Bard

Utilizing Infographics to Improve 5th-grade Students' Reflective Thinking Practices.

Written by: Mohammed Abuawad

Supervised by: Dr. Amani Raiyan

Abstract:

The purpose of this action research project is to investigate the influence of employing infographics on the development of reflective thinking in fifth-grade mathematics students. In fifth grade, I utilized infographics to teach the operations unit on mixed numbers. The study's sample size was supposed to be 38 fifth-grade pupils, but due to the teachers' strike in public schools, the sample size was reduced to one.

This study looked at how infographics may be used to motivate and strengthen observation and judgment abilities. Teacher observations, interviews, and assessments were used to collect data. According to the data analysis, the infographics enhanced and strengthened students' deep comprehension of rational number ideas and operations on them.

This study found that infographics had a good influence on reflective thinking. Students began studying, relating, and comprehending the infographics, as well as applying the information from them to solve issues by making judgments and even generalizations for their replies. In a nutshell, the students began to practice reflective thinking.

Following this, the students began to ask more in-depth inquiries. They also began producing and Analyzing infographics for the course. Students' performance improved as a result of their increased grasp of the content. They began to outperform their predecessors in terms of grades. As a result, their enthusiasm and attitudes toward mathematics improved.

As a math instructor, I would advise every teacher to apply the infographics employed in this study to enhance the condition of their classroom, assist students in making academic progress, and make students love what they are studying.

Finally, this study marked the start of my research journey to enhance my teaching skills and upgrade my teaching style and strategies.

Table of contents

0. The Researcher:

I am Muhammed Abuawad from the city of Hebron. I had my primary and secondary education at Alsirri Secondary Boys' School. In the 2009 High School Leaving Exams, I received an average of 87.7 percent in the scientific stream. I got distinctions in Mathematics, Physics, Technology, and Biology. In 2013, I graduated with honors from Hebron University's Faculty of Science and Technology with a bachelor's degree in Mathematics and its Teaching Methods. I married soon after graduating and was completely in debt. So, I had to work as a builder in the occupied territories of Palestine to pay for my wedding. My knees were gravely injured after four years of hard labor in tough conditions, and I had to stay at home unemployed for more than a year. During that time, I realized that pursuing a career in education and teaching was the ideal option if I wanted to maintain my physical health while also making use of my intellectual skills.

As a result, I was able to get teaching positions at a few private schools in South Hebron. I taught mathematics and science to primary pupils and attended various courses on using technology in the classroom. Following that period, I was appointed as an official teacher by the Palestinian Ministry of Education. Some of my job responsibilities are designing and delivering lessons that help students learn and apply math concepts, finding and preparing the materials and resources needed for the lessons, creating a safe and supportive learning environment in the classroom, keeping track of and reporting on students' learning outcomes, and participating in meetings with parents and staff. I have taught students ranging in age from fifth to tenth grade. At home, I spend most of my time in front of a computer screen developing lesson plans, exams, worksheets, and instructional DVDs. In addition, I research extensively about pedagogical practices, new teaching methods and approaches, and how to use them in my interactive classes.

I worked hard to advance my professional career. For instance, I have attended an intensive program aimed at modernizing teachers and obtained a recognized diploma as an outcome. I collaborated with numerous instructors in my region on test writing, conducting academic competitions for students, and Analyzing students' strengths and shortcomings. Furthermore, at the Training and Development Centre in Hebron, I engaged in several academic discussions and internships with mathematical supervisors. On the other hand, I obtained a certificate for completing an online programming course called "Arduino Robotics" which was designed and

presented by The Lebanese International University. This course was really valuable to me because I am a part of my school's programming team, where I educate students how to use Microsoft Office applications and assist them with their school projects.

During my teaching experience in both private and public schools, I've found that many primary school children struggle to understand mathematical issues, which leads to poor performance on math tests. Based on this observation, I collaborated with several colleagues to improve the situation by teaching students how to understand and analyze mathematical problems. Consequently, I wrote a book about the greatest tactics and tools for simplifying mathematics instruction for fifth-graders who study the Palestinian curriculum.

My book focuses on the most engaging lessons in the first and second semesters of fifth-grade mathematics textbooks. It addresses instructors and walks them through the process of creating the greatest physical tools for simplifying and clarifying the subject matter. I created the book to be plain and unambiguous, employing academic terminology often used by mathematics teachers. It is appealing and useful since it provides colorful visuals and simple directions. My book was reviewed by all of the mathematics supervisors in the Ministry of Education Directorate of South Hebron, and it received extremely positive feedback. Those supervisors also invited me to deliver my book to other mathematics teachers at a special event at the Doura City Central Hall. That event allowed me not only to present my book but also to gain advice from other instructors on how to obtain financial help from sponsors to publish it. Unfortunately, my book has not yet been made available to the public, but I am seeking funding to publish it.

