permissive. This style is also characterized by a lack of expectations from the child's behaviors. According to this style, parents are very involved with their children, but do not set them goals or means of supervision. Parents accept their children and respond to their needs. Parents who raise their children following this style do not ask them to behave in a certain way. In adulthood, children being raised according to this parenting style will be inattentive to avoid behavior that causes harm to others (Fuentes et al., 2015).

Parents who raise according to this parenting style try to be friends with their children, and do not fulfill the role of the parent properly. Expectations from children are very low and discipline is not shown in the children's behavior. They also allow their children to take their own decisions without supervision. According to this parenting style, children are not punished. Some permissive parents try to give their children what they themselves miss in childhood. The Baumerind's study conducted among those children showed that those children are undeveloped, uncontrollable and irresponsible (Checa & Abundis-Guiterrez, 2018). Children who have grown up in a permissive parenting style grow up to be more impulsive, and are incapable of controlling their behavior. (Odongo, Aloka & Raburu, 2016).

2.4.3 Uninvolved parenting style

According to this parenting style, parents are not involved in everything that happens during their children’s lives. They are disconnected from their children's reality. Parents are both unresponsive and unassuming. Parents who raise their children according to this parenting style do not know what is going on in their children's lives. They also do not spend time with their children, and usually do not know where their child is most of the day (Garcia & Serra, 2019). In addition, parents of this type are unaware of what their children are doing; there are almost no rules for their children, and their children do not receive guidance from them, love or attention. Uninvolved parents do not invest time and energy to meet their children's basic needs. It cannot be argued that uninvolved parents are not involuntarily involved. Sometimes, parents do not have enough awareness about raising children, and parents are often involved in other serious problems like financial and other problems (Garcia & Serra, 2019).

2.5 Academic achievements in mathematics

In many cases, people limit student achievement in mathematics to their grades at school. While grades are a very good assessment of student achievement in mathematics, there are plenty of other issues people need to consider when it comes to student achievement in mathematics. Besides grades, teachers

judge their students' achievement according to the investment each student performs during the lessons and at home. It can be said that student achievement in mathematics consists of student's participation with the teacher during the lesson, adherence to homework and assignments, and the largest percentage that reflects student achievement in mathematics are the grades (Muller, 2018). This is because there are other elements that are involved in teacher's evaluation such as the students' different abilities. While some students do not make mistakes during tests, others make mistakes that cause grades to drop. These mistakes do not change the teacher's assessment of a particular student, this is because students work with their teachers during a long school year, and grades are not the only factor that teachers usually take to evaluate students (Muller, 2018).

2.6 The relationship between parenting style and student achievement in mathematics

While elements such as maternal and paternal education, parental employment, and parental socioeconomic status have been explored as elements that affect children's achievement, there is another element of great significance that affects children's achievement. This element is of course parenting style (Inam, Nomaan & Abiodullah, 2016). When examining the authoritative parenting style, it can be seen that most researchers rank this style at the top of the scale of styles. According to the researchers, this parenting style is the best for raising children, because there is a certain balance between parents' demands from their children and the responsiveness of parents to their children's needs (Inam, Nomaan & Abiodullah, 2016).

Many studies that have examined the impact of parenting styles on children's achievement, in order to compare parenting styles and know which of them has the greatest positive impact on student achievement in mathematics, have found that authoritative parenting style is the most successful. The reference here is not limited to achievement in grades, students who grow up in an authoritative parenting style are more proficient and happy children. These children have great self-confidence which makes them believe that they can face new challenges and overcome them. They are also highly aware that disappointments can happen from time to time when they are not trying significantly. According to these findings, these students blame themselves and the effort they put in when they fail at school, or when they encounter a particular obstacle. They also place greater value on success when they achieve it (Pinquart, 2016).

While children who grew up in an authoritarian environment are children whose academic condition is not bad at all and they can be equally successful, the vast majority claim those children do the work out of fear of the punishment that awaits them at home. Motivation of these children is not derived from their desire to learn and know more, but from their parents' desire to succeed. These children are often insecure, stressed quickly and show high anxiety when encountering situations that are difficult to overcome (Cenk & Demir, 2016).

The students who grew up in an atmosphere of permissiveness are less successful children. These children are largely dependent on their teachers at school. They do not do homework, do not attend class and do not show a high desire to learn, but they expect their teachers to push them towards success for no justifiable reason. Those students along with the children raised by uninvolved parents are the least successful students (Cenk & Demir, 2016).

2.7 Discipline and Behavior at School

Just as parenting style affects student achievement in mathematics at school, it does the same with student's behavior. Children who grow up in an authoritative parenting style are children with a better ability to interact. They are sociable with their peers and with their teachers; they can have conversations and play games with their friends in the school yard (Ugurlu & et al, 2015).

They equally respect their teachers, show no impudence and generally exhibit far fewer discipline issues than children who grow up under a different parenting style. Children of parents who grow up in an authoritarian parenting style are children who can also show great respect for the teacher, just as they show great respect to their parents. Those children obey their parents without the parents giving an explanation; it can also happen at school. But what can happen at school with these children is that they come to school in order to release and express their energies that result from the massive pressure that their parents put on them. Hence, although those students are usually good students with fewer discipline issues, they are more problematic than children who grow up in an authoritative parenting style (Ugurlu & et al, 2015).

Children who grow up in a permissive parenting style are children with a discipline problem. These kids think there are no boundaries in life; no boundaries at home means no boundaries at school. They are not used to obeying rules; they think they can do and get what they want. Those children often encounter serious discipline problems. Children who grow up without parental involvement have the worst record when it comes to discipline issues. Those children are trying to draw attention from their environment in the most wrong ways. They adopt the stigma that children who are not academically good are children with discipline problems. So, it can be seen that those children exhibit the most disciplinary problems within the school (Ugurlu & et al, 2015).

2.8 Purpose of the study, research question and research hypotheses

The aim of the present study is to examine the relationship between parenting styles, student achievement in mathematics and discipline in high schools in the Arab society to answer the main research question:

Is there a connection between parenting style, student achievement in mathematics and discipline of high school students from Arab society?

The hypotheses of the research

- There will be a connection between parenting styles, student achievement in mathematics and their discipline.
- There will be a connection between the components of parenting styles, students' achievements in mathematics and their discipline.

From the main hypotheses, the following sub-hypotheses are derived:

1) A positive relationship will be found between the authoritative parenting style and student achievement in mathematics.
2) A positive relationship will be found between the authoritative parenting style and student discipline.
3) A positive relationship will be found between the authoritarian parenting style and student achievement in mathematics.

4) A negative relationship will be found between authoritarian parenting style and student discipline.

5) A negative relationship will be found between the permissive parenting style and student achievement in mathematics.

6) A negative relationship will be found between the permissive parenting style and student discipline.

7) A negative relationship will be found between uninvolved parenting style and student achievement in mathematics.

8) 8) A negative relationship will be found between uninvolved parenting style and student discipline.

3. Methodology

3.1 The research method

The study examines the relationship between parenting styles, student achievement in mathematics and school discipline. Examining the relationship among the three variables necessitates carrying out the quantitative method. The three concepts, parenting style, student achievement in mathematics, and student discipline, defined in the literature review, constitute the three research variables to be examined.

3.2 Study population

The study population consists of parents of students from Arab high schools in Israel. A total of 300 questionnaires were administered. 150 of them were given to parents. In addition, 50 questionnaires were handed out to teachers who teach in those schools. Parents and teachers were selected from the same schools to answer questions related to those students, thus there would be no biases in the study findings. In order to diversify the study participants, both mothers, fathers, male and female teachers responded to the survey.

3.3 Research tools

The study uses questionnaires to examine parents and teachers' responses in relation to the study population. To elaborate, parents got the parenting style questionnaire. A parenting style questionnaire is a questionnaire that asks questions about the way parents raise their children. The purpose of this questionnaire is to differentiate between parenting styles Arab parents adopt to raise their children. Parents were asked to respond to 10 statements.

In addition, a questionnaire of student achievement in mathematics and discipline was also handed out to the students' teachers whose parents participated in the study. The questionnaire included 10 additional statements. The questionnaire asks questions about the students' behaviors in class and within the school building. Besides, it asks questions about students' achievements in mathematics, participation and cooperation with their teachers in class.

3.4 Research variables

3.4.1 Dependent variables:

3.4.1.1 Student achievement in mathematics

Student achievement in mathematics is divided into two parts: academic achievements in mathematics that relate to student grades, and cultural achievements in mathematics that relate to students'

involvement in class, their participation, courtesy and respect they show towards their teachers. Therefore, both constitute the research two variables that examine student achievement in mathematics.

These two variables are ordinal scale variables, which rate student achievement in mathematics from 1 to 6, where value 1 means "it is not good at all", while value 6 means "excellent".

3.4.1.2 Student discipline

Student discipline is divided into two variables as well. The first variable is the behavior of students in class, whereas the second is the behavior of the students in school yard. These two variables are listed on a scale, according to which the teacher is asked to rate student discipline from 1 to 6, accordingly, value 1 means that "students exhibit discipline problems and their discipline is not good at all", while value 6 indicates "very good discipline".

3.4.1 Independent variables

3.4.1.1 Authoritative parenting style

The variable is a dummy variable. The variable answers the question of whether the parenting style is an authoritative style or not. Value 1 means that the parenting style is authoritative, while value 0 means that the parenting style is not authoritative.

3.4.1.2 Authoritarian parenting style

This variable is also a dummy variable. The variable answers the question of whether or not parenting style is authoritarian parenting style. Value 1 means that the parenting style is authoritarian, while value 0 means that the parenting style is not authoritarian.

3.4.1.3 Permissive parenting style

The variable is a dummy variable. The variable answers the question of whether or not parenting style is permissive parenting style. The value 1 means that the parenting style is a permissive parenting style, while the value 0 means that the parenting style is not permissive.

3.4.1.4 uninvolved parenting style

This variable is a dummy variable that checks whether the parenting style is an uninvolved style or not. The value 1 means that the parenting style is an uninvolved style, while the value 0 means that this style is not an uninvolved style. This variable was constructed from the parents' agreement or disagreement with the statement "the parents are not responsible for supervising children".

