

**EFFECTS OF MIND MAPS TEACHING
APPROACHES AND GENDER ON JORDANIAN 7TH
GRADERS' RATIONAL NUMBER ACHIEVEMENT
AND CREATIVE THINKING**

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UNIVERSITI SAINS MALAYSIA

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by

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LIST OF ABBREVIATIONS

DV	Dependent Variable
IV	Independent Variable
KR	Kuader Richardson's equation
CM	Conventional Method
PMM	Paper Mind Mapping
DMM	Digital Mind Map
RNAT	Rational Numbers Achievement Test
SPSS	Statistical Software Package for Social Sciences
TI-Protocol	Teacher Interview Protocol
TTCT	Torrance Test for Creative Thinking

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**KESAN PENDEKATAN PENGAJARAN PETA MINDA DAN JANTINA
TERHADAP PENCAPAIAN NOMBOR RASIONAL DAN PEMIKIRAN
KREATIF PELAJAR JORDAN GRED 7**

ABSTRAK

Tujuan kajian ini adalah untuk menentukan kesan peta minda digital dan jantina terhadap pencapaian Nombor Rasional dan Pemikiran Kreatif dalam kalangan pelajar gred tujuh Jordan.. Kajian ini menggunakan pendekatan reka bentuk kuasi eksperimen dengan Faktorial (3x2) yang disokong oleh data kualitatif. Untuk mencapai objektif kajian, satu set instrumen telah disediakan, termasuk Ujian Pencapaian Nombor Rasional (RNAT), Ujian Torrance untuk Pemikiran Kreatif (TTCT), soal selidik untuk menilai sikap pelajar terhadap kaedah pengajaran, dan protokol temu bual untuk guru. Sampel kajian terdiri daripada 120 pelajar (60 lelaki dan 60 perempuan) di Irbid Governorate, Jordan. Kumpulan kawalan diajar secara konvensional, manakala kumpulan eksperimen pertama diajar dengan kaedah peta minda kertas dan kumpulan eksperimen kedua dengan kaedah peta minda digital. Analisis ANOVA dua hala dan ANCOVA dua hala digunakan untuk menganalisis data. Keputusan analisis ANOVA dua hala menunjukkan bahawa kaedah pengajaran (CM, PMM, atau DMM) mempunyai kesan utama yang signifikan terhadap pencapaian nombor rasional dalam kalangan pelajar gred 7. Pelajar yang diajar menggunakan DMM menunjukkan Pasca-Pencapaian dalam Nombor Rasional yang signifikan berbanding pelajar yang diajar menggunakan PMM dan CM. Keputusan analisis ANOVA dua hala menunjukkan tidak terdapat kesan utama jantina (lelaki/perempuan) yang signifikan terhadap pencapaian nombor rasional dalam

kalangan pelajar gred 7. Selain itu, tiada kesan interaksi yang signifikan antara kaedah pengajaran (CM, PMM, dan DMM) dengan jantina (lelaki/perempuan) terhadap pencapaian nombor rasional dalam kalangan pelajar gred 7. Walaupun min skor Pasca-RNAT pelajar perempuan didapati lebih tinggi daripada pelajar lelaki dalam kumpulan CM, PMM dan DMM, perbezaan ini tidak signifikan secara statistik. Hasil analisis ANCOVA dua hala menunjukkan terdapat kesan utama kaedah pengajaran (CM, PMM, dan DMM) yang signifikan terhadap Pemikiran Kreatif dalam kalangan pelajar gred 7. Pelajar yang mengajar dengan DMM menunjukkan peningkatan yang lebih signifikan dalam Pasca-Pemikiran Kreatif berbanding pelajar yang mengikuti PMM dan CM. Hasil analisis ANCOVA dua hala menunjukkan terdapat kesan utama jantina (lelaki/ perempuan) yang signifikan terhadap Pemikiran Kreatif dalam kalangan pelajar gred ke-7. Pelajar perempuan menunjukkan prestasi yang lebih baik daripada pelajar lelaki dalam Pasca-Pemikiran Kreatif. Hasil analisis ANCOVA dua hala menunjukkan bahawa tiada kesan interaksi kaedah pengajaran (CM, PMM, dan DMM) dan jantina (lelaki dan perempuan) terhadap Pemikiran Kreatif dalam kalangan pelajar gred 7. Beberapa cadangan telah dibuat, iaitu menjalankan kajian yang serupa dengan kajian semasa bagi topik-topik Matematik lain dan subjek selain daripada matematik. Di samping itu menjalankan pengajian yang serupa di pelbagai peringkat pendidikan samada pada peringkat rendah, pertengahan, menengah atau universiti.