In 2022, I participated in the national education conference “Educational Experiences Worthy of Generalization” which was held in the city of Ramallah. I was invited by the Ministry of Education to share my teaching experience with virtual teaching during the pandemic of Covid-19. I gave a presentation regarding the entire experience: what went well, the challenges I experienced and how I dealt with them, and my recommendations for future online learning. I learned a lot from the other instructors who shared their experiences, and I got to participate in stimulating intellectual conversations with some of Palestine's greatest school teachers. Dr. Marwan Awartani, the Palestinian Minister of Education, presented all attendees with certificates of participation at the end of the conference.

In 2023, I competed in the Al-Quds Ambassadors Conference in Hebron against other school teachers who had worked on learning initiatives during the previous two years. "Learn how to Learn," my initiative, focuses on educating students how to identify their learning styles and customize their learning to meet their needs. I began my work with fifth-grade pupils at my school by teaching them about the various learning styles discovered by researchers. Then I led them in a series of exercises and games designed to make them aware of their differences and the fact that one learning style does not fit all. Following that, students were allowed to study new subjects in a variety of formats and to assess their comprehension with short quizzes. Students were asked to pick their favourite and most effective learning method by comparing the quizzes results. Finally, students were taught how to apply what they had learned in order to have a better learning experience and learn faster. Luckily and diligently, my initiative won, taking the second place in the tournament, and I got the opportunity to present it to the audience and encourage them to apply it in their classes for the benefit of their pupils.

Reflecting on my teaching experience, I can say that I sincerely think that if given the opportunity, all pupils are capable of displaying amazing aspects of their personalities. As a result, I listen to my pupils and offer them their own room to express themselves freely. I improve their academic understanding and performance while also building their self-esteem and social skills. I adapt my teaching approaches to match the requirements of my pupils, and I use as many technology aids and tools as feasible in my classroom. Furthermore, I maintain contact with my students' parents and other instructors in order to notify them about their achievements and failures, as well as to study the consequences of either outcome. I assess my students using various evaluation methods in order to provide the most accurate evaluation possible, and I am always willing to adjust the way I evaluate their work if they object to any approach. I love my pupils, and I teach them with love. I do my hardest to make them enjoy what they study, because if they do, their talents will be boundless.

1. Introduction:

As a result of the technological growth that has accompanied many aspects of life in recent years, the employment of contemporary technology in various forms in the educational process has begun, as well as the large spread of technology represented by ideas, processes, theories, applications, and products. This has been done to raise the level of performance and address issues that the educational process is currently facing.

The educational process was impacted by this technological development, as the teacher changed from a transmitter of knowledge into a facilitator of the learning process, taking advantage of what modern technologies provided him with explaining educational materials and guiding students. To increase performance and solve issues with the educational process, work has been done to use these contemporary technologies in a variety of formats.

Nassar (Nassar, 2019) highlighted that incorporating modern technologies in the educational process can effectively address various challenges faced by both teachers and students. as it increases students' excitement and attraction to the lesson and simplifies the academic subject to a large extent, and within a beautiful template that makes the student more willing to follow the lesson and benefit from it.

Thus, the technology used in the educational process, which can be applied to various educational levels, starting from the primary stage to the university level, works to save time and effort for both the teacher and the learner and also reduces the burden on the shoulders of the teacher and raises the level of quality of education. (Nassar, 2019)

When considering education as a whole, we observe that it relies heavily on traditional teaching methods, where the teacher shoulders the majority of the responsibility and the student's role is often passive. Consequently, numerous institutions strive to enhance education and alter this paradigm.

Education is the cornerstone of the advancement of societies and nations, hence, nations endeavor to enhance their education systems. This is achieved by implementing innovative teaching techniques that encourage positive student behavior and place teachers in leadership and facilitation roles. Recent technological advancements have shifted the focus of the educational process towards the student.

The movement toward what is known as the mental picture is one of the most significant tendencies that emerged from the interplay of all the preceding domains (ideas, processes, theories, applications, and products). There is no denying the significance of images in the educational process, their vital function in conveying and facilitating knowledge, and the lasting influence of their impact due to the learner's exposure to them through various senses and the stimulus they provide for a response. From this perspective, instructive illustrations, photos, movies, and others arose. (Al-Ghamdi , 2018)

Infographics are visual representations of data that are widely used in social media, publications, and newspapers today. It is this kind of drawing that is regarded as a fundamental and independent branch that aims to combine technological breakthroughs with aesthetic and creative sense to display information in a condensed, cohesive, and engaging way. As a result, it is regarded as one of the fundamental disciplines that integrate technological and educational advancement. (Abdul Maqsoud, 2018)

One of the elements that improve students' capacity to grasp in several ways and improve their ability to better articulate what is going on in their brains is the usage of the educational infographic approach as one of the tools of instruction. Since infographics are a technique for representing mathematics, they help pupils learn the subject more effectively. (Mahzry, 2016)

Infographics are regarded as a type of mathematical representation that is used in education and is one of the most effective methods of teaching mathematical concepts, because it is a teaching tool that supports mathematical concepts for students by assisting them in examining the main benefits of the mathematical situation. (Al-Sawaei, 2010)

