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THE EFFECT OF MATHEMATICS EVENTS ON THE ADJUSTMENT OF STUDENTS' ERRORS IN FRACTIONS

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ABSTRACT

The article discusses the common errors, the misconceptions and the problems related to the topic of comparing fractions and methods of teaching them. The following research is based on the qualitative approach which aims at examining the existing problems and ways of addressing them. The researcher discovered the significance of the conceptual instruction of the concept itself and the usage of the research methods, while avoiding indoctrinating the subject and using the ritual approach. The importance of the research lies in highlighting a vital and fundamental topic in teaching mathematics in the primary stage in order to provide the students with skills they can use in their later stages of learning.

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INTRODUCTION

Our world is undergoing a purely technological and scientific revolution and a cultural renaissance in various fields. Development in its various dimensions is an essential imperative in different societies. It is what makes us able to keep up with the progress and the growth in all aspects of life. One of the most important factors of development is the human; superior, talented and genius people are precious treasures and real human wealth. This scientific outburst is accompanied by the development in the human factor, especially among those with unique minds who are capable of thinking and creating. Therefore, the first goal of teaching and learning was focused on developing the students' thinking skill and refining their knowledge, whereas the educational theories search for developing the educational process in all its aspects. One of the most important aspects of development is finding the suitable teaching and instruction methods that enable the students to understand the teaching process and transmitting the information to students in an easy, logical and sequential manner (Barwell, 2003). Based on the aforementioned, it is expected that the strategies of teaching mathematics and dealing with the students' repetitive errors should witness a sort of tangible development to keep pace with the change around the world. Consequently, many studies and research have been conducted on those common mistakes that students make in relation to the concepts of the fractions; however, local studies have been rare. The multiplicity of strategies to solve this problem is numerous, yet addressing the mathematical actions has not drawn the researchers' attention as has been done with other educational strategies (Algani, 2018). As a result, for ensuring the success of developing any educational ideas in any educational curriculum, those involved in this development should carefully consider the mistakes that are repeated among students for the purpose of addressing them by discovering appropriate methods to deal with them, or create new educational opportunities from those errors. Fritz K. Oser's research on educational psychology have introduced the theory of the *negative experience*, which provided a clear definition of the concept *error*. It is claimed that an *error* is "an operation or a fact that is incompatible with the rule". Mistakes are necessary to refine the individual ideas in regard to being right and wrong, so that when comparing examples with opposites, while studying the mathematical concepts, errors would play the role of counter-examples. Consequently, the student must realize the error and find out what is not true. This negative experience supports the positive one and knowing what is true (Oser, Hascher*and* Spychiger, 1999).

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It should be noted that the process of learning negative experiences requires awareness and an ability to analyze the error and correct it. The student's errors in mathematics show that they have certain problems which considered an obstacle before the proper construction of mathematics, such as the difficulty to understand concepts, generalizations or acquire certain skills. Literature on the common mistakes in mathematics has revealed that the reasons behind the learners' errors could be summed up by poor reading ability, lack of understanding, lack of processing skills, the inability of coding, lack of motivation, interest and enjoyment working in mathematics, and poor formulation of questions submitted to them (Abu Abbas, 1986).

However, an important question arises which this study aims to answer: *What is the effect of Mathematics events on the adjustment of students' errors in Fractions?*

In mathematics, like other sciences, mistakes are common among students, particularly concerning concepts and the inability to separate topics and know what fits them, which in turn affects the accumulation of mathematics (Creswell *and* Plano, 2011). There are many ways and means that will diagnose the problem and work on solving it. Diagnosis is an integral part of the educational decision-making process because it provides significant information about persistent misconceptions among students; the most notable of these are diagnostic tests and individual interviews (Kettedin-Geller *and* Yovanoff, 2009). And like other subjects in mathematics, fractions are one of the central concepts in mathematics that facilitate the mathematical operations if used correctly. However, it is noted that there are many misconceptions around them, which occur because of incorrect teaching methods, ignoring passive learning and opposites as well as their low utilization. fractions are very essential for many other math topics such as relative numbers, which they cannot be mastered and learned unless mastering the learning of fractions (al-Haddad, 2008). For many educators, teaching mathematics is a difficult task for the teacher due to the abstraction of the mathematical concepts and their relationships. Moreover, there is not any single method of instruction that suits all the situations the teacher faces. Attempts by educational specialists to utilize modern strategies and methods in teaching mathematics are clearly seen (Faghihi *et al*., 2014). In her articles about the impact of parents and the surroundings on learning mathematics and its relationship with learning patterns and the fear of mathematics, Einat Heyd-Metzuyanim (2015; 2016) concluded that the parents' positive support leads to the development of learning mathematics among students and increases their motivation to study mathematics. She also pointed to the strong relationship between social pressure and the traditional method of learning, which leads to a fear of mathematics and math tests which she sees a vicious cycle: ritual Learning →difficulties in mathematics → math anxiety→ritual Learning.