4. Finding

After collecting the data, the data was fed into the SPSS software in order to analyze and display them. This chapter is divided into two parts. The first part is a descriptive part in which the demographic variables of the research participants and their answers are presented, while the second part presents the research findings and the relationship between the variables.

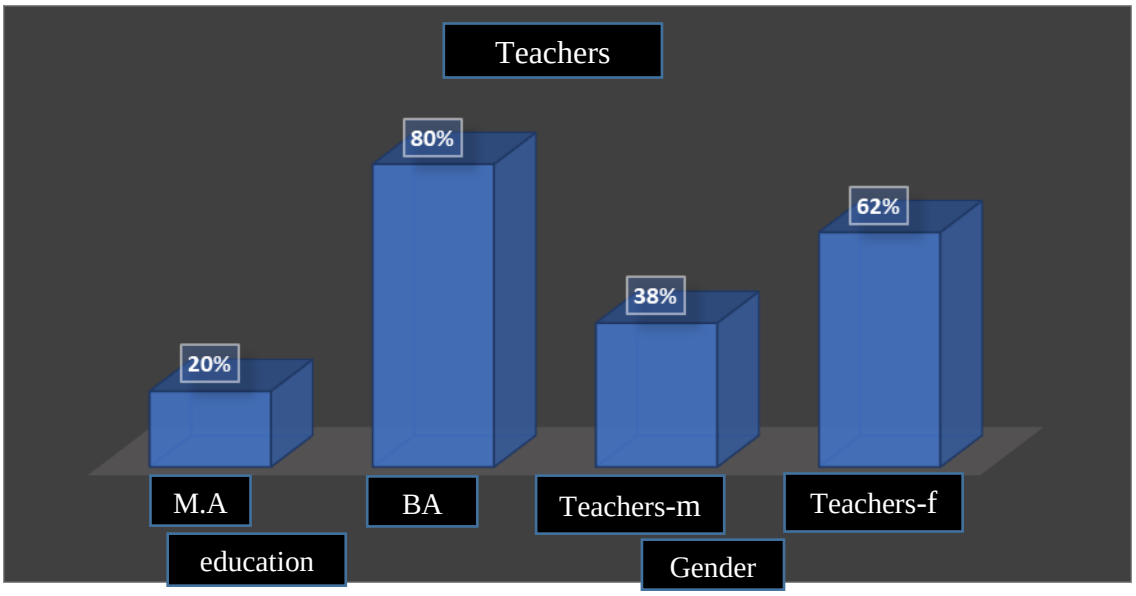
4.1 Descriptive statistics

Table 1: ***Description of the study population***

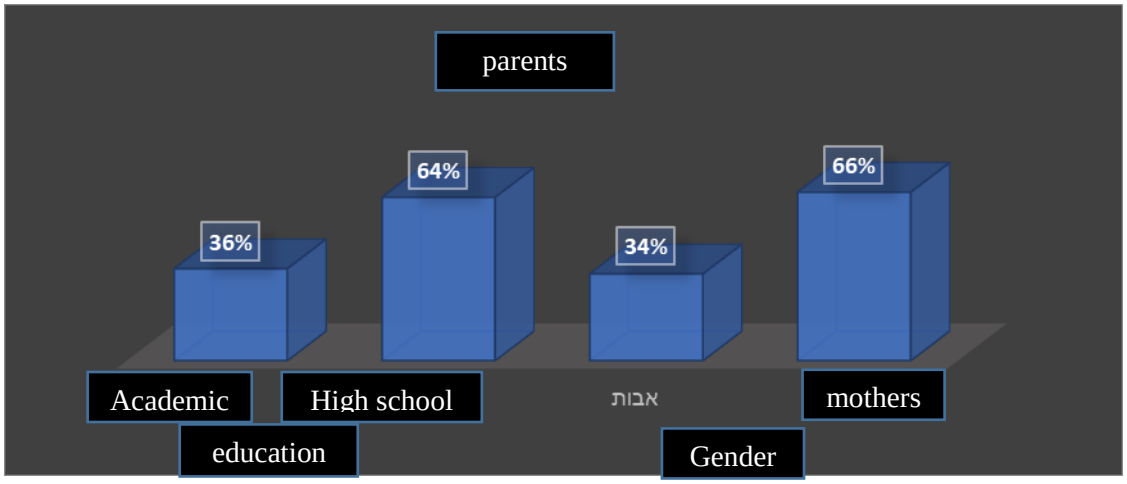
	Teachers	Parents
Gender	**Female: 62%**	**Mothers: 66%**
	Male: 38%	**Fathers; 34%**
Education	**B.A: 80%**	**High-school: 64%**
	M.A: 20%	**B.A & more: 36%**
Age		
means	**35.84**	**45.18**
Standard deviation	**(8.2)**	**(5.39)**
No' of participants	**50**	**150**

Table 1 shows that 62% of the study participants were women and 38% of them were teachers. Only 20% of the teachers a master's degree. The average age of the teachers participating in the study was 35.84 years. 66% of the parents who participated in the study were mothers. It can also be seen that most parents do not have a higher education, with 64% of them having a high school education and below. Only 36% of the parents had a bachelor's degree or a higher one. The average age of the parents was 45.18 years as shown in graph (2) and 35.84 for teachers as shown in graph (1).

Graph (1): distribution of the research sample according to teachers



Graph (2): distribution of the research sample according to parents



From these data it can be concluded that most of those involved and interested in the education system are women, this is because most of those who agreed to participate in the study were women. It can also be seen that the parents' education figures are low.

Table 2: Distribution of research variables by parenting style

Variable **Means** **Standard deviation**	**Authoritative** **Means** **Standard deviation**	**Authoritarian** **Means** **Standard deviation**	**Permissive** **Means** **Standard deviation**	**Uninvolved** **Means** **Standard deviation**
Academic achievement	5.66 (0.49)	5.53 (0.51)	3 (1.34)	1.76 (0.92)
Cultural achievements in mathematics	5.75 (0.45)	4.53 (1.45)	3.5 (1.31)	1.61 (0.65)
Classroom discipline	5.66 (0.65)	4.84 (0.89)	2.91 (0.99)	2.07 (1.18)
Discipline in the school yard	5.33 (0.77)	4.3 (0.94)	3 (1.12)	1.61 (0.86)
Number of participants	36 (24%)	39 (26%)	36 (24%)	39 (26%)

Table 2 shows that students' achievements in mathematics whose parents educated them according to an authoritative parenting style is much higher than those of students whose parents educated them according to other parenting styles. These results are true both for academic achievement as well as for

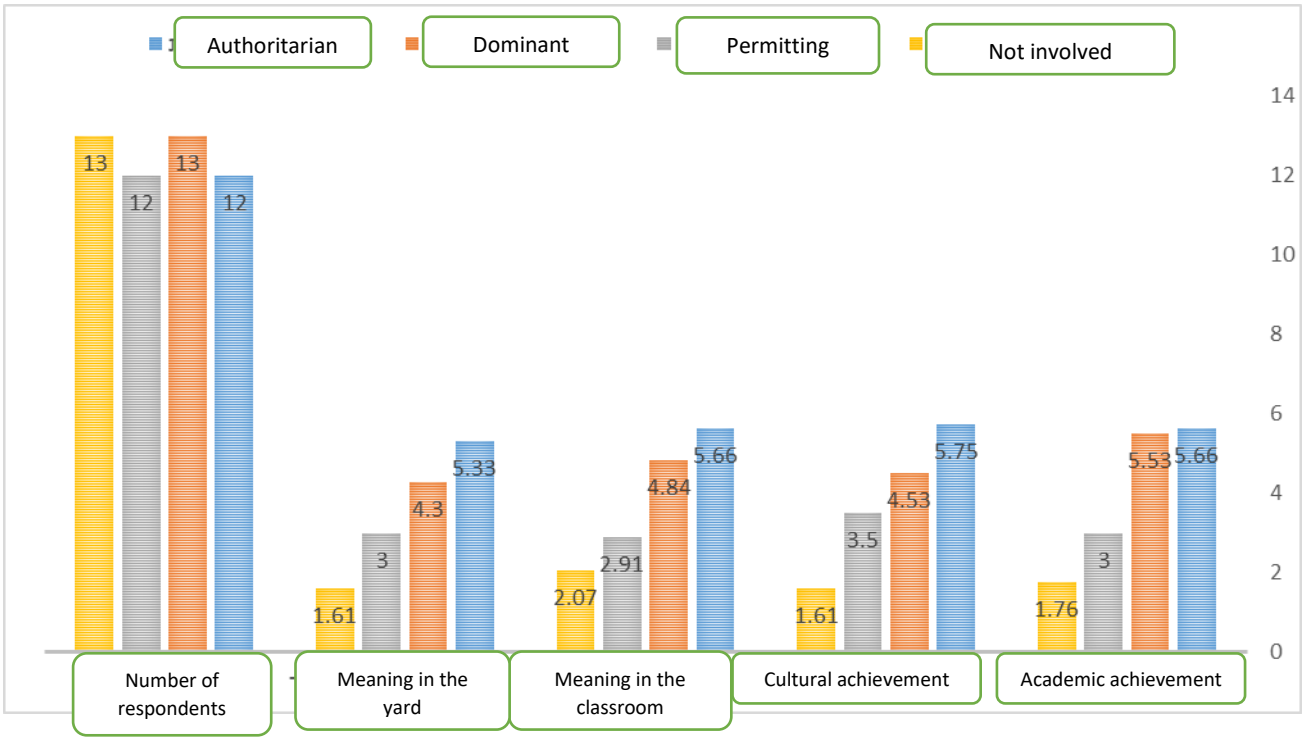
cultural achievement. Moreover, the table shows that the average of the academic achievements in mathematics of the students whose parents educate them according to an authoritative parenting style stands at 5.66, this average is very close to excellence. The average of the achievements in mathematics of students whose parents educate them according to an authoritarian parenting style is 5.53. This average ranges from 'good' to 'very good', and is much higher than the averages of children whose parents educated them using the permissive style or uninvolved one, with an averages in both styles that stands at 3 and 1.76 respectively.