Effective mathematics instruction must be built on a variety of approaches that support the educational process to be effective and accomplish what is asked of it. Mathematical representations, like infographics, are used in mathematics and include images, drawings, tables, figures, text, and symbols. The infographic replaces the old, boring templates with fresh, appealing ones that make it easier for learners to comprehend math. (Badawi, 2007)

Academic success is a major worry for experts in the fields of education and psychology since it has such a significant impact on a student's academic career. Achievement refers to a person reaching their maximum potential at every stage of life, from early infancy to later years. (Lamas, 2015)

Buckley believes that teaching using infographics represents a reflective process based on building mental models and includes forming, testing, enhancing, and refining apparent mental models or a problem. (Buckley, 2000)

On the other hand, The Ministry of Education cannot neglect reflective thinking since it is the peak of mental operations, and educators must work hard to foster it. It forces the individual to constantly prepare, assess his approach to the procedures and actions he takes to make the best option, and reflective thinking depends on how to deal with issues and alter phenomena and occurrences. (Pont, Nusche, & Moorman, 2008)

A person who thinks reflectively may comprehend relationships, summarize material to support his position, assess and look for alternatives, and analyze premises. (Abdulwahab, 2005)

With the aid of reflective thinking, students can evaluate an idea, consider it from various perspectives, list its constituent parts, point out any existing relationships between them, highlight any gaps, and determine the causes of the results by looking at the connections between the parts of the idea. He then created answers to the issues mentioned, which aids in developing a person who can study on their own, which is the aim of 21st-century education. (beers, 2014)

Through my work in the field of education, I became aware of the research issue, which is exemplified by students' inadequate degree of reflective thinking in the basic stage in general and the fifth grade in particular in governmental schools. Students' interest in mathematics is low, and they perceive the subject as being rigid, inflexible, and dependent on memorization, which may be a sign of the presence of a negative attitude towards the subject.

Due to the nature of mathematics, being a vital subject related to the student’s life and problems, there has been an urgent need to use strategies and methods commensurate with these requirements in terms of solving achievement problems and developing reflective thinking.

However, when put into practice, this goal frequently runs afoul of reality due to teachers' inadequate proficiency in raising achievement and fostering reflective thinking abilities, as well as their lack of access to the necessary equipment, devices, teaching aids, administrative data, and organizational systems.

After teaching the same topic for over four years, I've noticed that students struggle with poor reflective thinking. The current study seeks to ascertain the impact of employing infographics

in mathematics instruction on the development of reflective thinking in fifth-grade students by evaluating and analyzing the response to the following questions:

1. How does using infographics motivate students towards learning mathematics?
2. What is the effect of using infographics in teaching mathematics on the development of fifth-grade students' observations?
3. What is the effect of using infographics in teaching mathematics on the development of judgment among fifth-grade students?

The Al-sirri Secondary School for Boys, located in the neighborhood of Al-sirrah in the town of Dura, which is a part of the Hebron Governorate, is the site of this study. The school is notable for having a tiny student body, which in this academic year consisted of about 215 students in fifth through twelfth grades. Few students have parents that are from nearby areas; the minority of students are from the neighboring villages (Imreish and Khursa). All of the students at the school are members of a community whose rituals and customs support education which they are primarily influenced by an Arab-Islamic culture. The vast majority of the students are from affluent families.

The study's sample size was supposed to be 38 fifth-grade students. at Al-sirri Secondary Boys' School, aged between 10 and 11 years. Where they demonstrate high levels of achievement, a cooperative spirit by cooperating with their teachers and one another to make sure that any initiative that would benefit them is successful, strong abilities that allow them to advance in their personal development, and a positive attitude towards learning.

But unfortunately, Due to the social conditions that occurred at the time of applying the study, such as a strike by government teachers and other circumstances, the study sample was reduced to one student (case study).

2. Literature review

2.1 theoretical background:

This review of the literature looks at studies in education that describe visual and mathematical literacy, as well as the skills needed to be both. The educational benefits of infographics are investigated, with a focus on visual and mathematical literacy abilities. According to the study conducted for this evaluation, it is necessary to possess visual and mathematical literacy skills to comprehend infographics and interpret the information presented in them. The research study underlined the power of infographics to lessen the cognitive load, clearly communicate abstract and complicated information, and promote memorability.

Infographics have been used in various fields for a long time, but their use in mathematics education has a unique history. Hermann Minkowski, a German mathematician, was given the French Academy of Sciences' Mathematics Prize for his book on the theory of quadratic forms. Due to the very young age of 18 (Hancock, 1964, p. vii), was one of the first to use infographics in mathematics education. In 1896, Minkowski introduced the use of infographics in his book Geometry of Numbers, which was considered revolutionary at that time. (Hancock, 1964, p. viii)

Minkowski's use of infographics was seen as a new way of presenting mathematical concepts and information. It made complex concepts more accessible and easier to understand. Infographics were used to illustrate geometric shapes, angles, and other mathematical concepts. This approach was more effective than traditional methods of teaching, which relied on abstract formulas and symbols. (Hancock, 1964, p. ix)

Today, infographics are commonly used in mathematics education. They are used to present statistical data, mathematical models, and graphs. Infographics are essential in helping students visualize mathematical concepts and understand the relationships between them. They can also help students understand complex mathematical concepts much more quickly than traditional methods.