**EFFECTS OF MIND MAPS TEACHING APPROACHES AND GENDER ON
JORDANIAN 7TH GRADERS' RATIONAL NUMBER ACHIEVEMENT AND
CREATIVE THINKING**

ABSTRACT

The purpose of this study was to determine the effect of mind maps and gender on rational number achievement and creative thinking among Jordanian seventh-grade students. The researcher used a quasi-factorial design (3x2) approach that was supported by qualitative data. To achieve the study's objectives, four instruments were used, including the Rational Number Achievement Test (RNAT), the Torrance Test for Creative Thinking (TTCT), a questionnaire to assess students' attitudes toward teaching methods, and an interview protocol for teachers. The researcher used the tools on a purposive sample of seventh-grade students in Irbid Governorate, which included (120) students divided into three groups: 60 female students and 60 male students. The control group is taught conventionally, while the first experimental group is taught with paper mind maps method and the second experimental group with digital mind maps methods. Two-way analysis of variance (ANOVA) and two-way analysis of covariance (ANCOVA) were used to analyze the data. The results of the two-way ANOVA analysis indicated that the teaching method (CM, PMM, or DMM) had a significant main effect on achievement in rational number among 7th-grade students. Students who were taught using the DMM improved more in Post Achievement in Rational Number than students who were taught using the PMM and CM. The results of the two-way ANOVA analysis revealed that there was no significant main effect of gender (male/female) on rational number achievement among 7th-grade students.

Furthermore, there was no significant interaction effect of teaching method (CM, PMM, and DMM) or gender (Male & Female) on rational number achievement among 7th-grade students. Although the Post-RNAT score mean of female students was found to be higher than that of male students in the CM, PMM, and DMM groups, this difference was not statistically significant. When compared to PMM and CM, the results showed that DMM helped both male and female students improve their Rational Number Learning Achievement level. Simultaneously, it was discovered that PMM helped both male and female students improve their Rational Number Learning Achievement level more than CM. A two-way ANOVA analysis showed that there was no significant difference in mean Pre-TTCT scores based on gender (male & female) or the interaction of teaching method (CM, PMM, & DMM) and gender (Male & female). The results of the two-way ANCOVA analysis revealed that there was a significant main effect of teaching method (CM, PMM, & DMM) on Creative Thinking among 7th-grade students. Students who taught with the DMM demonstrated greater improvement in Post Creative Thinking than students who taught with the PMM and CM. The results of the two-way ANCOVA analysis indicated that there was a significant main effect of gender (male & female) on Creative Thinking among 7th students. Female students performed significantly better than male students in Post Creative Thinking. The results of a two-way ANCOVA analysis indicated that there was no interaction effect of teaching method (CM, PMM, & DMM) and gender (Male & female) on Creative Thinking among 7th-grade students. The implication of this study can be seen in terms of practice in the school context in which it offers an alternate method for teaching and learning rational numbers. Moreover, this study also provides a justification on the effectiveness of mind map as a teaching method that could benefit teacher and all stakeholders in planning steps to be taken to encourage

creative thinking in mathematics curriculum. Several recommendations were made on the Mathematic topics or on other subjects similar to the current one on subjects other than mathematics. Conducting studies similar to this one at various stages of education (elementary, intermediate, secondary, and university levels).

CHAPTER 1

INTRODUCTION

1.1 Introduction

A good educational process never aims to develop methods for storing, arranging, or organizing learned experiences in the learner's memory; rather, it aims to retrieve those learned experiences from the learner's memory at the appropriate time, so that he or she can make the best use of them in his or her practical life. The primary goal of the educational process and learning mathematics is to produce graduates who have a wealth of information and knowledge to meet societal needs. Learning mathematics is an effective way to develop mental discipline and promote logical reasoning and mental rigor. Mathematical knowledge is essential for understanding other school subjects such as science, social studies, and even music and art. Mathematics brings order to life and prevents chaos (Sandberg et al., 2020). Furthermore, mathematics is the foundation of modern organized life. Individuals cannot resolve any issues in their daily lives without the use of numbers and mathematical evidence, which is not an overstatement. There are times, measurements, rates, wages, taxes, and money exchange, among other things. We must contend with confusion and chaos in the absence of these data (Sandberg et al., 2020). As a result, mathematics has been man's constant companion since the dawn of time.

In this regard, the importance of mathematics in our daily life can never be emphasized; thus the success of learning mathematics depends on choosing the appropriate teaching methods in terms of the student's level, the educational material, and the available environment, as well as choosing the specific means that would motivate students and raise their interest in achieving the desired goals. However,

behind every successful teaching method, there must be a competent and flexible teacher, an entrepreneur, and familiarity (or novelty) with everything new in the world of education, and ready to embrace any changes in methods of teaching that enable students to become creative thinkers (Umber et al., 2020).

Mind maps provide a dynamic, distributed learning environment that expands the physical learning space and allows students to develop, organize, and structure their ideas using higher-order thinking skills while also improving their understanding (Gossack-Keenan et al., 2020). Mind maps would not produce results unless a thorough examination of the student's abilities and preparations is conducted. The mind maps teaching strategy is based primarily on drawing a map or a shape that reflects how the mind could read information. The main idea is represented by the center of the shape, while the branches are the classification of this idea. The concept is further subdivided based on the specialty or classification. The Mind Maps strategy enables the learner to easily collect information and deliver it to the student's mind. Connecting ideas helps with information retrieval, and a mind map can be created by hand or with computer programs (Nazri & Anida, 2020).