In the context of cultural achievement, it can also be seen that children whose parents educated them according to an authoritative parenting style had the highest average, with 5.75, whereas the average of the children whose parents educated them according to the authoritarian style was 4.53, an average that ranges from 'good' to 'very good'. The average of students whose parents educated them according to the permissive style and the uninvolved parenting style was 3.5 and 1.61, respectively. These averages range from 'not good at all' to 'not good'. So when looking at student achievement in mathematics in general, it can be noted that students whose parents educated them according to an authoritative parenting style have the best achievements in mathematics, then children who are educated according to the authoritarian style, then those whose who were educated following the permissive style. At the end lies students whose parents were not involved in their educational process.

The table also shows that the discipline average of students who are educated according to an authoritative parenting style was the highest concerning two aspects, discipline within the classroom and discipline in the school yard. Moreover, the table shows that the average of class discipline among these students is 5.68, an average close to excellence, while the average among students whose parents educate them according to authoritarian style was 4.84 - between 'good' and 'very good'. This average was higher than the average of students whose parents educated them according to the permissive style and the uninvolved, which stood at 2.91 and 2.07 respectively. These averages range from 'not good at all' to 'not good'.

The table also tells the readers that the average of discipline in the school yard among students whose parents educated them according to an authoritative parenting style is 5.33. This average is considered the highest among the rest and lies between 'very good' and 'excellent'. Immediately after that comes the average of students whose parents educated them according to the authoritarian style, which stands at 4.3; an average that is also considered very high, but is slightly lower than that of children educated according to the authoritative style. At the bottom, there exists the permissive style along with the uninvolved parenting style. The average of the permissive parenting style stands at 3. This average is found between 'bad' behavior and 'reasonable' behavior in the school yard. This happens when the average of students whose parents are not involved in the educational process is 1.61. When looking at students' discipline, in general, it can be seen that students who are educated according to an authoritative style are the students with the best discipline, followed by students whose parents are authoritarian. At the bottom, unsurprisingly, are students whose parents are not involved in the educational process, as shown in graph 3:

Graph 3: Summary of the averages of the research variables according to parenting styles



4.2 Inferred Statistics

Table 3: Logistic regression model for predicting the relationship between authoritative parenting style and student achievement in mathematics and discipline.

List of variables	**First model**	
	Authoritative parenting style	
	B (S.E.)	**Exp(b)**
Academic achievement	0.41 (0.2)	**2.66
Cultural achievement	0.27 (0.19)	**1.75
Discipline in class	0.06 (0.2)	*1.87
Discipline in school yard	0.11 (0.08)	***2.12
Fixed		-4.34
-2 log likelihood		50.04
N		150

Level of significance: p < 0.05* p < 0.01** p < 0.001*** L

Table 3 presents findings regarding the relationship between authoritative parenting style and student achievement in mathematics and discipline. The relationship was examined by analyzing findings of the logistic regression model. The two research hypotheses tested in this model are:

1) There is a positive relationship between the authoritative parenting style and student achievement in mathematics.
2) There is a positive relationship between the authoritative parenting style and students discipline.

The table shows a significant positive relationship between the authoritative parenting style and the children's academic achievements in mathematics. In other words, parents who raise their children according to the authoritative parenting style increases the chance that their children's achievements in mathematics will be good at 2.66, (wald = 6.28, p <0.01).

Also, the table indicates a significant positive relationship between the authoritative parenting style and the students' cultural achievements in mathematics. Thus, the fact that parents raise their children according to the authoritative parenting style increases the chance that their cultural achievements in mathematics will be good at 1.75, (wald = 7.09, p <0.01).

In addition, the table also indicates a significant positive relationship between authoritative parenting style and student discipline class. So, parents who educate their children according to the authoritative parenting style increases the likelihood that their discipline in class will be significantly better at 1.87, (wald = 8.1, p <0.05).

In the end, a significant positive relationship was found between authoritative parenting style and student discipline in the school yard. Thus, the fact that parents educate their children according to an authoritative parenting style increases the probability in 2.12 that their behavior in the school yard will be significantly better. (wald = 11.79, p <0.001).

Table 4: Logistic regression model for predicting the relationship between authoritarian parenting style and student achievement in mathematics and discipline.

List of variables	**Second model**	
	Authoritarian parenting style	
	B (S.E.)	**Exp(b)**
Academic achievement	**0.28 (0.16)	1.72
Cultural achievement	0.41 (0.12)	1.32
Discipline in class	**0.07 (0.11)	2.07
Discipline in school yard	*0.27 (0.12)	1.01
Fixed		0.87
-2 log likelihood		48.17
N		150

Level of significance: p < 0.05* p < 0.01** p < 0.001***

Table 4 presents findings regarding the relationship between authoritarian parenting style and student achievement in mathematics and discipline. The relationship was examined by analyzing findings of the logistic regression model. The two research hypotheses tested in this model are:

1) There will be a positive relationship between the authoritarian parenting style and student achievement in mathematics.
2) There will be a negative relationship between the authoritarian parenting style and students' discipline.

The table shows a significant positive relationship between the authoritarian parenting style and the students' academic achievements in mathematics. Thus, parents who educate their children according to the authoritarian parenting style increases the probability by 1.32 that the academic achievement of the students will be significantly good, (wald = 2.86, p <0.01).

In addition, the table indicates that there is an insignificant positive relationship between the authoritarian style and students' cultural achievements in mathematics. Thus, parents who educate their children according to the authoritarian style increases the chance in 1.52 that students' cultural achievements in mathematics will be good, (wald = 10.53, n.s).

The table also shows a significant positive relationship between authoritarian parenting style and student discipline in class. Thus, parents who educate their children according to the authoritarian parenting style increases the chance in 1.07 that students' discipline in class will be good. (wald = 0.36, p <0.01).

At the end, the table also shows a significant positive relationship between authoritarian parenting style and student discipline in the school yard. Thus, parents who ducate their children according to the authoritarian parenting style increases the chance that their discipline in the school yard will be good at 1.31. (wald = 4.99, p <0.05).

Table 5: Logistic regression model for predicting the relationship between permissive parenting style and student achievement in mathematics and discipline.

List of variables	**Third model**	
	Permissive parenting style	
	B (S.E.)	**Exp(b)**
Academic achievement	*-0.24 (0.24)	1.28
Cultural achievement	*-0.41 (0.27)	1.51
Discipline in class	*-0.17 (0.21)	0.84
Discipline in school yard	*-0.19 (0.13)	0.82
Fixed		0.87
-2 log likelihood		44.06
N		150

Level of significance: p < 0.05* p < 0.01** p < 0.001***

Table 5 presents findings regarding the relationship between permissive parenting style and student achievement in mathematics and discipline. The relationship was examined by analyzing findings of a logistic regression model. The two research hypotheses tested in this model are:

1) There will be a negative relationship between the permissive parenting style and student achievement in mathematics.
2) There will be a negative relationship between the permissive parenting style and students' discipline.

Table 5 shows a significant negative relationship between the permissive parenting style and the students' academic achievement. Thus, parents who educate their children according to the permissive parenting style lowers the chance by 1.28 that the students' academic achievement will be good. (wald = 1.02, p <0.05).

Table 5 also shows a significant negative relationship between permissive parenting style and the students' cultural achievements in mathematics. Thus, parents who educate their children according to the permissive parenting style lowers the chance by 1.51 that the studnets' cultural achievements in mathematics will be good. (wald = 2.25, p <0.05).

In addition, the table shows a significant negative relationship between the permissive parenting style and the discipline of students in class. So, parents who educate their children according to the permissive parenting style lowers the chance at 0.84 that the students' discipline in class will be good. (wald = 0.65, p <0.05).

Finally, the table also shows a significant negative relationship between the permissive parenting style and students' discipline in the school yard. Thus, parents who educate their children according to the permissive parenting style lowers the chance by 0.82 that the students' discipline in the school yard will be good. (wald = 1.91, p <0.05).

Table 6: Logistic regression model for predicting the relationship between uninvolved parenting style and students' achievement and discipline.

List of variables	**Fourth model**	
	Permissive parenting style	
	B (S.E.)	**Exp(b)**
Academic achievement	*-1.38 (0.57)	0.24
Cultural achievement	*-1.14 (0.46)	0.31
Discipline in class	*-1.11 (0.52)	0.32
Discipline in school yard	*-1.07 (0.53)	0.34
Fixed		15.74
-2 log likelihood		29.25
N		150

Level of significance: p < 0.05* p < 0.01** p < 0.001***

Table 6 presents findings regarding the relationship between uninvolved parenting style and students' achievement and discipline. The relationship was examined by analyzing findings of a logistic regression model. The two research hypotheses tested in this model are:

1) There will be a negative relationship between the uninvolved parenting style and students' achievement
2) There will be a negative relationship between the uninvolved parenting style and students' discipline.

Table 6 shows a significant negative relationship between the uninvolved parenting style and student achievement in mathematics. So parents who are not involved in their children's educational process lowers the chance by 3.24 that their children's academic achievement will be good. (wald = 5.79, $p < 0.05$).

In addition, table 6 also shows that there is a significant negative relationship between the uninvolved style and students' cultural achievements in mathematics. So, parents who are not involved in their children's educational process lowers the chance at 4.31 that their students' cultural achievements in mathematics will be good. (wald = 6.16, $p < 0.05$).

Also, table 6 also indicates a significant negative relationship between the uninvolved parenting style and student discipline in class. Thus, parents who are not involved in their children's educational process lowers the probability by 4.32 that their children's discipline in class will be good. (wald = 4.56, $p < 0.05$).

Finally, a significant negative relationship was found between the uninvolved parenting style and student discipline in the school yard. Thus, parents who are not involved in their children's educational process lowers the chance that their children's discipline in the school yard will be significantly better at 4.34, wald = 4.07, $p < 0.05$).

5. Discussion

The study examined the relationship between the four main parenting styles and students' achievement and discipline at school. The four parenting styles examined are the authoritative, the authoritarian, the permissive and the uninvolved. In addition, students' achievement was divided into two parts, academic achievement that constitutes student grades, and cultural achievement such as respecting schedules and timetables, submitting homework and participating in class. Moreover, student's discipline was also divided into two parts, student behavior in class and student's behavior in the school yard. The study examined the relationship between each parenting style individually with student achievement in mathematics and discipline.

The first hypothesis tested was:

1) There will be a positive relationship between the authoritative parenting style and students' achievement.