Infographics have since become an essential tool for presenting mathematical concepts and data. As technology continues to advance, the use of infographics in mathematics education will likely continue to evolve and expand.

2.1.1 What is Infographic?

People use the term "infographic" to refer to a variety of topics. Although infographics and data visualizations are frequently used interchangeably, they have different meanings in the context of infographic design.

A typical description for infographics up until recently was simply "a visual representation of data," Even though that definition is no longer current and is more suitable for data visualizations. The term "infographic" was originally used for designing graphics intended for newspapers and magazines. that were originally formed from the phrase "information graphics.".

The term "infographics" now has a new meaning that it pertains to a comprehensive graphic design that combines data visualizations, illustrations, text, and images in a way that communicates a complete narrative. In this sense, data visualizations are no longer regarded as full infographics on their own but rather as potent tools that designers frequently employ to support the visual presentation of their ideas. (Krum, 2013, p. 6)

Mark Smiciklas defines an infographic as a kind of image that uses design and facts to help people and organizations convey their message to their audience effectively. (Smiciklas, 2012, p. 3)

Infographics are defined by Baglama and others as data visualizations that allow audiences to quickly and easily understand complex data. (Baglama, Yücesoy, Uzunboylu, & Ozcan, 2017, p. 26)

There are several reasons why visual information is a more efficient means of communication for humans. The primary reason is that our strongest sense of input for seeing the world around us is vision. John Medina, a developmental molecular biologist, writes in Brain Rules that, “Vision is by far our most dominant sense, taking up half of our brain’s resources.” (Medina, 2009, p. 240)

According to (Krum, 2013, p. 15), The human brain reserves a significant portion, ranging from 50 to 80 percent, for processing visual information, which encompasses sight, visual memory, colors, shapes, movement, patterns, spatial awareness, and image recall.

2.1.1.1. Infographics types:

infographics can be divided into several types as follows:

1- As for presentation, there are three types:

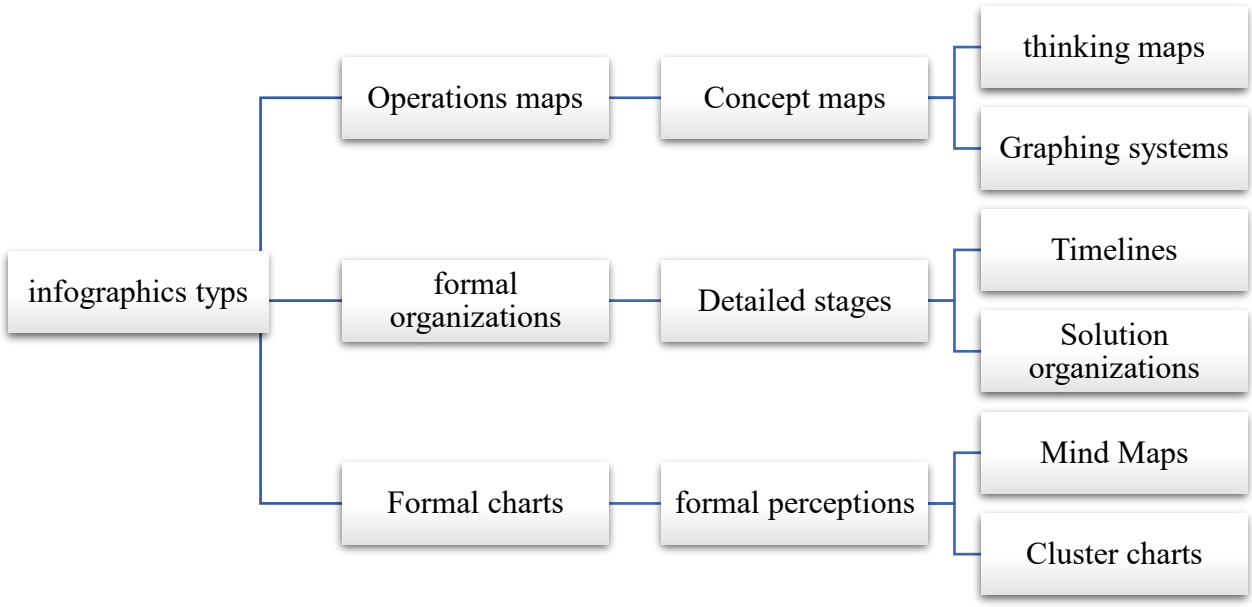
- Fixed infographic which consists of a fixed image and some text.

- Infographics that are animated fall into two categories based on their design: videos that use data and information to illustrate ideas and facts, and infographics that use moving data and information.
- Interactive infographics allow the audience or learner to actively participate in the presentation by controlling various aspects of it.