Academic achievement is considered one of the pillars of the educational process because of its great importance in indicating the student's level of knowledge. Students' academic achievement refers to the extent of success or failure of the subject. Similarly, academic achievement contributed to measuring the extent to which students successfully achieve the educational goals that are based on performance evaluation. Academic achievement is the main entrance through which students' failure problems can be identified in schools (Akpur, 2020; Kachel & Jennings, 2020; Murphy et al., 2020; Daker et al., 2020). Academic achievement also plays an important role in promoting students' academic growth as it assesses the extent of student development

and progress, and it also helps develop their own cognitive and academic skills and other skills that enhance students' self-confidence (Arnold et al., 2020).

The importance of mind maps is not limited to improving students' academic achievement and providing them with information and educational concepts in a way that is related to reality but also works to develop students' thinking and improve their creative skills. Mind maps also contribute to developing thinking and creativity among learners as an important strategy in improving learners' cognitive and mental abilities. Creative thinking is a complex and purposeful mental activity guided by a strong desire to search for solutions or arrive at original previously unknown products. Creative Thinking is distinctive, comprehensive, cognitive, and complex, as it contains ethical, emotional, and overlapping cognitive elements. All of these elements combine to form a distinct state of mind; researchers employ a variety of expressions consistent with the concept of Creative Thinking (Beaty et al., 2020; Talebi & IranNejad, 2020).

1.2 Background of Study

This study is carried out in selected schools in Jordan. Jordan is strategically located in the heart of the Middle East, bordered by Saudi Arabia on the southwest, Syria on the northwest, Iraq on the west, and Palestine on the east. Jordan's population is approximately 10.7 million, 42% of the population resides in the governorate of the capital Amman with 43.3% of the population under 15 years of age and 62% between the age of 15 and 64 (MOICT, 2019). It is also one of the few Arab countries with a very small disparity in primary school attendance rates between urban and rural areas. Jordan is a developing country without significant natural resources; as such, it relies primarily on human capital. Thus, the Jordanian people are her only resource and, indeed, her initial ability to survive as a nation. Jordan is a developing, middle-income

country with scarce natural resources and educated human resources (Saheer & Chris, 2003).

The educational ideology of Jordan is based upon the Islamic Arab civilization, the Jordanian constitution, and the principles of the Great Arab Revolt (1916). The structure of the educational system in Jordan begins with the kindergarten stage, which is not compulsory, and is mostly private. It is two years long, followed by ten years of compulsory basic education, and two years of secondary academic or vocational education. The students sit for a General Certificate of Secondary Education Examination (Tawjihi). Basic Education is free, and secondary education is provided in public schools. All of the government schools are separated (male and female schools). Jordan also ensures a high level of gender parity in access to basic services; the gender parity index for the gross enrolment ratio in primary education is 0.98. It is also one of the few Arab countries with a very small disparity in primary school attendance rates between urban and rural areas. This is mainly because public financing for basic schooling is more pro-poor than other education levels.

Mathematics is considered a major subject to teach in schools for all grades in Jordan. For example, in the 7th grade, which is the first grade for the secondary level it's compulsory to take one lesson every day for 45 minutes in mathematics throughout the semester. However, scholars like Barbieri et al. (2020) and Dyson et al. (2020) observed that students faced numerous challenges when learning mathematics. The difficulties faced by students differ according to their diverse minds and intellectual abilities. As a result, it is critical to focus on the underlying causes of these difficulties and to propose potential solutions for overcoming them. The difficulties of learning are challenges that students face, which make them unable to communicate with subject teachers, unable to respond to the activities, especially the mathematics teacher's

activities during school hours, and make them live in tension, anxiety, and discomfort. This corresponds to the researcher's concept of being a mathematics teacher who is fully aware of the existing problems and weaknesses in students' mathematical achievement. This awareness necessitates the conduct of this research on the most effective teaching strategies for overcoming the weaknesses in students' learning, attitude, and skills in mathematics.

One of the mathematical concepts that students must learn during their academic stages is rational numbers and there are many fundamental difficulties associated with students' learning and understanding of the concepts. Rational numbers are a fundamental concept in mathematics and are used in a wide range of mathematical applications. However, students often have difficulty understanding and working with rational numbers (McKenzie, 2017). Similarly, recent research reported that students with difficulty in rational numbers have learning difficulties with other mathematics concepts (Dyson et al., 2020). This can lead to a lack of achievement in this area of mathematics, as well as a lack of confidence and interest in the subject. Many students struggle to obtain rational numbers, particularly fractions. For example, 50% of 7th graders failed to order numbers from small to large on the Jordanian National Assessment of Educational Progress (JNAEP): $\frac{2}{7}$, $\frac{5}{9}$, and $\frac{1}{12}$ (Martin et al., 2007). The rational number unit is one of four units in the first semester of the 7th-grade mathematics curriculum, accounting for 25% of the curriculum; this reflects the importance of this concept.