Algani (2018) argues that learning mathematics during schoolis done through three stages manifested in working on a strong foundation, doing exercises in mathematics, and finally, the self-stage. Understanding teaching and learning theories and being able to apply them in mathematics instruction is a prerequisite for teaching mathematics. For years, psychologists began to develop ideas and opinions about the nature of the learning process. Since the seventeenth century, a set of views on theories of learning began to emerge gradually. Although most psychologists consider learning to be an associative process, however, there is no complete agreement among them on the nature of this process; this difference can be observed in two main directions:

The behavioral trend: It is the direction of the connection between the stimulus and the response and is symbolized by (S-R). According to this trend, the learned link is between the stimulus and the response and that learning is an acquired tendency for an organism to respond in some way when faced with a particular stimulus in a particular situation (Raphael and Joseph, 2001).

The cognitive trend: It is the direction of correlation between stimuli, which is symbolized by (S-S). According to this trend, the learned link is between stimuli and learning tends to be acquired by the organism who expect successive events when a particular stimulus appears in a situation (Raphael and Joseph, 2001).

Jean Piaget's theory of learning: Jean Piaget is one of the earliest cognitive theorists. According to his theory, the individual moves through four different stages of mental development. It was found that the occurrence of these stages does not change between the individuals. One of the most important issues a teacher faces while acting the role of a learning organizer is to know how s/he affects the development of thought. Moreover, adapting the curriculum, in a broad sense, with the level of mental development of students is seen as one of the most important educational tasks that form the basis of Piaget's "learning style". The study of the relationship between the learning environment and the students' mental development forms the basis of the educational pattern (Muhammad, 2015).

The stages of growth at Piaget's: As mentioned earlier, the individual goes through four stages of mental development as defined by Jean Piaget and these stages are:

Stage one: The sensorimotor Stage: This stage starts from birth to the age of two. The child's learning at this stage consists of the growth and the organization of his physical and mental activities in a series of well-defined verbs called schemes. Children also learn to coordinate between their feelings and movements, and learn to associate word symbols with real things (Natour, 2011).

Stage Two: The Preoperational Stage: This stage lasts from age of two till seven. During this stage, the child is able to form most of the experiences of the outside world in schemes that grow from the surrounding environment. At this stage, the child cannot make inductive or deductive inferences. He is also unable to distinguish between truth and fiction. Moreover, the child is unable to perform logical operations, and at this stage the child is characterized by the phenomenon of self-centeredness (Rashid, 2009).

Stage 3: The Concrete Operational Stage: This stage extends from the age of seven to twelve, or thirteen. The study of the characteristics of growth at this stage helps the teachers to understand their work and the way they should deal with their students. At this stage, the child is able to perform logical and sub logical operations. Moreover, the child will be able to learn the meaning of numbers and the concept of time;

he also will be able to perform the processes of deduction and induction (Abbas, 2017).

Piaget's theory and the teaching of mathematics: Depending on Piaget's stages of growth, the following can be observed:

- The mathematics teacher should expect that some students do not have a level of mental development commensurate with their age. This means that some students have reached the preparatory stage but are still in the stage of concrete operations. Consequently, the teacher has to use the appropriate teaching strategies for the students' mental abilities and helps them progress to higher stages of development (Raphael and Joseph, 2001).
- Piaget believes that middle school students enjoy working with shapes, models, and tools. They need to link the new abstract concepts with the reality and their personal experiences; subjects in mathematics must be presented through concrete examples (al-Natour, 2011).

The theory of epistemology (Bachelard Knowledge Theory)
The scientific knowledge theory of Bachelard is characterized by several characteristics that make it distinct from other theories of knowledge or epistemology among philosophers, the most important of these characteristics are the following:

- His philosophy is based on the constructive philosophy (Badawi, 1980), which believes that thinking is a building that is constantly determined in the light of the continuous scientific developments, and rejects the counter-ways of thinking. Many philosophers argue that Bachlard's philosophy calls for a negative dialectic in its construction of a movement of destruction and reconstruction of knowledge (Badawi, 1980).
- It entails looking at knowledge from its perspective of development, i.e., it is, a process of continuous development and growth. In other words, knowledge must be seen as the result of prior knowledge; they are but cumulative knowledge that indicate each other.
- The knowledge of Bachard is characterized by the existence of multiple comparisons at multiple levels. These comparisons take a critical historical form and it focuses specifically on the systematic form of thinking that is being applied to the history of science and the basic ideas that we use.
- Bachlard's epistemological theory was characterized by its remarkable interest in shortcomings, error and failure in the fields of science. This interest has been preceded by its interest in the advantages. As a result, the scientific topics become a sort of criticism, though what important in science is not the imagined sensory image presented by this world.
- Bachelard’s theory is a scientific theory in knowledge because it derives its subjects, issues and approaches from the science itself. In other words, it takes the scientific knowledge as a basis and tries to provide scientific solutions to the general knowledge issues.
- Bachelard's epistemology is not closed and incomplete theory, which is based on two principles:
  - The relativity of knowledge.
  - The principle of audit ability.

In this sense, epistemology is regarded by Bachelard as the only scientific philosophy that keeps pace with the scientific developments. Accordingly, Bachlard divided the epistemological stages of the evolution of the human mind into three stages and defined attributes for each stage (Badawi, 1980):

The first stage: the concrete: at this stage, the mind is preoccupied with the first images of the phenomenon and relies on philosophical formulas that glorify nature and believe in the unity of science.

The second stage: the abstract concrete: at this stage the mind adds the physical experience and the geometric forms and it is based on the philosophy of simplicity.

The third stage: the abstract: at this stage, the mind gets involved with the processing of information taken from reality but is separated from direct experience. That is, the mind is correlated and integrated with experience at this stage.

Misconceptions about fractions: One of the most important aspects of the mathematics teacher's low level of performance is the students' low level of performance in the subject of fractions. This decline is linked to the students' low level and the basic concepts in this subject. Fractions, in general, and the operations connected to them are considered as difficult topics for the students in the basic stage. It is one of the basic mathematical subjects on which a great deal of knowledge is established. Hence, the importance of the teacher mastering the instruction of mathematics since the first stage, appears. So that any decline in the students' levels reflects the low level of teachers' performance in this subject. This results in serious damages to the cognitive structure of mathematics among students. Despite the context in which children use fractions, it is generally agreed that this topic provides teachers with insight into the developments of children's understanding as well as the relationships between numbers. These understandings are based on children's personal experiences, their intuition, and also their formal knowledge acquired in the classroom. Although fractions are complex in nature, however, they provide students with important pre-conceptual foundations for understanding other types of numbers and algebraic operations in the last years of their school experience. Despite the critical conceptual correlation between the mathematics threads such as space and measurement provided by fractions, this topic still poses problems and difficulties for children in primary school (Yusof *and* Malone, 2015).

Children tend to make all kinds of mistakes, not only in the calculation of fractions but also in the basic concept. The recognized difficulties in learning fractions are reflected and documented in a number of research which have studied various aspects of the subject. As early as 1958, Harting acknowledged that the concept of fraction is complex and cannot be comprehended at once: it can be obtained through a long process of successive development. Orton (1992) supported this view when he wrote that the concept of fractures evolved over a long period of time during which children experience different meanings of fractions in a variety of situations. The researchers conclude that this complex topic

causes more problems for primary and middle school students than any other area of mathematics. Therefore, teaching fractions is important and challenging at the lower level of schooling. Thus, in teaching fractions, teachers must provide experiments involving other mathematical concepts including number, height, weight, and money and they must be assigned to meaningful situations the children can relate to. A deep understanding of the concept of fractions, the comparison between fractions and the meaning of fractions facilitate the process of learning fractions and converting them to decimal or complex fractions and also comparing between them. The topic of comparing fractions is fundamental and mastering it means easier understanding of the material that follows whereas a lack of deep understanding of the concept of fracture leads to several problems, later on.

Methodology and Data Analysis: Life stories expose the significance and subjective interpretation given to his life by an individual, and to certain events that occur during the course of his life (Plummer, 1995). In this research work I am trying to expose the teaching methods used by teachers of mathematics in Arab schools in Israel, of 5 pupils of the Arab sector in Israel. Raising their personal stories is intended as information that can be used as a parameter for the effective improvement of their experience in the school. Location of the participants was carried out through personal acquaintance with their teachers and parents who helped in finding additional research participants. The collection of research data was done through semi-structured interviews conducted with each of the participants alone. Each interview extended from half an hour to fifty minutes. The appointed time of the interview was fixed in advance, and at the beginning of the meeting each pupil received brief information about the subject of the interview and was asked to agree to its recording, with the explanation that the research was anonymous and confidential. Agreement was given verbally by the pupils, parents and teachers. The personal questions made use of the narrative interview technique that allowed for the presentation stories in a mathematics lesson that can explain the experience of pupils in solving questions to understand their misconceptions in fraction. Participants in the research included 5 Arab pupils during their first term in a 5th grade at primary school stages. All of them are of the different socio-economic background. According to the report of their teachers, and their achievement in mathematics level is high (all the names of the interviewees are fictitious).