2- In terms of layout, it is done as follows: Information is generally represented in an infographic by a combination of lines, shapes, and arrows. As a result, it is separated into a group of shapes and visuals that are represented in:

- radial drawing
- Stepwise operations
- tables
- Illustrations
- chart
- Maps
- relations
- lists (Darwish & Al-Dakhni, 2015)

Tools that address the sense of sight are divided into three basic types, all of which contribute to arranging information, building basic skills, understanding lesson content, and thinking about building mental models and systems (Qarni, 2013, p. 19), which is explained in the following chart:



2.1.1.2. What to consider when designing an infographic:

- Pick a topic for each infographic.
- Select information that can be shown visually.
- Make sure that the information shown is accurate.
- Give a unique title to the infographic.
- Use pictures and graphics, simplify information, and avoid long sentences.
- Pick appealing colors that match the information shown.
- Make the basic components coherent by showing the relationships and grouping related information and connecting them together.
- Cite and attach a list of information sources. (Abdel Aziz, 2018, p. 47)

2.1.1.3. Infographic design programs:

Several computer programs can help in designing infographics, and the most commonly used among these programs are the following: (Mageed & Hasan, 2021, p. 173)

- Adobe Illustrator: It is famous for its high flexibility and ability to produce beautiful results.
- Adobe Photoshop: Photoshop can be used to create infographics, but it will not be as adaptable as Illustrator since it is mainly an image editing program. However, it can still be used to present data in attractive ways.
- Inkscape: For those who prefer to use free software, this is a viable alternative to Adobe Illustrator.
- Tableau: This program is free and exclusively compatible with Windows. It is designed to create vibrant and distinctive designs.
- Adobe Fireworks: A nice program for creating infographics, but it has little use and effectiveness.

Besides these programs, some websites help in creating and sharing infographics to make graphic statistics.

- Piktochart: This website is dedicated to creating and developing infographic designs, making it a great resource for beginners in the world of infographics. One of its advantages is the ability to easily drag and drop shapes, along with access to a variety of free templates to help get started with designing infographics.

- Creately: If you need to create charts and graphs, a helpful tool is available that offers pre-designed templates and diagrams. You can simply add your data to complete your work and share it with others.
- Canva: This free website provides you with many designs to create infographics, and it features many ready-made infographic templates to help you design without the need for a professional designer.
- Venngage: It is another free tool for designing infographics, and it is characterized by simplicity and ease of use, and it contains many different graphics that help you in any field of study.
- Visual.ly: It is one of the most important tools that includes more than 25 thousand designers who share their designs through social networking sites.
- Easel.ly: A free tool that does not require downloading, through which you can create a wonderful infographic in a few minutes through ready-made and pre-made templates, and you can choose from many formats.

2.1.1.4. How to design an infographic:

To create an infographic, you only need your own creativity and a designer who can help you present the information clearly. However, not all designers have the same style or expertise. Some of the websites that offer infographic services have free and paid plans. The paid plans give you more features than the free ones. Infographics do not have a fixed format or size.

Infographic design is a service offered by professionals who have expertise in this field. Content owners and designers who wish to use infographics as a primary or secondary medium can benefit from their creativity and skills. Infographics are an effective and influential method of content delivery on the web.

2.1.1.5. advantages of infographics:

Therefore, there are several advantages to infographics. Below, I've listed some of them:

- Simplifying difficult and massive amounts of information to make it easier to grasp, as well as relying on visual cues to transmit information.
- Changing information and data from dull numbers and texts to engaging images and drawings.
- The ease with which the infographic may be published and distributed via social media.

- Help to keep the information longer.
- This characteristic enables it to be utilized across numerous fields and disciplines of data, showcasing its wide-ranging applicability.
- One of its key features is the capability to communicate and transfer information in various languages, allowing for seamless interaction with individuals from different linguistic backgrounds.
- Deliver the message to others.
- Show a large amount of data in a meaningful way.
- It has the potential to improve cognitive abilities such as critical thinking, information linking, and organization, thereby enhancing overall mental capacity.
- By combining texts and graphics, it presents information, patterns, or trends in a more comprehensible manner than plain text, thereby improving the ease of understanding.
- Easy to read. (Al-Jariwi, 2014)

The educational graphics in textbooks need to be re-evaluated to be prepared in a correct technical and educational manner with the appropriate infographic design and added to the educational content instead of other types of outdated graphics, according to some educators, despite all the previous advantages of the infographic. (Al-Khafaji, 2021)

2.1.2. Secondly, visual learning:

After discussing infographics in such detail, it is important to comprehend how they connect to education. Learning styles are the various methods and approaches that people use to learn new things. They involve the individual techniques and preferences that help someone acquire and retain information more effectively. Some people tend to favor a specific way of interacting with and processing information, depending on their sensory and cognitive strengths. One example of such a learning style is the visual style, which relies on images, diagrams, and colors.