As a consequence, achievement in students' rational numbers in the concept of mathematics necessitates an instructional strategy that includes radial structures that allow concepts to be visually organized (Davies, 2011). A mind map supports the topic under study. After all, the procedures are relatively simple for inexperienced learners

(Merchie & Van Keer, 2012). Shih et al. (2009) demonstrated that the use of mind maps collectively improved mathematic concept knowledge and was expected to be more valid in guiding and assessing students' emerging knowledge structures.

It can be stated that teachers, in general, seek to provide educational material to the students in a familiar way without focusing on all of the student's cognitive and mental aspects, and research for the best approaches that would support thinking and develop cognitive skills. All of the above is a basic pillar for the researcher in using the mind maps strategy in students' learning of numerical subjects to improve students' achievement and creative thinking as an important part of the teaching process. As a result, it has yet to be determined whether the reviewed literature revealed a genuine lack of research concerning the importance of mind maps and methods in improving students' achievement skills and developing their creative thinking, hence the need to conduct this study.

In the context of Jordanian education, there is a need for innovative and effective teaching strategies to enhance students' achievement in mathematics. According to a report by the Organization for Economic Cooperation and Development (OECD), Jordan's mathematics education system faces several challenges, including a lack of resources, the predominant use of traditional teaching methods, and a shortage of trained teachers (OECD, 2018). The teaching method is regarded as a fundamental pillar in the educational process, and its significance stems from the fact that it is the tool that assists students in understanding and assimilation the learned material. Therefore, the success of the educational process depends on choosing the appropriate teaching method in terms of the level of students, the educational material, and the available environment, as well as choosing the specific means that would motivate students and raise their interest in achieving the desired goals. Behind every successful

teaching method is a flexible teacher who is also an entrepreneur and is up to date on everything new in the educational world (Umber et al., 2020).

To achieve the educational objectives, which is the introduction of systemic thinking, the development process must be a comprehensive, integrated, and intertwined process in all its components and stages. That simply means the necessity of having a comprehensive, interdependent, interactive, and coherent system, so that modernization and comprehensive change of the system can be made, hence modernizing the education system has become a must Nationalism if we want to achieve distinguished education that achieves the goals set for it in all its educational, human, social, political, economic and cultural aspects (Riihimaki & Viskupic, 2020).

The importance of the diversity of teaching methods will work out to achieve the education and learning goals, and this is what applies to the strategy of mind maps, as it is considered one of the active learning strategies and tools that contribute to strengthening memory, retrieving information, and generating creative ideas that are prepared through paper or computer programs or websites or smart device applications. All these diversities help in accelerating learning and discovering knowledge faster, especially when there is a drawing diagram that shows the basic concept, the main and sub-ideas, and of course, the learner performs this activity on his own (Stokhof et al., 2020).

For the learning process to be carried out in a way that guarantees the success of the educational learning objectives, the objective process of education must be with a predetermined purpose or goal. In other words, what students learn is determined by their level of active participation in discussion, dialogue, problem-solving, exploration,

or organized work carried out by the teacher and in which the student or learner participates through effective teaching practice (Dyson et al., 2020).

The importance of teaching methods can never be emphasized as it improves the quality of the educational process, considering individual and gender differences among students, which contributes to improving academic achievement and developing Creative Thinking among students. This has been confirmed by many studies (Alao & Abubakar, 2011; Alsrouf & Al-Ali, 2016) in their studies that examined the importance of teaching methods in improving skills, cognitive and achievement abilities besides clearing misconceptions about gender differences, developing creativity, and Creative Thinking among students.

The use of mind maps in mathematics education has been studied extensively over the past few decades. Research has suggested that mind maps can enhance students' understanding of mathematical concepts, as well as their creativity and problem-solving abilities (Kinchin, 2014). Mind maps have also been shown to be effective in helping students organize and remember information, as well as in facilitating collaborative learning (Novak, 1998). Furthermore, mind map, which is one of the instructional strategies that uses a non-linear approach to learning, tends to encourage the learner to think radically and to use only keywords and images that are non-linearly linked together for new and prior knowledge (Dhindsa & Anderson, 2011), but it is rarely observed in gender differences (Engel & Randall, 2009; Davies, 2011). Gender differences are considered as to whether it responded to the claim that the mind map works based on a similar pattern of how the human brain works. Nonetheless, evidence from the advancement of neuroscience shows that men and women have different brain structures and functions. To dispel these misconceptions, the effect of gender is

investigated further to determine how their differences are defined in students' rational number achievement and creative thinking.