The findings of the study revealed a significant positive relationship between authoritative parenting style and students' cultural and educational achievement. These findings matched the first research hypothesis and what is found in the literature review. According to the literature review, this kind of education positions children at the center, this is because the children's parents behave with their children in a way that gives the children self-confidence. Parents treat their children like adults, explaining to them every step and every decision made. In this way, parents maintain a good relationship with their children and

make them feel that they have autonomy. Here, parents set high goals for their children, and exercise control over their children's accomplishments. If they see that their children are having a hard time, they intervene. Here, parents maintain their children's independence and only intervene if necessary. Punishment, according to this style, is not necessary. If parents choose to punish their children, they explain to them the reason for the punishment. Parents who educate their children according to this parenting style are characterized by being both demanding and responsive. That is, they demand from their children, and at the same time they respond according to the child's behavior (Doinita & Maria, 2015). From this, it can be concluded that this parenting style is the best of the other styles. Findings show that children have the best achievements in mathematics.

The second hypothesis:

2) There will be a positive relationship between the authoritative parenting style and students' discipline.

In addition to the positive relationship between authoritative parenting style and student achievement in mathematics, the findings of the study show a positive and significant relationship between the authoritative parenting style and student discipline, both in class and in the school yard. This finding is consistent with the research hypothesis and the literature review. According to the literature, this is because parents who educate their children according to an authoritative parenting style do not put pressure on their children; they give them their space and let them express themselves. Children have autonomy, but at the same time there is a feeling that they are responsible for their actions. Hence, they choose to behave in a good way that is compatible with the responsibility placed on them. Parents avoid punishing their children as much as possible. Instead, they let them feel that it is their responsibility to behave well (Radcliff & et al, 2018). Punishment gives children a feeling of lack of autonomy. Therefore, I see that parents should avoid punishment as much as possible. When children feel autonomous, they take on the responsibility of not being intrusive children. Moreover, having conversations with the children and explaining why their behavior was not good is better than punishing them without knowing why they are being punished.

The third hypothesis:

3) There will be a positive relationship between the authoritarian parenting style and student achievement in mathematics

The findings of the study also show a positive relationship between the authoritarian style and student achievement in mathematics. This finding is partially consistent with the third research hypothesis. This is because there was a significant relationship between this parenting style and only the academic achievement, but there was not a significant relationship between the authoritarian style and the cultural achievement. According to the literature, parents who educate their children according to this parenting style set high goals for their children. In addition to the high goals, they also exercise slave supervision over their children. Parents barely give their children space and autonomy, and they control their children by giving commands and instructions (Jadon & Tripathi, 2017). What is written in the literature explains the children's academic achievements in mathematics. Studying the cultural achievements in mathematics, literature suggests that children who are educated according to this parenting style are severely punished if they make a mistake (Jadon & Tripathi, 2017). This issue suggests that fear motivates children and makes them successful at school, and so parents achieve their goal - high grades. But when looking at their responsiveness with their teachers at school, it can be imagined that these students are not as responsive as students who are educated according to an authoritative style, which is

the reason for the lack of the relationship significance. Hence, despite the good achievements in mathematics of the children, it is still clear that children who are educated according to the authoritative style have better achievements in mathematics. To compare both parenting styles one can examine table 2, which shows that the achievements in mathematics of students raised by authoritative parents are higher than children raised by authoritarian style.

The fourth hypothesis:

4) There will be a positive relationship between authoritarian parenting style and discipline among students

The findings also indicate a positive and significant relationship between authoritarian parenting style and student discipline. This is true for discipline in class and also within the school yard. This finding contradicts the research hypothesis and what is found in the literature review. This hypothesis was written on the basis that children raised by authoritarian style are pressured by their parents, and so they turn to school to relieve stress. This style of education can behaviorally disappoint parents, due to the stress and lack of autonomy they exert on their children. However, the findings of the present study show that this is not true of children in Arab society. Heavy punishment exposes children to negative reactions and negative behavior, although the goal of the parents is educational. This parenting style can cause emotional damage to their children, and lead to negative behavior in the school yard (Friendson, 2016). Nevertheless, the findings of the study revealed otherwise, the behavior of children raised by this style is good behavior both in the school yard and in class. It is conceivable that Arab society is closer to East Asian societies, which educate their children according to the authoritarian parenting style which make the children behave well in class and at home. It is possible that child's supervision is very significant here. It helps parents controlling the discipline of their children as well. Nevertheless, when comparing the authoritarian parenting style to the authoritative style by looking at the data in table 2, it can be seen that the discipline average among the students educated according to the authoritative style, is higher. So, it can be said that although education according to the authoritarian style is good, still the authoritative style is better.

The fifth hypothesis:

5) There will be a negative relationship between the permissive parenting style and student achievement in mathematics

The findings also show a negative and significant relationship between the permissive parenting style and the students' academic and cultural achievements in mathematics. These findings are consistent with the research hypothesis and the literature review. Based on these findings, it can be said that the permissive style is considered unsuccessful compared to the first two styles. This is because this parenting style stems from the parents' lack of awareness concerning the way the educational procedure should be. Parents do not exercise supervision over their children and give them too much freedom, but on the other hand they care about their children and are willing to provide them with all the needs they want. The result is that children get everything they want, but at the same time there is no one to guide them on the right path to reach their goals. This model is abundant in the Arab society (Fuentes & et al, 2015). This parenting style is very common in Arab society. Parents think that by satisfying their children's needs, they make them appreciate them. Yet, in practice children are educated without knowing that there are boundaries; consequently, their achievements in mathematics are low, and this has far-reaching consequences in the future.

The sixth hypothesis:

6) **There will be a negative relationship between the permissive parenting style and students' discipline**

The findings of the study revealed a negative and significant relationship between the permissive parenting style and students' discipline in class and in the school yard. These findings matched the literature review and research hypothesis. According to the review, children who are educated according to the permissive style are not used to having boundaries. Their parents do not set them educational goals neither behavioral. Consequently, children develop habits that they are allowed to do what they feel like doing without limits. At school, they think it is natural to behave this way and they are even surprised with boundaries at school. Hence they are expected to be problematic at school (Checa & Abundis-Guiterrez, 2018). This behavior has future consequences, because if the child does not realize that his behavior is incorrect, he can be violent in adulthood, and cause himself and his family lots of problems. The last two findings place this parenting style at the bottom of the scale of the effective parenting styles.

The seventh hypothesis:

7) There will be a negative relationship between the style of uninvolved parenting style and student achievement in mathematics

The findings of the study revealed a negative and significant relationship between uninvolved parenting style and student achievement in mathematics. In this case, too, the research hypothesis was confirmed, and it is consistent with the literature review. It is not surprising that when parents are not involved in their children's educational process, children have no boundaries, no goals and no one to guide them on the right path. These children have no one to ask them what they have done at school, or who help them with homework. They are isolated both at home and שא school (Garcia & Serra, 2019). Hence, it is not surprising they have the lowest achievements in mathematics in school.

The eighth hypothesis:

8) There will be a negative relationship between uninvolved parenting style and students' discipline

The findings of the study revealed that there is a negative relationship between uninvolved parenting style and student discipline. This finding confirms the research hypothesis and illustrates what is written in literature. This finding actually reinforces the claim that this parenting style is the worst of the four styles. According to this style, parents do not exercise supervision neither provide children with their needs. Parents are simply not involved in the educational process. This creates serious problems such as discipline issues. As found in the latter finding, there is a negative relationship between uninvolved parenting style and student discipline, which is consistent with the research hypothesis and reinforces the literature review. Children whose parents are simply not involved cannot be expected to be successful children in school (Garcia & Serra, 2019). Hence, it can be said that these children are actually victims in our society who can eventually turn to the world of crime, drugs and alcohol with lack of their parents' supervision and involvement.

6. Summary and Conclusions

There are four common parenting styles. From them, other parenting styles are derived. The four most common parenting styles are the authoritative, the authoritarian, the permissive and the uninvolved.

According to the authoritative parenting style, children are at the center. The get the love and warmth they need and their parents set goals they need to accomplish. This style is considered the most effective because its impact on student achievement in mathematics and discipline is most positive. According to the authoritarian style, parents determine a set of goals to be achieved by their children, but there is no balance with the parents' responsiveness, so the children have to obey without any explanation. The effect of this style on student achievement in mathematics is positive, but its effect on the child's behavior can be both positive and negative. The two worst parenting styles are the permissive style, according to which the child receives a lot of attention from his parents but no goals are set for him. Hence, parents expect to be appreciated by their children just because they give them everything they want. According to the literature, this parenting style has been found to be ineffective because children develop habits of carelessness and irresponsibility, in addition to belief they deserve everything without putting in any effort. This style negatively affects student achievement in mathematics and behavior at school. Finally, the fourth parenting style that this study discusses is the uninvolved. Following this style, children do not receive attention from their parents and parents do not set goals or rules for their children. Hence, parents are detached from their parents. The result is translated in poor school performance, in addition to serious discipline issues.

This study examined the relationship between parenting style and student achievement in mathematics and discipline. The aim was to examine whether parenting style could influence student achievement in mathematics and their behavior at school. Student achievement in mathematics was defined as the academic achievement when the reference here is the student grades, while the cultural achievements in mathematics relate to students' adherence to schedules and their collaboration with their teachers. In addition, students' discipline was defined as their discipline in class in the school yard.

The conclusions of the studies show:

1) Authoritative parenting style is the best of the four. Children who are raised according to this style had the best results both in terms of achievement and discipline.
2) Authoritarian parenting style is a very good and successful style, this is because the children's achievements in mathematics in terms of grades were good, but in terms of meeting deadlines and class participation, students of authoritarian parents were less good than children of authoritative parents.
3) Contrary to what is found in the literature, authoritarian parenting style has a good effect on student discipline in class and in the school yard.
4) Permissive and uninvolved parenting styles were the least good styles. The permissive style was better than the uninvolved one, but in both of these parenting styles children’s achievements in mathematics and their discipline were not good.

7. Ethics

To maintain research ethics, the participants were informed that the information they provide would be used solely for the purpose of the present study; the information would not be published neither accessed by anyone other than the researchers. Participants were told about the purpose of the study. They were informed that filling the questionnaire express their consent to participate in the study. In addition, to avoid bias in the findings, the link to the questionnaire was sent exclusively to those who agree to participate.