Visual learning is a teaching and learning technique that uses visuals and technology to connect ideas, concepts, facts, and other information. This is one of three main learning styles in the widely used Fleming VAK/VARK model, which also covers kinesthetic and auditory learning. (Al-Dhuwaikh, 2016, p. 11)

A student who has this learning style depends on their ability to perceive and memorize visual information. They can learn more effectively when they have a clear visual representation of the material that the teacher or book is trying to convey.

Students who prefer this style are characterized by translating what they see appropriately, and individuals possess the ability to perceive the relationships between visual experiences through visual associations. They also possess advanced skills in receiving, processing, and interpreting visual experiences, which enhances their awareness of educational experiences when presented through visual media. The visual pattern uses sentences such as (Let me see) and can complete a new task after seeing someone doing it. It prefers to work and accomplish what is required based on written instructions and orders. (Al-Dhuwaikh, 2016, p. 14)

Visual thinking is the ability of an individual to conceptualize and communicate an idea or information using visual elements such as pictures and drawings, rather than relying on a large amount of verbal or textual information that we typically use to interact with others. It also involves a cognitive process that enables the individual to interpret the visual form and transform the visual language that it conveys into written or spoken verbal language. (Abdel Aziz, 2018, p. 49)

The person possesses the ability to handle concrete materials and identify them through visual perception. They can also comprehend the spatial organization of objects, analyze and evaluate information, and cope with ambiguity. (Abdel Aziz, 2018, p. 49)

2.1.2.1. There are several advantages to visual learning:

Below, I've listed some of them:

- Explain the hierarchy and order of things.
- Bring ethereal ideas to life
- Draw the user's attention.

2.1.2.2. Visual thinking tools:

How to express the learner's visual formations in so-called visual thinking tools, which are as follows:

- Symbols: Although more abstract, they are the most prevalent and employed in communication.
- Pictures: pictures are among the most precise modes of communication, but their high cost and difficulty in maintaining constant availability have kept them from being extensively employed.
- Shape diagrams: some students use them to depict concepts and answers, and they may include:

- Pictures-related drawings: They have distinct objections to an object or idea, and they employ these objects as alternative images of the body in detail, utilizing printed clippings or computers.
- Drawings associated with the notion share the same qualities and traits as the concepts to aid in their differentiation if necessary.
- Comics rely on the learner's imagination to show the connections between topics.

2.1.2.3. Visual thinking skills:

Visual thinking necessitates the development of a set of abilities in students through activities such as interpreting pictures, shapes, and drawings, as well as recognizing the links between styles and other things.

Based on a review of the literature on visual thinking abilities, such as the work of (Abdel Aziz, 2018), the following visual thinking skills may be identified:

- The ability to recognize and describe the shape: It's the capacity to figure out the proportions and nature of the exhibited form.
- Ability to perceive linkages in a figure and identify and classify the qualities of those relationships is referred to as shape analysis.
- The capacity to link the parts of relationships in form and detect concordances and flaws in them is referred to as the capability of linking relationships in form.
- The ability to see and comprehend ambiguity: the ability to clear gaps and fallacies in relationships in order to bring them closer together.
- The capacity to derive new meanings and attain scientific notions and principles is referred to as the art of deriving meanings.
- Training the learner in visual communication skills allows him to examine his work, and his mind monitors and controls when executing other visual abilities.
- The capacity to perceive the arrangement of items in space and the difference in their location depending on the location of the human observing them is referred to as spatial perception.
- Visual memory is the ability to retain visual images in order to access them later.
- Mental rotation is the ability to shift mental pictures of an item.

2.1.3. Thirdly, we must know the definition of reflective thinking so what exactly is reflective thinking?

The ability to reflect on one's learning and learn via reflection on experience is an essential skill for learning and development. Reflective thinking needs higher-order thinking abilities, which necessitate thoughtful consideration and the capacity to reason through every choice.

Reflective thinking is a process that involves looking at the bigger picture and understanding all of its implications. It is not simply about listing your past actions or future goals in a simple list. It involves making a sincere effort to understand why you did what you did and why it is important. This often includes examining your emotions, feelings, and reactions. (Boud, Walkr, & Kogh, 1985)

Reflective thinking means thinking about what you've experienced and trying to learn from it. It's like looking back at something that happened and trying to figure out what you can learn from it. This can help you gain new knowledge and understand things better. (Boud, Walkr, & Kogh, 1985, p. 18)

Students that engage in reflective learning examine how they understand their actions, thought processes, and experiences as well as how they have impacted them and others. (Mann, Gordon, & MacLeod, 2009, p. 596)

It is important to remember, nevertheless, that for children to acquire the capacity for reflection, they must be exposed to educational opportunities that give them the skills necessary to engage in reflective activities. (Schon, 1984, p. 27)

2.1.3.1. **Reflective thinking skills**:

we cannot proceed without mentioning the five important reflective thinking skills:

1. Observation
2. Communication
3. Judgment
4. Decision-making
5. Motivation and team working. (Mirzaei, Phang, & Kashefi, 2014)

Reflection involves challenging assumptions about the nature or method of problem-solving. Unlike problem-solving, which focuses on finding solutions to problems, reflection involves questioning the premises or presuppositions that underlie the problem itself. This process is sometimes referred to as problem-posing. Making an assumed situation challenging and casting doubt on its veracity is known as issue posing. (Kember, et al., 2000, p. 384)

2.1.3.2. Reflection components:

Reflection is the process of reflecting on an event or a circumstance and learning from it to get better the next time. Reflection has three main components, which are:

a) Self-awareness, or getting in touch with who you are, what you have experienced, and what has shaped your worldview, is the first step in reflection.

b) Self-improvement comes next in the reflective process. Knowing your strengths and shortcomings will help you focus on the areas that need it most.

c) You can take charge and make the necessary changes in your life through reflection.