Research has shown that gender can also play a role in students' achievement in mathematics. Studies have found that female students tend to perform less well in mathematics than male students and that this gender gap may be influenced by a range of social and cultural factors (Else-Quest, Hyde, & Linn, 2010). According to Hassan (2019), "the term gender is important in Science, Technology, and Mathematics (STM) because it described the social definition of sex-role rather than distinct biological distinction itself, STM is seen as the subject of male and female" (p.42). Some studies have confirmed that there is a difference in teaching and learning between male and female students according to gender, as both males and females tend to technical borrowings in teaching and learning. Mental maps contribute significantly to improving educational outcomes and improving students' achievement, but the differences between females and males in education do not apply (Rice, 1994; Trowbridge & Wandersee, 2005). We emphasize that learners tend to teach skills in a clear and specific manner when it comes to gender orientation.

Overall, the topic of the effects of mind maps (paper and digital) and gender on rational number achievement and creative thinking among 7th-grade Jordanian students is an important area of research that has the potential to inform the development of effective teaching strategies in mathematics education.

1.3 Problem Statement

Learning rational numbers is a complex mathematical concept that many students struggle with (e.g., Kinnear & Kinnear, 2017). Research has shown that traditional teaching methods may not be effective in improving students' achievement

in rational numbers, nor in developing their creative thinking skills (e.g., Alqahtani, 2021). Learning rational numbers can be challenging for many students, as it involves understanding abstract mathematical concepts that are not easily represented by physical objects. Some common difficulties that students may face when learning rational numbers include difficulty in understanding how fractions and decimals are related and how to convert between the two. Moreover, students may have difficulty understanding that rational numbers can be larger or smaller than whole numbers and that their size can be compared using benchmarks such as 0, 1, and 2. Also, students may have difficulty understanding how real-world problems can be represented using rational numbers and mathematical expressions.

Therefore, it is important to explore alternative teaching strategies that may enhance rational number achievement and creative thinking among students. Rational numbers are fundamental in mathematics and are essential for understanding higher-level mathematical concepts. However, many students struggle with rational numbers, and this difficulty can affect their future academic success (e.g., Bazzini, 2017). Additionally, creative thinking is a valuable skill for students to develop, as it can improve problem-solving abilities and lead to innovative thinking (e.g., Beghetto & Kaufman, 2014). Therefore, exploring teaching strategies that enhance rational number achievement and creative thinking among students is critical for improving their academic success and prospects.

Although there has been some research on the use of mind maps to enhance students' learning in mathematics, there is a lack of research that specifically examines the effects of paper and digital mind maps on rational number achievement and creative thinking among Jordanian 7th-grade students. Additionally, there is a gap in the

literature regarding the potential differences in the effects of mind maps between male and female students.

There have been several studies that have investigated students' poor creative thinking in terms of the Torrance components of fluency, originality, flexibility, elaboration, and linking information. For example, A study by Runco and Jaeger (2012) found that many students struggle with the fluency component of creative thinking, which involves generating a large number of ideas. The researchers found that students who had more exposure to creative activities, such as art or music, tended to be more fluent in their idea generation. Park and Kim (2015) found that many students struggle with the originality component of creative thinking, which involves generating ideas that are new and different. The researchers found that students who were more self-confident and had a stronger sense of self-efficacy tended to be more original in their idea generation. Another study by Li and Li (2017) found that many students struggle with the flexibility component of creative thinking, which involves generating ideas that are different from one another. The researchers found that students who were more open-minded and willing to consider alternative perspectives tended to be more flexible in their idea generation. Furthermore, Sun, Zhang, and Zhang (2017) found that many students struggle with the elaboration component of creative thinking, which involves adding detail and depth to ideas. The researchers found that students who were more conscientious and detail-oriented tended to be more elaborate in their idea generation.

Overall, these studies suggest that students' poor creative thinking is related to a variety of factors, including exposure to creative activities, self-confidence, open-mindedness, conscientiousness, and domain knowledge. Teachers can help students to develop their creative thinking skills by providing opportunities for creative activities,

promoting self-confidence and open-mindedness, and encouraging detailed and thoughtful idea generation.

Creative thinking is an important aspect of mathematics, and it can have a significant impact on achievement in this field. When students engage in creative thinking in mathematics, they are more likely to be successful in solving problems, discovering new mathematical concepts, and developing their mathematical abilities. Creative thinking can be defined as the process of generating new and innovative ideas, approaches, and solutions to problems. In mathematics, this often involves using unconventional or non-traditional methods to solve problems or approaching mathematical concepts from a new perspective. When students engage in creative thinking in mathematics, they can explore different ways of thinking and develop a deeper understanding of mathematical concepts. This can help them to make connections between different mathematical ideas and to solve complex problems more effectively. Furthermore, creative thinking can help students to develop a love of mathematics and a desire to learn more about the subject.