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The relationship between leadership style, school climate and students' persistence in middle and high schools in Arab society in Israel

Abstract

The present study examines the relationship between leadership style, school climate, and students' persistence in middle and high schools in Arab society in Israel. Various studies have shown that leadership style, in general, and school climate, in particular, impacts the students academically, emotionally, and socially.

Moreover, they are even considered vital factors that influence students' persistence or dropping out of the education system. Therefore, the purpose of the present study focuses on examining the relationship between leadership style, school climate and students' persistence in middle and high schools in Arab society in Israel. The current study was conducted in the quantitative methodology, in which 100 teachers from five in middle and high schools from the Arab community in the north of the country have participated. The researchers used two types of questionnaires to collect data: the first measures school climate, whereas the second examines the principals' leadership style The findings of the study indicate positive associations between a human-centered leadership style, ethical school climate and students' persistence at school. This finding points to the importance of nurturing a moral school climate and a human-centered leadership style as crucial factors influencing student persistence.

Keywords: school climate, leadership style, students' persistence, Arab schools

Introduction

The school principal is one of the essential factors in school educational practice. The principal's leadership style and the way mathematics teachers perceive s/he has a significant impact on his/her perception in everything relatedto school. As such, s/he affects the school atmosphere and the formation of an ethical climate which can, for better or worse, jeopardize the mathematics teachers' behavior, the effectiveness of their work, and the student's behaviorand mental well-being (Sotrak, 2004).

According to Kelly and colleagues (2005), a human-centered leadership style is a supportive style that encourages participation, strengthens team commitment, fosters relationships within the staff, and cares about employee well- being (Kelly et al., 2005). Principals with a human-centered leadership style emphasize the importance of peopleand adopt the approach that states that management's primary goal is to create a good harmony between people and the organization. These principals have a natural tendency to take care of the employees, nurture them and make decisions considering the employees' well-being.

In contrast, there is a task-oriented leadership style. Unlike the above technique, the school principal thinks logically, sets clear goals and policies, determines the nature of people's responsibilities in their job, and provides technical support for planning, organizing, and implementing procedures for the school (Murphy et al., 2005). Task-oriented principals are primarily concerned with meeting the goals they have set, while the employees are only the means to achieve those goals. Those principals are perceived as very dedicated to their tasks, challenging, and less attentive to employees. Their decision-making is influenced primarily by achieving their goals.

A school climate describes the set of internal characteristics at school, including the perceptions of the organization members, values, social beliefs, and standards. It refers mainly to the relationship and atmosphere among the organization members to balance the school's organizational, personal, and systemic aspects (Cohen et al., 2009). This climate contributes to a sense of security and belonging among students, develops their desire to study and be at school, challenges them, gives them a good learning experience, improves their self-image, and leads them to academic success.

Many studies have examined the impact of school climate on academic achievement, yet few have examined the effects of school climate on students' persistence in the education system. According to Calderon et al., school climate is a significant factor influencing students' industry or dropping out of the education system. According to them, students stay in the school climate for many hours every day; they are greatly affected emotionally and socially. In addition, school climate is a crucial factor that impacts creating an environment that develops personal security and a sense of belonging, physical protection, mental health, moral development, and academic functioning among students. Pasternak (2003) adds that school climate is one factor that most affects students' mental health, achievement, and improvement in their cognitive, academic, social, and emotional functions (Pasternak, 2003).

Following those mentioned above, the influence of the school principal and school climate on students on different and varied levels is particularly noticeable. In light of this effect, there is a vital need for this type of research at schools in Arab society in Israel to deeply examine the degree of influence a leadership style and school climate have on students' persistence at schools in the Arab community in Israel. To investigate the subject of the study, several hypotheses were established:

1. There is a positive relationship between leadership style and school ethical climate.
2. There is a positive relationship between human-centered leadership style and students' persistence at school.
3. There is a positive relationship between school moral climate and students' industry at school.

In light of the existing research literature that deals with the impact of school leadership style and climate on students' persistence, it is interesting to investigate whether school leadership style and climate do affect students' persistence rates at schools in Arab society in Israel. Therefore, the main research question is: "Is there any connection between leadership style, school climate and students' persistence at schools in Arab society in Israel?"

Literature Review

Many researchers have defined the concept of leadership according to their perceptions and from different social experiences. For example, a leader, from Fiedler's (1964) point of view, is the person who can influence the members of a group. The source of his leadership is not his authority nor part of his resources, but rather his ability to control his followers and motivate them towards fulfilling the group's tasks.

Similarly, Schneider and Monsongo (2010) believe that leadership is a trait that describes the leader's

ability to lead people under his command toward a common goal. Researchers as Igbaekemen (2014) define leadership as the art of influencing people to strive voluntarily towards achieving goals. Leadership, as various scholars claim (Iqbal et al., 2015; Alghazo & Al-Anazi, 2016; Abdul Basit & Sebastian, 2017; Bush & Glover, 2002), is a process in which a person (the leader) influences other people to achieve a goal through directing them in a way that makes the plan more cohesive and coherent. In addition, leadership plays a crucial role in creating an atmosphere or a culture that promotes the development of the organization members with efficiency and excellence.

Educational leadership

Research literature shows that, in general, leadership style is of great importance to the functioning of employees in the system, their satisfaction, their level of productivity, and their level of motivation (Matson, 2018; Grimm, 2017; Mehwish & Batool, 2015; Buble, Juras & Matic, 2014; Eyal, & Roth, 2011). According to Zuman (2009), since the principal is the personality responsible for what happens at school, it is likely that he has the enormous to navigate the system in a dynamic reality. By utilizing these powers and following his leadership style, the principal can influence the teachers, both positively and negatively. The principal's style of leading and how his/her teachers perceive s/he have a significant impact on his/her perception and approach towards school practice (Sotrak, 2004).

Educational leadership is a long-term journey that requires patience, tolerance, and forbearance from its holders. According to Opletka (2015), educational leadership aims to identify the strengths of the followers and create conditions that will allow them to grow, develop, lead different processes, and create a shared vision at the regional, school, and school personal levels. As Harpaz (2009) argues, educational leadership stems from an academic identity and commitment to an educational goal. In his opinion, the educational leader is characterized by agility and mental flexibility that allow him to face future difficulties and invest in developing organizational or personal abilities that will enable rapid real-time adaptation to the changes that occur.

The educational leader, as Opletka (2015) argues, strives to develop a school culture that includes an orderly and safe work environment, opportunities for significant students' involvement in school activities, teachers' participation in pedagogical decisions, use of external resources to support school goals and strong school- community ties. To achieve all the objectives mentioned above, the school principal has to obtain the teachers' cooperation (Elboim-Dror, 2000).

Leadership styles

There are different leadership styles, which differ from each other in three main factors:

- The leader's perception of his role and powers
- The perception of the society of the leadership roles
- The degree of the leader's exposure to his followers

As mentioned above, the role of leadership is to improve the employees' behaviors and sharpen their inclinations to achieve the organization's common goals. Mehrad and Fallahi (2014) note that leadership style determines the purpose and nature of guidance and the teamwork plan and its characteristics. Adizes (2004) adds that the differences in leadership styles are reflected in differences in behavior patterns. For example, a democratic leadership style, as Adizes argues, is based on the principles of equality, liberty, and rationality. It is characterized by openness, friendliness, and cooperation. In contrast, an authoritarian leadership style is based on principles of control and power and is characterized by closure, trouble, and lack of flexibility (Yashi, 2019).

1. **Authoritarian Leadership**: This leadership style, also called autocratic, is characterized by the fact that the principal makes all the decisions in the organization without the partnership of others. According to Khan and others (2015), the leader in the center of power in such a style exclusively makes all decisions. In addition, Iqbal and others (2015) argue that these leaders are characterized by a philosophy of "I say." They, exclusively, take decisions that emphasize the organization's tasks and its optimal productivity at the expense of any human consideration. Apart from this, Zareen and others state that this style gives little opportunity to the staff, and the staff members have no room to make suggestions, even if it is for the benefit of the team or the organization (Zareen et al., 2015).
2. **Laissez-Faire leadership style**: This is a leadership style whereby the principal provides little guidance to employees; he gives them as much freedom as possible (Tarsik et al., 2014). This style seems like a simple style without lots of intervention between the leaders and the followers. According to Bergen and Bressler (2014), leaders of this style avoid making decisions, are reluctant to take action, and get absent when they need to take a particular activity or position. Additional researchers (Antonakis et al., 2003; Monzani, 2015) note that this leadership style is characterized by avoidance of responsibility, leaders who do not respond to problems, and get absent when needed. Such leaders are inconsistent, hesitant to express an opinion and hesitate to respond to any event in the organization.

There is a consensus among various researchers that this leadership style is problematic (Gonen and Zakai, 2005; Yukl, 2010; Monzani, 2015). Lack of involvement can cause devastating damage to the organization and the employees. Followers who do not receive guidance and support may lose interest in work, which, in turn, negatively affects the organization's performance, the atmosphere, the culture, and the employees' satisfaction in the organization.

3. **Transformational leadership**: Such leadership expresses willingness to guide the followers to realize their full potential. It focuses primarily on the leader's emotional and cognitive aspects (Bass et al., 2003). This leadership motivates the followers to make an effort and encourages them to act and achieve qualitative performances in their missions. Various scholars argue that those leaders are endowed with four components: **charisma** which is the leader's ability to evoke strong emotions and identification with his goals; **inspiration** which is conveying a vision to others, encouraging challenges and empowering inspiration in their work; considering others which includes supporting the employees, encouraging them and ensuring opportunities for growth; intellectual stimulation which is raising the employees' awareness towards problems and the need to solve them creatively (Bass et al., 2003; Al-Daibat, 2017). According to Opletka (2012), transformational leadership highlights the importance of the vision for increasing the team's professional and organizational commitment and motivating its members to work for their common goals.
4. **Transactional Leadership**: This style is based on the relationships between the leader and the followers based on a mutually agreed set of expectations. Both the leader and the followers are aware of the actions that can be obtained in the framework of these expectations, especially when the transactional leader knows how to identify those expectations and respond accordingly. The leader can build a clear connection between the action and the reward (Opletka, 2012). Avolio et al. (2004) classify transactional leadership into two categories: **conditional** refers to the degree to which the leader rewards the followers after the tasks have been performed. According to this behavior, he clarifies to his subordinates the work expected of them and specifies the conditions under which they will be rewarded for their achievements. The use of incentives and rewards given in exchange for fulfilling tasks increases the employees' motivation to invest in the organization. The second is **the management by exceptions** which is divided into active management by exceptions and passive by exceptions. Active management by exceptions refers to the extent the leader rewards the followers after the tasks have been performed. In

this behavior he clarifies to his subordinates the work expected of them and specifies the conditions under which they will be rewarded. The use of incentives and rewards given in exchange for fulfilling tasks increases the employees' motivation to invest in the organization. In contrast, passive management by exceptions is manifested in the leader's intervention when followers cause problems or fail in performing their duties (Rukmani et al., 2010).