Reflective thinking and critical thinking are usually used synonymously. But critical thinking is the deliberate process of evaluating information to create an opinion or come to a conclusion, and it varies based on its underlying aim.

2.1.3.3. Reflective thinking models:

There are various models for reflective thinking; I've selected four that are the most frequently used.

a) **ERA Cycle**:

Involving only three steps, this reflection model is considered one of the simplest:

- Experience
- Reflection
- Action (Jasper, 2003, p. 2)

The cycle says that we'll begin with an experience, whether it's something we've never seen before or something we know about. This experience could be good or bad, and it might not have anything to do with our job. After we experience something, we start to think about it. We take some time to figure out how we feel about it and what we should do next.(Jasper, 2003, p. 2)

The last step of the cycle - taking action - is the result of this process. What we do as a result of an incident varies depending on the person. The cycle will continue as a result of this action and the subsequent experience. (Jasper, 2003, p. 2)

b) **Kolb's Experiential Learning Cycle**:

The paradigm is centered on theories of individual learning and highlights the concept of comprehension being acquired through real-life experiences. It comprises four significant stages: (Kolb, 2014, p. 44)

- Concrete experience
- Reflective observation
- Abstract conceptualization
- Active experimentation

According to the paradigm, every experience begins with either something entirely new to us or something we are already familiar with. The next step involves reflecting on the situation and taking note of any novel occurrences. This process helps us to generate new ideas and insights. For example, we may try to understand why something unexpected happened and what we can learn from it. In the final stage, we apply our newfound insights to a range of different situations, allowing us to expand our understanding and develop a more comprehensive perspective. By following this paradigm, we can enhance our ability to learn from our experiences and apply our knowledge in a variety of contexts. (Kolb, 2014, p. 45)

The above example illustrates how our reflections and experiences can have a direct impact on our learning. This paradigm is comparable to the one employed by new-born to grasp fundamental concepts such as heat and cold. For instance, if a new-born accidentally touches a hot object and gets burned, they will become more cautious and learn to avoid such objects in the future.

Similarly, by reflecting on our experiences and learning from them, we can enhance our understanding and develop new insights that can help us navigate similar situations more effectively in the future. This paradigm highlights the importance of experiential learning and the role it plays in shaping our understanding of the world around us. (Kolb, 2014, p. 45)

c) **Gibb's Reflective Cycle**:

This particular model of contemplation includes additional levels and elaborates on the first two. Although it may be one of the more complex models, having

distinct stages in the process can provide a sense of comfort. Gibb's cycle consists of six stages: (Gibbs, 1988, pp. 49-50)

- Description
- Feelings
- Evaluation
- Analysis
- Conclusion
- Action plan

Like previous approaches, Gibb's begins by summarizing the scenario under consideration. The next step in the process is to concentrate on our emotions during and after the event, as suggested. Afterward, we are encouraged to assess the situation and determine what we believe to be positive and negative aspects of it. (Gibbs, 1988, p. 50)

After evaluating the situation, we can try to understand it better by examining the circumstances. This analysis will lead to a conclusion about any potential actions that could have been taken to produce a different outcome. The subsequent step is to create an action plan outlining the steps we can take in the future if we encounter a similar situation. (Gibbs, 1988, p. 50)

d) **Retrospective, Introspective, and Prospective Thinking**:

To help educators reflect on their prior work, we've developed a three-part reflective practice framework. Perspective-Taking: Looking Back, Looking Forward This cycle of reflection takes into account the educator's past, present, and future work in order to generate future effective strategies. Additionally, it aids educators in consciously tuning into their inner selves through introspective thought to increase their self-awareness.

- Retrospective Thinking: Look Back
- Introspective Thinking: Look Inward
- Prospective Thinking: Look ahead (Barrett, 2021)

2.2 previous study:

In chronological order from oldest to newest, I included a few of the earlier studies that addressed the study's topic or one of its aspects:

2.2.1. Kousa's study:

(Kousa, 2019) conducted a study to investigate the utilization of infographic technology in teaching mathematics, with the aim of enhancing conceptual comprehension of graphs and improving overall mathematical understanding, on the experimental group and control group in one of the public primary schools in Makkah. He utilized this form in its original state during the second semester of the academic year 1437-1438 AH. To measure the dimensional performance in the two research groups, a conceptual comprehension test was prepared to measure the aspect, interpretation, and application, and a scale that makes mathematics.