Achievement in mathematics is closely linked to creative thinking because it requires students to be able to think critically and apply their mathematical knowledge in novel ways. By encouraging students to engage in creative thinking, teachers can help them to develop the skills and confidence needed to achieve success in mathematics. In summary, creative thinking is an important component of achievement in mathematics. By fostering creative thinking in mathematics, students can develop a deeper understanding of mathematical concepts, make connections between different ideas, and become more confident and successful problem solvers.

Mind mapping is a visual learning strategy that involves the use of diagrams, symbols, and images to organize and connect ideas. This strategy can be especially useful in teaching mathematics, as it can enhance performance and creative thinking by helping students to visualize and understand complex mathematical concepts. Mind mapping is an important teaching strategy in mathematics because it can enhance performance and creative thinking by helping students to understand complex mathematical concepts, encouraging creativity, improving recall and application of mathematical concepts, and supporting differentiation. The purpose of this study is to investigate the effects of paper and digital mind maps on rational number achievement and creative thinking among 7th-grade Jordanian students. The study also aims to examine potential gender differences in the effects of mind maps on these outcomes. The results of this study can help to inform teaching strategies and improve the academic success of students in mathematics. Additionally, the study can contribute to the literature on the use of mind maps in mathematics education and may provide insights into gender differences in learning.

1.4 Research Objective

The main objective of this study is to determine the effect of mind maps on students' rational numbers achievement and creative thinking in 7th-grade students in Jordan. However specifically, the following objectives are set to be achieved.

1. To determine the effects of teaching method (CM, PMM & DMM) and gender on 7th-grade students' achievement in rational numbers.
 - a) To determine the main effect of the teaching method (CM, PMM & DMM) on 7th-grade students' achievement in rational numbers.

- b) To determine the main effect of gender on 7th-grade students' achievement in rational numbers.
 - c) To determine the interaction effect of the teaching method (CM, PMM & DMM) and gender on 7th-grade students' achievement in rational numbers.
2. To determine the effects of teaching method (CM, PMM & DMM) and gender on 7th-grade students' creative thinking
- a) To determine the main effect of the teaching method (CM, PMM & DMM) on 7th-grade students' creative thinking.
 - b) To determine the main effect of gender on 7th-grade students' creative thinking.
 - c) To determine the interaction effect of the teaching method (CM, PMM & DMM) and gender on 7th-grade students' creative thinking.
3. To find out the effect of teaching methods on 7th-grade students' rational number achievement and creative thinking from a student's perspective.
4. To find out the effect of teaching methods on 7th-grade students' rational number achievement and creative thinking from the teacher's perspective.

1.5 Research Questions

The current study aims to answer the following research questions:

- RQ 1.1 Is there any significant main effect of the teaching method (CM, PMM & DMM) on 7th-grade students' achievement in rational numbers?
- RQ 1.2 Is there any significant main effect of gender (Male/ female) on 7th-grade students' achievement in rational numbers?

- RQ 1.3 Is there any significant interaction effect of teaching method (CM, PMM & DMM) and gender (Male and Female) on 7th-grade students' achievement in rational numbers?
- RQ 2.1 To what extent do teaching methods affect 7th-grade students' rational number achievement and creative thinking from a student's perspective?
- RQ 2.2 Is there any significant main effect of teaching method (CM, PMM & DMM) on Creative Thinking among 7th-grade students?
- RQ 2.3 Is there any significant main effect of gender (Male/ female) on Creative Thinking among 7th-grade students?
- RQ 3 Is there any significant interaction effect of teaching method (CM, PMM & DMM) and gender (Male and Female) on Creative Thinking among 7th-grade students?
- RQ 4 To what extent do teaching methods affect 7th-grade students' rational number achievement and creative thinking from the teacher's perspective?

1.6 Research Hypothesis

The Following Null hypotheses are set to be tested.

- Ho1.1 There is no significant main effect of the teaching method (CM, PMM & DMM) on achievement in rational numbers among 7th-grade students.
- Ho1.2 There is no significant main effect of gender (Male/ female) on achievement in rational numbers among 7th-grade students.
- Ho1.3 There is no significant interaction effect of teaching method (CM, PMM & DMM) and gender (Male & Female) on rational number achievement among 7th-grade students.

- Ho2.1 There is no significant main effect of the teaching method (CM, PMM & DMM) on creative thinking among 7th-grade students.
- Ho2.2 There is no significant main effect of gender (Male/ female) on creative thinking among 7th-grade students.
- Ho2.3 There is no significant interaction between the teaching method (CM, PMM & DMM) and gender (Male & Female) on creative thinking among 7th-grade students.

1.7 Significance of the Study

The current study provides numerous advantages to the practical side of the teaching-learning process. This study can reveal the actual scenario of mathematics teaching and learning. The findings of this study can benefit several groups of people, including students, teachers, educational researchers, and policymakers in the following ways:

Students can benefit from the study's findings by improving their achievement in rational numbers and developing their creative thinking skills. The use of mind maps in the classroom can help students to visualize and organize their understanding of mathematical concepts, leading to greater understanding and confidence in their abilities.