Various researchers have found that transactional leadership is less effective than transformational style. In their view, transformational leaders can feel their environment more and cultivate personal relationships with their subordinates. Therefore, teachers will be more satisfied as followers of a transformational leader compared to the transactional or the "Laissez Faire" leader (Shaul, 2011; Rukmani et al., 2010).

School climate

A school climate refers to the quality and nature of school life; it reflects norms, goals, values, teaching and learning methods, and interpersonal relationships at school. Four main areas shape the climate: safety, relationships, teaching and learning, and the environmental structure. One of the fundamentally essential dimensions of school climate is interpersonal relationships, which is how each student feels connected to at least one responsible adult at school. Personal and supportive attitude, adaptive teaching and assessment methods for students, and belief in their ability influence students' persistence at school (Cohen et al., 2009).

There is growing evidence that school climate can affect students' social, behavioral, and learning environments. The social framework has a significant influence as qualitative and quantitative support, i.e., the number of resources the student can turn to when s/he needs and the likelihood that the student will use this network of connections (Zullig et al., 2010). Most studies address the extent to which the perception of school climate shapes literary adaptation; simultaneously, they give lower weight to the emotional and behavioral consequences. Surprisingly, given that in middle school, symptoms of depression, low self-esteem, and behavioral difficulties occur (Cohen et al., 2009).

School climate has a profound effect on the students' mental and emotional health. Many studies have found that a positive climate is directly related to declining students' absenteeism in middle and high schools due to its strong influence on motivation for learning, academic success, reducing violence, bullying, and sexual harassment and as being a protective factor for learning and overall positive development (Kuperminic et al., 2001).

Many studies document biological and psychological cognitive changes in early adolescence that may negatively affect the school environment (Way et al., 2007). The changes in middle schools concerning the relationship between teacher-student and the changes in the relationship with the peer group affect the students' perception of the school climate and their psychological and behavioral aspects. Way and colleagues (2007) examined the pathways of change in students' perceptions regarding four dimensions connected to school climate:

- Teacher support, peer group support
- Student autonomy in class
- Clarity and consistency of school rules and regulations

They examined the effect of these change pathways on the psychological and behavioral adjustment among 1451 adolescents at three different periods in middle schools. The findings indicate that all

dimensions of school climate perception weaken during middle school. Moreover, a direct link has been found between this weakening and the students' psychological and behavioral adaptation (Way et al., 2007).

Other developmental theorists emphasize the importance of trust and caring in relationships, self-expression and autonomy in choices, and decision-making, as critical factors for normal development. A study of 1,415 American and Chinese middle school adolescents examined the relationship between three dimensions of school climate (teacher support, peer group support, and opportunities for classroom autonomy), psychological adjustment, and learning. Positive correlations were found between the three dimensions of the climate, the student's self-esteem, and achievement grades. In addition, a negative relationship was found between teachers' support, peer group support, and depressive symptoms, i.e., the higher the teachers' and peer group support, the lower the depressive symptoms. These findings dominate both cultures and both genders (Jia et al., 2009).

Dimensions of school climate Teacher-student relationship

The source of the educational practice lies in the teacher-student relationship as a relationship that represents a whole world of content, methods, and emotions. Various thinkers and philosophers like Buber and Fromm have emphasized the need for interpersonal relationships that stem from caring, concern, and responsibility toward others. Both emphasized the importance of the relationships that arise from the individual's inner desire to include others out of love. They see the human and caring relationship as a primary source of the individual's happiness (Shel, 2013). The social environment at school and academic satisfaction are closely intertwined with the teacher- student relationship. Satisfaction with school refers to enjoyment, interest, and desire to be at school (Zullig et al., 2010).

Gehlbach et al. (2012), which examined teacher-student relationship changes among middle school students, found that relationships tended to be less favorable throughout the year from the students' perspective. Moving to middle school, the student's relationship with their teachers tends to be less personal and less positive. Teacher- student relationship may be the key to understand the process of alienation from school. Students with a weak social connection with their teachers, tend to feel more detached and alienated. Studies on high school students' persistence point to poor relationships with teachers being central to leaving school (Zullig et al., 2010).

Supportive and caring teachers develop students with higher motivation and self-efficacy (Gehlbach et al., 2012). Supportive teachers are perceived by middle and high school students as those connected to their students on the emotional level, use different teaching strategies, push for students' academic success, and demonstrate decency when interacting with students (Suldo et al., 2009). Teachers' support has been shown to influence the students' behavioral, emotional, and cognitive involvement. Adolescents who exhibit school involvement in the emotional dimension tend to develop fewer emotional problems because they feel protected by the supportive relationships with the educational staff and peer group (Li & Lerner, 2011).

The support of the peer group

During adolescence, adolescents spend less time with their family and more with a peer group, usually within a school setting (Crosnoe & Johnson, 2011). The term peer group includes different circles ranging from the best friends of those boys to all the teens from the same age group in their environment, regardless of the degree of closeness. School and class are social places by nature, and peer group has significant influences on achievement, behaviors, and beliefs within those places (Crosnoe & Johnson, 2011).

Mental well-being was found to be consistently associated with peer group support. The support of the peer group plays a significant role in the adolescents' adaptation over time. It is a predictor of emotional symptoms such as anxiety, social stress, depression, interpersonal relationships, and self-esteem (Walsh et al., 2010).

Despite the impact of family support and teacher-student relationships on educational outcomes, there is little information regarding the relationship between peer group support and these educational outcomes. The school is organized so that, besides studying and activities, there are also characteristics of social interactions within the peer group, such as sports activities, breaks, and mealtimes. Their peers' sense of social support and acceptance satisfies the adolescents' need for belonging and helps them develop satisfaction, influencing behavioral, emotional, and cognitive involvement (Wang & Eccles, 2012).

Perceiving the degree of school democracy

The democratic educational theories were primarily developed under the philosopher and psychologist John Dewey (1859-1952). Dewey has worked hard to benefit from free education based on the students' experience and not on "coercing" knowledge from above; this is what he called democracy. He stressed the need to expand the educational view beyond the learning relationship between teachers and students because education is the social process by nature (Dewey, 1969).

The democratic dimension is the school climatic component that relates to the sense of involvement, choice and decision-making, fairness, and the ability for autonomous self-expression. Democracy is not just a form of the regime but, in fact, a state of life, a culture that puts the person first, not the organization (Segal and Richter, 2007).

The degree of democracy at school depends not only on the name and central vision of the school but on the active applications of democratic educational approaches. Applying a democratic education approach allow students to take a significant part at school and perceive it as a creation they are partners in. Students' perception of school climate as democratic, contributes to increasing responsibility and participation in school activities, strengthens the students' persistence, and reduces violent behaviors (Lannegrans-Willems, 2012; Sliwka, 2008).

Ethical climate

Climate is a comprehensive and multidimensional concept that includes many factors such as interpersonal relationships, norms, the degree of supervision or freedom, cohesion, a sense of belonging and satisfaction, order and procedure, sharing, competitiveness, and more. Patterson (2005) defines the organizational climate as a concept that combines behavioral components, assumptions, and values shared by the organization members with a common corporate culture. Out of the idea of the organizational climate, Victor and Cullen (1988) deduced items dealing with morality and hence, called it an ethical climate. They define the moral organizational climate as a kind of element in the corporate culture. In their view, organizational culture is broader and includes overall components of behaviors and symbols. Specifically, the ethical climate pertains to the organizational norms that directly relate to the administrative procedures and practices with different ethical implications. Both researchers presented two dimensions of moral climate: a climate of caring and concern which works for the well-being of others, and the formal climate based on regulations and policies established by the organization, including professional employee codes (Victor & Cullen, 1988).

Victor and Cullen (1988) presented a classification of five ethical climates with empirical metrics for identification:

1. Caring, ethical climate

2. Instrumental ethical climate
3. The moral climate of "rules and regulations."
4. The ethical environment of "laws and codes."
5. The ethical environment of "independence."

Two dimensions characterize the five types of ethical climate: the first concerns the motive of the person who makes the moral decision (generosity or moral principles), and the second concerns the level from which the considerations for decision-making stem (the individual, organizational and social groups) (Zehava and Peled, 2003).

Focusing on two types of climate - the caring and the instrumental sharpens the distinction between them and defines the ethical climate as a caring climate that indicates the employees' concern for the well-being of others. This climate is a product of the decision-maker and the cosmopolitanism from which the problem for the whole, the motive of generosity and the consideration for making the decision, stems. In contrast, in the instrumental ethical climate, personal and organizational interest is emphasized. It is a product of the decision-maker, which is based on a single consideration for making the decisions. This climate is based on an instrumental reference towards the individual so that the individual is another organizational resource, where everyone in the organization maximizes only his/her benefit (Victor & Cullen, 1988).

Persistence at school

Students' persistence in the education system is expressed in their desire to continue learning and avoid leaving school. In 2000, the "Student Rights Law" was enacted in the Knesset. According to the law, the state is responsible for ensuring the child the optimal conditions for proper learning, while recognizing his/her needs and rights to meaningful learning. The state tries to guarantee these rights with the help of the education system and the various services available for children and youth to ensure the students' persistence in the education system and prevent the dropout phenomenon (Ministry of Education, Culture and Sports, 2000).