RESULTS AND DISCUSSION

In this section the findings of the interviews are presented in an attempt to understand the methods the students use to learn fractions in their mathematics lessons. The research findings are presented following two categories: teacher's influence and the students' learning style.

We asked different students in the fourth grade to solve the following question:

Write: >, < OR = $\frac{2}{5}$[ ] $\frac{2}{8}$

Adam, who is defined as an excellent student by his teachers and who received 100 in both the fraction testandthe final exam in 4th grade, answered correctly:

$\frac{2}{5}$[>] $\frac{2}{8}$,

The researcher: Why do you think this is the correct answer?
Adam: if the numerators are equal so the bigger fraction is the one with the smaller denominator. That's what the teacher told us,

Researcher: Can you further explain?

Adam: if the teacher said so, then it is true.
Samar: for sure this is the correct answer $\frac{2}{5}$[>] $\frac{2}{8}$,

The researcher: Why do you think this is the correct answer?

Samar: if we have two cakes the same size and we divide the first one into five parts and the second into eight parts then the parts of the first cake are bigger in size than the second one. Then the researcher gave each of the students a question about fractions that required higher thinking:

Samar answered correctly $\frac{4}{6}$[<] $\frac{7}{9}$ as opposed to Adam who had trouble solving the problem and consequently answered incorrectly. Moreover, he couldnot explain himself, although both students are defined as excellent and got over 90 in mathematics in the fourth grade.

The research findings are presented following two categories: *teacher's influence and the students' learning style.*

Teacher influence: Teachers should support the pupils, explain the material in a meaningful way, encourage thinking in class, and specifically during the mathematics lessons and promotesa positive attitude within the pupils towards studying the material. When Adam was asked for an explanation for the correct answer, he replied that: "if the numerators are equal so the bigger fraction is the one with the smaller denominator. That's what the teacher told us". This finding is supported by Yousef Methkal Abd Algani (2019), who says that a teacher should teach mathematics by exploring the mathematical concepts rather than by memorization them. He adds that a large number of the teachers do not apply the skills of the 21st century in teaching mathematics and its concepts. Procedural method increases the misconceptions in mathematics and also the common mistakes among pupils and causes a week foundation in mathematics, and leads to difficulties in mathematics, in the future (Algani, 2019).

Learning style of pupils: Learning style is a significant factor in understanding the material. That what Adam says when he solved the mathematic question correctly: " if the teacher said so, then it is true". Adam's type of response shows that he replied ritually as opposed to Samar who answered based on high thinking skills; she answered exceptionally to the first question. This finding is supported by Yousef Methkal Abd Algani (2019), who claims that students depend on the memorizing method when learning the mathematical material; the lack of deep understanding is due to their blind belief in their teachers. Consequently, students develop a sort of fear from mathematics and also several misconceptions towards the topic.

Conclusion and Recommendation

The topic of fractions is one of the most important topics in mathematics. As earlier mentioned, most students have great

difficulty in understanding it or solving mathematical exercises. Moreover, teachers may face difficulties teaching the subject and using modern as well as innovative methods. Teachers might face difficulties in understanding the question, solving it and determining on the most effective way to access that question. As a result, they will find it hard to explain it to the pupils. However, by understanding the source of the pupils' common mistakes and their misconceptions, teachers can access the pupils' thinking and understand the issues that cause the pupils to make those mistakes and so focus more on those important points. I think that the main problem is the student's learning style, whether conceptual learning or prucedural. The problems the students face in fractions could affect them negatively in the long term. Therefore, it is very important to deeply understand the subject by researching and exploring it, rather than by teaching the material in the traditional way. It is worth mentioning that the best solution to overcome misconception in learning mathematics is by giving the students the opportunity to grasp the concept of the fractions. Consequently, students must be trained to learn the concept of fractions by doing. First of all, they should have a clear and tangible idea of the concept of fractions, then compare between fractions by dividing identical shapes into parts according to the data of the question. Using the coceptual learning will facilitates building a solid foundation for students because it gives them the chance to learn more about the subject. It is true that coceptual learning is more complex for the teacher when explaining the material, yet it is more effective, for the student, when dealing with the teaching material. Coceptual learning is the key to success for the student, because it grants the students with skills and basics of the subject and and relalte it to previous topics.

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