The study can help teachers to identify effective teaching strategies for enhancing rational number achievement and creative thinking among their students. The study's results can inform the development of teaching practices that incorporate the use of mind maps in the classroom.

The study can contribute to the existing literature on the use of mind maps in mathematics education and provide insights into the potential differences in the effects of mind maps on male and female students. The results of the study may also inspire future research that explores the effectiveness of mind maps in other areas of mathematics and other academic subjects.

And finally, the study's findings can inform educational policies and initiatives that aim to improve students' achievement and creativity in mathematics. The use of mind maps in the classroom can be incorporated into existing curricula and educational programs to enhance the learning experiences of students.

In summary, the study's findings can benefit teachers, students, education researchers, and policymakers by providing insights into effective teaching strategies for enhancing rational number achievement and creative thinking among 7th-grade Jordanian students.

1.8 Limitations of the Study

During this study, the researcher adhered to the following restrictions:

The research was conducted in two Jordanian secondary schools (Sama-Alrousan Secondary School for females and Sama-Alrousan Secondary School for males). The research was carried out during the first term of the 2019-2020 academic year. The intervention lasted five weeks, four times (45 minutes) per week, and was also restricted to 7th-grade male and female students. The research evaluated only one rational number out of four. The current study's findings were limited to the rational numbers unit in 7th grade only. Therefore, limiting the topics to only rational numbers

is insufficient to generalize the entire body of knowledge. Finally, the time and scope of this study limit how students can be taught using the mind map.

1.9 Operational Definition

There are references to various unfamiliar terminologies throughout this research. The following are definitions for the key terms:

1.9.1 Paper Mind Map

A way to express a personal view of the world through ideas and graphs rather than just words; the idea is expressed through branches, images, and colors. It is used as a memory technique that relies on visual memory to quickly review illustrations and recall rules and instructions (Gossack-Keenan et al., 2020). Paper mind map: A mind map created using pen and paper, usually on a large sheet of paper or a whiteboard. Paper mind maps are often used in brainstorming sessions, note-taking, and as a visual aid during presentations. They can be easily created and modified by adding or removing branches and nodes (Kachel & Jennings, 2020).

In the context of this study, a paper mind map refers to a sketch for the concepts of the lesson made by using keywords, symbols, and drawings that a student creatively designs to express his/her understanding of concepts or a lesson designed on paper.

1.9.2 Digital Mind Maps

The Digital Mind Map, according to Abd El-Baset (2016), is a creative graphic drawing based on specialized computer programs that consist of branches that cross the center using lines, words, symbols, and colors. They are used to represent the connections between ideas and data. In another definition, using computer software

assists students in thinking, producing, and organizing their thoughts. Furthermore, since mind maps are generated by computer programs, digital mind maps can be defined as creative free sketches. It is formatted similarly to a traditional mind map; it begins in the center and branches out using lines, arrows, words, symbols, and colors.

Digital mind map: A mind map created using computer software or apps, often with additional features such as the ability to add multimedia content like images, videos, and links. Digital mind maps can be easily edited, rearranged, and shared with others. They can be stored and accessed electronically, which can make them more convenient and accessible than paper mind maps.

1.9.3 Achievement

Academic achievement measures the number of scientific concepts among students, and it is one of the most important indicators on which educational systems depend to measure the amount of learning. It is an indicator of the education policy and to what extent the educational goals are achieved. Achievement is defined as the knowledge and skills acquired by the student because of studying a specific subject or a unit of education (O'Dell et al., 2000). Murphy et al. (2020) defined it as: "how we reach numerical indications of the extent to which the goals are achieved." And what the student acquires in terms of knowledge, skills, and values after passing through experiences and educational attitudes for a particular topic. In the context of this study, achievement refers to the level of understanding and performance of students about rational numbers.

1.9.4 Rational Number Achievements

The progress demonstrated by the student in understanding some educational materials - the rational numbers in this thesis - after using mind maps, measured by Rational Number Achievement Test (RNAT).

1.9.5 Creative Thinking

It is thinking characterized by non-imitation, and its outputs are novel and valuable to both the person's thinking and the culture to which they belong. Strong motivation and high perseverance drive the thinker; it is simply a complex and purposeful mind activity directed by a strong desire to search for solutions or novel original outcomes that were not previously known (Akpur, 2020). Creative thinking is characterized by breaking free from the ordinary, a renewal as the creative human being is characterized by the capacity of imagination and flying in the unfamiliar horizon.

Creativity also refers to dealing with existing problems in a real way to discover them objectively (without any tendency to falsify or overlook them), also the ability to see, understand, and deal with different points of view. However, Creative Thinking is characterized by not allowing complete influence by people at the expense of opinions based on the person's point of view. The creative person has their idea, as they are independent and always trusts their thoughtful views (Talebi & IranNejad, 2020). Operationally Creative Thinking is The ability to generate new and original ideas, approaches, or solutions. Creative thinking involves a combination of divergent and convergent thinking and is often associated with innovation and problem-solving.