Shaky relationships between students and school can affect their persistence or formal stay at school, even though they are detached from the learning process (Dover, 2005). Students' persistence in the education system is influenced by many factors, the student, the family and the community, yet quite a few of them are dependent and related to the education system and school. Various researchers (Cohen-Navot et al., 2001; Lahav, 2004; Sasson- Peretz, 1998; Calderon et al., 2009) pointed out key factors that affect students' persistence at school:

1. **Family factors**: Characteristics of a low socio-economic situation such as families with many children, unemployment, or low income may influence a students' persistence at school, or they're dropping out.
2. **Cultural factors**: Schools have become a social arena where children are exposed to diverse behaviors, values , and norms. Cultural factors have been found to affect students' persistence so that the importance of education affects their desire to continue learning or leave school.
3. **Personal factors**: The students' personal characteristics which are connected to low academic achievement, problematic school behavior, many absences from school, negative attitudes towards school, social problems at school, in addition low motivation, are all considered factors that negatively affect students' persistence at school.

4. **School-related factors**: school climate is a significant factor that affects the students' persistence at school. Many researchers and educators point out that inefficient teaching methods and low teaching quality, low expectations of the students by their teachers, are significant factors behind staying or leaving school. One of the salient strategies identified as effective in ensuring students' persistence in learning is creating a safe, protected, and positive school climate and promoting diversity, uniqueness, and creativity.

Ethical climate and persistence

Various studies have found that school climate is one of the practical and influencing factors in students' persistence or drop out. Rosenthal (2003) argues that dropouts, as opposed to persistent students, have low self- esteem, low self-confidence, feelings of worthlessness, problems with interpersonal communication, impulsive behavior, difficulty in self-control, and higher attention deficit disorders. It is necessary to create a positive school climate that contributes to strengthening students' persistence in school.

In a study by Levy-Yitzhak (2007) that focuses on the intrapsychic experience of dropout youth versus persistent youth, the researcher presents themes that explain the dropout factors such as problems in the functioning, learning, and performance, low achievement, low self-esteem, low satisfaction and a sense of alienation from school. Bachmann (2002) argues that a school ethical climate affects the nature of the student's connection to the educational system: feeling protected, staff support, and close interpersonal relationships. When these are missing or defective, the risk of dropping out increases. Adams and Christensen (2000) add that when trust is broken, cooperation is terminated, even if both parties have apparent interests in maintaining the relationship between them. Trust plays a vital role in the success of teaching and learning processes—a strong correlation between trust and school attendance (Adams and Christensen, 2000). Trust between the involved persons at school enables an open school climate and healthy interpersonal relationships. Trust is more acceptable in an environment of caring than in an atmosphere of rules (Coleman, 2008). Consequently, it can be noted that trust can be a mediating factor between the ethical climate at school and persistence in studying. Trust is more significant in schools with a caring, moral environment.

Hypotheses: (a) there is a positive relationship between leadership style and school ethical climate, (b) there is a positive relationship between human-centered leadership style and students' persistence at school and (c) there is a positive relationship between school ethical climate and students' persistence in school.

The main research question: Is there any connection between leadership style, school climate, and students' persistence at school in Arab society in Israel?

Methodology

The research method

The present study is based on the quantitative paradigm, which uses questionnaires that examine both school climate and leadership style. In quantitative research, the data can be quantified and statistically processed. The quantitative research paradigm assumes that knowledge is "there" waiting to be uncovered and that the researchers' role is to be "objective" and not allow their attitudes, values, and beliefs to penetrate the research process. Epistemologically, quantitative research is deductive and confirmatory (Strauss, 1987).

Study population and sample

The sample Includes teachers from Arab middle and high schools in Israel. The sample included 200 teachers, 134 males, and 66 females. The average years of seniority are 7.5 (range from two years to 15 years in teaching). One hundred sixty-four teachers with a bachelor's degree (82%) and 36 with a master's degree (18%

Research tool

Respondents were asked to fill in three questionnaires: the first examines school ethical climate (ethical/instrumental), according to (Victor & Cullen, 1987); the second concerns the leadership style (human- focused/task-focused) in middle and high schools in the Arab sector and the third examines the demographic variables.

Findings

The present study examines the relationship between school leadership style, climate, and students' persistence at schools in Arab society in Israel. The following data is taken from the Ministry of Education's website regardingthe percentage of industry in each researched school:

Table 1: Percentages of persistence in the selected middle and high schools in Arab society (data of 2019 from schools of Ordinary Education).

School name	Percentage of persistence
High school 1	74.3
High school 2	96.3
High school 3	85.5
Middle school 1	88.9
Middle school 2	87.3

Diagram 1*: Persistence data according to schools*:

It can be seen from Table 1 and Figure 1 that High School 2 has the highest percentage of persistence (96.3%) followed by Middle School 1 (88.9), then High School 2 with a percentage of 87.3, followed by High School 3 (85.5%).

The lowest is High School 1, with a persistence percentage of 74.3%.

The present study examines the relationship between school leadership style, climate, and students' persistence in Arab society in Israel. For carrying out the research, statistical data (means and standard deviations) of the variables of the study according to the school were calculated. Data is presented in

Table 2 and Diagram 2.

Table 2: Averages and Standard Deviations of school climate and school leadership style

	M-SCH* 1 N=40		**M-SCH 2 N=40**		**H-SCH** 1 N=40**		**H-SCH 2 N=40**		**H-SCH 3 N=40**		**Total N=200**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Caring ethical climate	**3.26**	0.123	**3.28**	0.115	**2.93**	0.067	**3.77**	0.228	**3.37**	0.242	**3.33**	0.310
Instrumental ethical climate	**2.16**	0.261	**3.09**	0.168	**4.62**	0.130	**1.51**	0.315	**3.47**	0.114	**2.96**	1.095
Human-focused leadership style	**4.59**	0.167	**4.21**	0.155	**1.37**	0.188	**4.69**	0.130	**2.62**	0.263	**3.49**	1.312
Task-oriented leadership style	**1.51**	0.165	**2.30**	0.179	**4.57**	0.139	**1.20**	0.120	**3.59**	0.128	**2.60**	1.278
Persistence	**88.9**		**87.3**		**74.3**		**96.3**		**85.5**			

* M-SCH= Middle school. ** H-SCH= High school

Diagram 2: Values of school climate and leadership style:

It can be seen from Table 2 and Figure 2 that in High School 2, which has the highest persistence rate (96.3%), the perception of the school climate as caring is extremely high (M = 3.77; SD = 0.228). High School 2 has a high rating of human-focused leadership style (M = 4.69; SD = 0.130). Middle School 1, which has a persistence percentage of 88.9%, the perception of the school climate as caring is (M = 3.26; SD = 0.123). Middle School 1 has a high rating of human-focused leadership style (M = 4.59; SD = 0.167). Concerning Middle School 2, which has a persistence percentage of 87.3%, the perception of the school climate as caring is the highest (M = 3.28; SD
= 0.115). Middle School 2 has a high ranking of human-focused leadership style (M = 4.21; SD = 0.155). High School 1, which has a very low persistence rate (74.3%), the instrumental school climate perception is extremely high (M = 4.62; SD = 0.130). High school 1 has a high rating of task-oriented leadership style (M=4.57; SD=0.139). High School 3 that has a persistence percentage of 85.5%, the instrumental school climate perception is (M = 3.47; SD = 0.114). It also has a high rating of task-oriented leadership style (M = 3.59; SD = 0.128).

To test the significance of the differences presented above, one-way Anova tests were calculated to examine the difference between the averages of the climate (caring/instrumental) and the averages of leadership styles (human-focused/task-focused) schools. Results are presented in Table 2.

Table 3: One-way Anova results of school climate and school leadership style

	F
A caring climate	$F(4,95)= 59.501^{**}$
Instrumental climate	$F(4,95)= 631.411^{**}$
Human-focused leadership style	$F(4,95)= 1219.801^{**}$
Task-oriented leadership style	$F(4,95)= 1811.012^{**}$

Note: ** - Significance level of p <0.001

Table 3 shows a statistically significant difference between teachers' caring perception of ethical climate among all schools [$F(4,95)=59.501$, $p<001$] so that the average of the caring perceptions towards the school ethical climate is higher in High School 2, followed by Middle School 1, followed by Middle School 2, followed by High School 3 , while the lowest is High School 1. It was also found a statistically significant difference between teachers' instrumental perceptions regarding the school ethical climate among all schools [$F(4,95)=631.411$, $p<001$] so that the average of the instrumental perception regarding the ethical climate is higher in High School 1, then High School 3, followed by Middle School 2 and then Middle School 1, while the lowest is High School 2. There is a statistically significant difference between teachers' caring perceptions of the human-centered leadership style [$F(4,95)=1219.801$, $p<001$] so that the average human-centered perception of the leadership style is higher in High School 2, followed by Middle School 1, followed by Middle School 2, followed by High School 3, while the lowest is High School 1. The findings also show a statistically significant difference between the teachers' perception of a task-oriented leadership style among all schools [$F(4,95)=1811.012$, $p<001$] so that the average of the perception of task-focused leadership style is higher in High School 1, then High School 3, followed by Middle School 2 and then Middle School 1, while the lowest is High School 2.

In order to test the hypotheses of the study that relate to the relationships between climate perception and leadership style and persistence, Pearson tests were calculated to test the correlations between the variables. Results are presented in Table 3:

Table 4: Correlation results for testing the relationship between school climate, leadership style and persistence:

	Persistence	**Ethical caring climate**	**Ethical instrumental climate**	**Human-focused leadership style**	**Task-oriented leadership style**
Ethical caring climate	r= 0.791**		r= -0.691**	r= -0.618**	r= 0.591**
Ethical instrumental climate	r= -0.946**	r= -0.691**		r= 0.910**	r= 0.945**
Human-focused leadership style	r= 0.897**	r= 0.591**	r=- 0.910**	r=- 0.975**	
Task-oriented leadership style	r= -0.899**	r= -0.618**	r= 0.945**	r= -0.975**	

Note: ** - Significance level of p <0.001

Table 4 shows a statistically significant strong positive relationship between perceiving the ethical climate as caring and persistence (r = 0.791, p <0.001); so that the more caring the perception, the higher the persistence, and vice versa. Moreover, a statistically significant strong negative relationship is found between perceiving the ethical climate as instrumental and persistence (r = -0.946, p <0.001); so that the more instrumental the perception, the lower the persistence. In addition, a statistically significant positive relationship is found between human- centered leadership style and persistence (r = 0.897, p <0.001), so the more human-centered the leadership style is, the higher the persistence, and vice versa. Furthermore, a statistically significant strong negative relationship is found between task-focused leadership style and persistence (r = -0.899, p <0.001); so that the more task- focused the leadership style is, the lower the persistence. And, a statistically significant moderate positive relationship is found between human-centered leadership style and a caring school climate (r = 0.591, p <0.001); so the more human-centered the leadership style is, the more caring the school climate perception will be. Finally, a statistically significant positive relationship is found between task-focused leadership style and the instrumental school climate (r = 0.945, p <0.001); so the more task-oriented the leadership style is, the more instrumental the perception of the school climate will be, and vice versa. Thus the three hypotheses were confirmed.

Discussion

Nowadays, the leadership of education is distinctive from other areas of leadership.

It is distinguished as a separate academic field because school is perceived as different from industrial companies and other organizations. This field was founded in 1875 when the first book for school principals was published. American principals have gained much autonomy, and the increase in the number of schools has required specific attention to the training of school principals. The purpose of the

field is controversial: several researchers see it as a field of application, whose goal is to develop knowledge that focuses on the personnel problems (principals, supervisors, etc.), whereas others attach importance to the scientific thinking as well as a critical and empirical examination of theories. The field of education leadership also has secondary objectives, such as improving the training of principals, examining the effects of school reforms, and evaluating various processes conducted at schools.

There is no doubt that education is a significant basis in every person's life that helps him shape his worldview and personality, make personal and professional decisions, and create a good base for promoting the individual in society on several levels. Believing that good education is the basis for a better life, we chose to examine the issue of persistence with an emphasis on the school ethical climate (both caring and instrumental) as an influential factor and leadership style (human-focused and task-focused). The present study examines the impact of school climate on its various dimensions (the instrumental ethical climate, law and code, and moral, caring climate according to Victor & Cullen, 1987), and leadership style on students' persistence in Arab middle and high schools. **Hypotheses:** (a) there is a positive relationship between leadership style and school ethical climate, (b) there is a positive relationship between human-centered leadership style and students' persistence at school and (c) there is a positive relationship between school ethical climate and students' persistence in school.

The main research question: Is there any connection between leadership style, school climate, and students' persistence at school in Arab society in Israel?

The primary purpose of this study is to examine whether there is a relationship between leadership style, school climate, and students' persistence at schools in Arab society in Israel. For examining such a relationship, teachers were given a questionnaire to explore the ethical environment (caring and instrumental) and explore leadership styles (human-focused and task-oriented). Over the years, many studies have been done on the subject. Most studies have shown unequivocally that school climate affects students' dropout, based on the extensive literary background in this study, but few have examined the impact of ethical environment and leadership style on students' persistence, especially in Arab society. The hypotheses of the study are:

(a) there is a positive relationship between leadership style and school ethical climate; (b) there is a positive relationship between human-centered leadership style and students' persistence at school; and (c) there is a positive relationship between school ethical climate and students' persistence in school.

Dropout from school is one of the risk behaviors that exist among adolescents. It has negative consequences on dropouts both in their present life and later in the future (Cohen-Navot et al., 2001; Lahav, 2004). Various studies have mentioned that school is a significant factor influencing students' attendance, so that the educational challenge is to understand the persistence processes better so that educators can intervene and support students until they complete their studying successfully.

The set of the leader's organizational behavior patterns towards his subordinates is called leadership style. This style stems from the principal's assumptions and values, the goals and norms of his behavior, and the employees' professional level and motivation. These perceptions are reflected by the behaviors and management practices the principals adapt (Menz, 1991). School leadership style has a direct impact on the school climate and affects both teachers and students. (Blase, 1986, Farber, 1983). Hence, we confirm the first hypothesis which assumes a positive relationship between leadership style and school ethical climate. In the second part of the first hypothesis, we thought that the more human the leadership style is, the more caring the ethical climate will be. For example, in High School 2, it was found that the average of the human-focused perception regarding leadership style is the highest. Moreover, High School 2 shows the highest average of caring perception regarding the ethical climate. On the contrary, in High

School 1 it was found that the average of human-focused perception concerning leadership style is the lowest with the lowest average of caring perception concerning the ethical climate. The success of principals, nowadays, depends more than ever on collaborations with others. Collaborations can be in the intra-organizational circle with the teaching staff, and also in the outer circle with customers, supplier's supervisors, instructors and other factors (Opletka, 2007). The leader's behavior patterns towards his subordinates is called leadership style. This style stems from both the leader's personal assumptions and values, his/her goals and norms of behavior, and the employees' professional level and motivation.

The results of the study also show a positive relationship between human-focused leadership style and persistence. Hence, we confirm the second research hypothesis, so that in High School 1, which is characterized by the highest average of human-focused leadership style (M = 4.7), we get high persistence rates (96.3).

And at the same time, High School 1, with the lowest perception average of human-focused leadership style (M= 1.37), also shows the lowest percentage of persistence (74.3). In a study that examined the impact of teachers' perception of school principal's leadership style and decision-making style, on teachers' perception of their profession and job satisfaction, it was found that leadership style based on change and innovation affects teachers' satisfaction, their perception and the principal's style of leadership (Bolger, 2001). The relationship between teachers and school principal documented many cases in which teachers refuse to obey the principal's instructions, especially when they do not trust him and they perceive principal's instructions as unreasonable (Snowden & Gorton, 2002). Another study suggests that an authoritarian leadership style adversely affects employees' attitudes and beliefs in their principal and their satisfaction (Sagie, 2002).

The study results confirm the third hypothesis, which states that in schools with a caring, ethical climate, the persistence percentage is higher (High School 2 shows the highest average perception of the caring environment

- 3.77 and the highest percentage of persistence - 96.3.

Accordingly, the lower the ethical, caring climate, the higher the percentage of school persistence is (e.g., High School 1). These findings reinforce the hypothesis that there is a link between the school ethical climate and persistence, so that the more caring the school climate is, the higher the persistence average will be. A caring environment will be mainly promoted by the decision-maker who cares for those around him (Victor & Cullen, 1987).

So, schools should be characterized by values of loyalty to people and respect for their integrity (Start, 1991). In schools characterized by an instrumental ethical climate, the students' level of persistence is low.

For example, High School 1 shows the highest average of instrumental climate perception (4.62) and the lowest persistence percentage (74.3).

The present study's findings are consistent with other studies that show that school, the classroom will all its dynamics and processes are related to students' persistence at school, beyond the relationship attributed to the background, personality, and family factors. In his study, Levy (2007) claims a link between dropout and school climate, whether directly or indirectly affect factors such as feeling protected, staff support, and close interpersonal relationships, which form part of an optimal ethical climate; when these are deficient or missing, the chance of dropout, increases.

The results of this study indicate the effect of the ethical climate on students' persistence at school, and

that an optimal and caring ethical climate leads to the intensification of students' persistence.
In addition, the results indicate the effect of leadership style on the ethical, caring climate that leads to a positive impact on the persistence data. The current research contributes to the literature review, and principals can understand the importance of the ethical climate and their leadership style as factors that have a far-reaching impact on diverse aspects of their schools. Consequently, there is a need to invest in improving the ethical climate and leadership style if necessary.

Summary and Conclusions

The study results show that a positive ethical and caring climate is an essential factor for a healthy and proper education system. The study results show a connection between leadership style and school moral climate so that the more human-focused the leadership style is, the more caring the ethical environment will be.
The study results indicate a positive relationship between a caring, ethical climate and students' persistence at school .Hence, there is an emergent need to foster a more caring ethical climate and improve it. It can be said that effective principals who work for teachers' compliance within their authority avoid using force and coercion and prefer empowering teachers and strengthening their commitment to the school.

Add to this, the use of expertise to promote trust between the principal and his staff increases the teachers' motivation and loyalty to the organization. It has been found that a leadership style based on positive, egalitarian relationships of collaboration between principals and teachers, allows for similar relationships between the teachers. They develop communication patterns of cooperation and mutual support instead of competition and striving against each other.
The school can produce a variety of climates, but a school system that wants to promote education, achievement, and belonging should emphasize the development of a caring, ethical environment that is driven by social motives, caring for others, to increase persistence rates. The caring climate is a more positive moral climate that leads to both an increase in trust and persistence rates.

The belief that school is the natural place for every student where students receive an education that prepares him/her for a better life places the phenomenon of persistence as a significant phenomenon. Persistence on coming to school reduces the risk of exposing children to negative wonders and behaviors such as drugs and violence.
These behaviors can negatively affect the life of the students. In the Arab sector, where persistence is less than in the Jewish sector, all the reasons for this phenomenon must be examined, including the ethical climate at schools and the leadership style of the school principals. The factors that affect persistence at school can be used to find ways to improve the situation and increase the percentage of persistence. School climate and leadership style factors are factors that school administration can influence; the benefit of enhancing them will affect the school, teachers, and students.

Research recommendations

Strong emphasis should be placed on systemic improvement of school culture and climate from class and upwards, with effective collaboration between students, teachers, and parents and also strengthening the bond between the educational staff and students. While principals, supervisors, or education policymakers want to find ways to increase the persistence rates, they should attach more importance to the school climate and cultivate a more human-focused leadership style. Priorities can be expressed in various ways, beginning from creating awareness of the vital contribution of school and classroom climates, going over

the students' perception for improving theireducational process, and diverting more resources and efforts to improve it. A leadership style that relies on the principal's support for the teachers, their participation in decision-making, and the formulation of school policy increases motivation among teachers and reduces burnout from work.

As educators, who are a critical factor in working on education, we need to understand the importance of fosteringa positive ethical school climate. Principals need to adopt a more collaborative policy with the teaching staff to create a more caring school climate to try to promote it as much as possible. We have to increase the percentage of persistence significantly.

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He has published over forty mathematical papers published in world and local law journals, and has authored dozens of academic books in various mathematics disciplines. Also connects math textbooks for elementary, middle and high schools.

It should also be noted that he has an interest in various other fields of knowledge; in physics and English he is a member of the matriculation books, and in the Arabic language, he is a member of early childhood and elementary school textbooks, he is also a member of many books in literature and poetry.

Dr. Hibi recently began researching in the field of mathematics education and mathematics teaching, where he has published and continues to publish articles on the subject of teaching methods in mathematics for its various branches.