1.9.6 Conventional Method

It is the traditional method of teaching in which students and instructors interact face-to-face during the educational process. This method improves discussion, but its main disadvantage is that it focuses on memorizing curriculum content from the schoolbook to repeat it on the test. This teaching method teaches passive students but does not improve their Creative Thinking (O'Dell et al., 2000). The conventional method was operationally defined by the researcher as the traditional method of teaching in which the only tools of instruction are a board, pens, and schoolbooks.

1.10 Conclusion

The first chapter provides a clear and understandable introduction to teaching methods and the importance of using the best of them to improve the teaching and learning process. In addition, the importance of mind maps in teaching students and how they help them improve rational number achievement and creative thinking. The first chapter provides a brief background of the study, in addition to emphasizing the importance of education and employing strategies that support the teaching and learning process of 7th students and how they develop cognitive, deductive, and reasoning skills, as well as how gender influences achievement and creative thinking.

The first chapter, it could be said, worked on a sequential clarification of the study problem and how it crystallized in the researcher's mind, and the researcher also demonstrated the importance of using strategies that support the teaching and learning of research questions.

CHAPTER 2

LITERATURE REVIEW

This chapter provides a thorough review of the literature on all of the study variables. This chapter also discussed the theoretical framework and the conceptual framework.

2.1 Introduction

Developing the field of education and raising the level of the educational process is one of the main pillars for the advancement and development of societies. The progress of any society depends on its quality of education, and the educational process must be developed by paying attention to all its components, including the teacher, the method of teaching, the subject matter, and the students themselves. One of the primary concerns for students is identifying the methods that teachers use to provide knowledge, information, and skills to them in a way that is commensurate with their abilities and preferences, meets their needs, and takes into account individual differences (Liubych & Samoylyukevych, 2020).

Because the educational process seeks to influence the student's behavior or provide them with the required information, skills, trends, and values, A thorough understanding of teaching methods is required to achieve instructional objectives. It can invest in and employ them in the way that the teacher intended as a mediator in the educational situation, assisting him to make the educational process enjoyable, fascinating, appropriate to the student's abilities, and relevant to their lives, needs, preferences, desires, and future aspirations (Tatto et al., 2020).

The teacher's extensive knowledge of pedagogy aids him/her in conveying his/her message, as well as assisting students in successfully achieving educational learning goals and acting as a catalyst for the student to research, explore, and work, resulting in the permanence and continuity of information (Tatto et al., 2020). The supply of varied learning resources and their designs for educational activities that respond to individual variations among students, on the other hand, ensures that every student actively participates in the classroom. so that learners think they are clever and active participants in generating and obtaining information to address their intellect and talents. As a result, the teacher must provide instructional information in ways that target all students' intellect while still accounting for individual variances (Liubych & Samoylyukevych, 2020).

The learner is one of the fundamental pillars of the educational system; how they interact and what they acquire as a result of this interaction in terms of experiences, knowledge, skills, attitudes, and values. Many educators argue that a good teacher in any subject can positively influence students through communication. During the classroom learning process, the teacher's communication with the students teaches them how students think and how they apply what they have learned through their behavior. As a result, the majority of educators agree that regardless of how educational technology advances, the day will not come when something completely replaces the teacher's presence (Murphy et al., 2020).

As a result, there is a need to use new media in teaching to support the teaching and learning process while also taking into account the students' desires and individual differences. Therefore, recent teaching and learning theories presented a different voice on the elements of the educational process, including the teacher and the learner, as well as the educational process itself, as opposed to learning theories. So, Constructivism

theory and the old educational thought have asserted that the teacher is the source of information, its basis, and its transmission to students who receive it passively without active participation (Elashhab, 2020).

Teaching methods are one of the crucial areas of education that have been affected by these modern trends, whether at the intellectual level or the applied level, and this was evident on two main axes: the first axis is related to the intellectual aspect, and the second axis is connected to the applied part in educational situations, and scientific education in general, and teaching methods. Individual capability development in society is so effective because it enables students to face these enormous challenges and deal with them using comprehensive systemic thinking rather than single or two-way thinking, which necessitates preparing future generations with that thought (McInerney & Green-Thompson, 2020).

The educational system which relies on traditional teaching techniques has become an old one, as the requirements of the new century try to find new teaching methods that facilitate understanding the hard subjects, respect the students' abilities to raise the total gain, and help the student gain the required knowledge that is needed for not just succeeding in his/her tests but also for gaining life skills that are the goals of the educational process.

2.2 System of Education in Jordan

The Hashemite Kingdom of Jordan views education at present as a change in the knowledge structures of the learner, or the development of new knowledge structures that organize and explain their experiences, as it is no longer merely adding new knowledge to his previous knowledge in a quantitative way, but rather as a creative process to learn to update the basic changes in the knowledge structure of the requester