2.2.2. Siddiq:

(Siddiq, 2018) study was carried out to explore the influence of using infographics in mathematics education on academic success and the development of visual thinking abilities among sixth-grade female students in Makkah, Kingdom of Saudi Arabia in order to reach the study's goal, the researcher utilized a semi-experimental design through an experimental approach. The researcher created the following study instruments and materials: an accomplishment exam, a visual thinking skills test, and "Infographic" designs. The study's sample comprised of 60 sixth-grade students who were divided into two groups. The experimental group consisted of 30 students who were taught using infographics, while the control group of 30 students was taught using the traditional teaching method. The study's findings revealed the following: In the accomplishment exam, The experimental group showed statistically significant differences ($\alpha \leq 0.05$) compared to the control group. In the visual thinking abilities exam, there were statistically significant differences ($\alpha \leq 0.05$) in the mean scores of the experimental and control groups in favor of the experimental group. The correlation coefficients between the students' achievement exam scores and their visual thinking abilities test results indicated a statistically significant difference in favor of the experimental group.

2.2.3. Syed:

(Syed, 2020) conducted a study with the aim of exploring how the use of infographics in teaching mathematics curriculum for Muslims can contribute to the development of academic

achievement (Present and delayed) and the ability to develop graphics among mathematics students at Al Gunfudha university and Om-Alqura University. To answer the research question and verify its assumptions, the empirical method was utilized. The research sample comprised of 60 level 5 students in the mathematics department. Students are divided into two groups (Experimental group and control group) During the first semester, each group consisted of 30 students who were registered in the mathematics curriculum for Muslims of the academic year (2019-2020).

The research tools are

1- Academic achievement tests in the curriculum.

2- Assessment card for visual shows design skills.

Research results are:

1- There is a significant statistical difference at ($\alpha \leq 0.05$) in the average grades of the experimental and control groups following the administration of the academic achievement exam. (Experimental Group Outperforms)

2- There is a significant statistical difference at ($\alpha \leq 0.05$) between the average grades of the control group's current and delayed post-application academic achievement tests.

3- There is no significant statistical difference at ($\alpha \leq 0.05$) between the average grades of the experimental group's current and delayed post-application academic achievement tests.

4- There is a significant statistical difference at ($\alpha \leq 0.05$) between the average grades of the experimental and control groups in the evaluation of their visual display design skills. (Experimental Group Outperforms)

2.2.4. Al-Shamrani & Al-Zahrani's:

(Al-Shamrani & Al-Zahrani, 2021) conducted A study to investigate the impact of using educational infographics on the academic physics achievement and attitudes of female high school students in Jeddah. The research employed a quasi-experimental approach, with 72 girls from a Jeddah school participating in the study. The girls were divided into two groups, with 36 in the experimental group that used infographics to learn. The study used an achievement test of physics and a measure of attitudes toward the use of instructional infographics in teaching. The results showed that the girls in the experimental group performed better on their physics test than those

in the regular class, with a statistically significant difference at ($\alpha \leq 0.05$) between the mean values of the trend scale before and after application in favor of after application.

2.2.5. Barakat:

(Barakat, 2022) conducted a study with the aim of investigating the impact of using infographics in teaching mathematics on the academic performance and development of visual thinking skills of sixth-grade students in Mecca, Kingdom of Saudi Arabia. In order to achieve the study's objective, the researcher employed a semi-experimental design using an experimental technique. The researcher created the following study instruments and materials: an accomplishment exam, a visual thinking skills test, and "Infographic" designs. The study's sample comprised of 60 sixth-grade students who were divided into two groups. The experimental group consisted of 30 students who were taught using infographics, while the control group of 30 students was taught using the traditional teaching method. The study's findings revealed the following: In the achievement exam, The mean difference between the experimental group and the control group has a statistical difference ($\alpha \leq 0.05$), which is beneficial to the experimental group. In the visual thinking abilities exam, there were statistically significant differences ($\alpha \leq 0.05$) in the mean scores of the experimental and control groups in favor of the experimental group. The correlation coefficients between the students' achievement exam scores and their results in the visual thinking abilities test indicated a statistically significant difference in favor of the experimental group.

2.2.6. Francis:

(Francis, 2022) conducted a study with the aim of investigating research in education that describes visual and mathematical literacies, as well as the competencies that contribute to an individual's visual and mathematical literacy. The study focuses on exploring the educational advantages of infographics, with a specific emphasis on visual and mathematical literacy skills. As per the study conducted for this review, it is essential to possess visual and mathematical literacy abilities to understand infographics and the information conveyed through them. The studied research underlined infographics' potential to minimize cognitive load, understandably transmit abstract and complicated information, and help in memorability. I analyze infographic examples to demonstrate the importance of visual and mathematical literacy abilities, as well as the possible educational uses of infographics.

2.2.7. Ibrahem and Alamro:

(Ibrahem & Alamro, 2021) conducted a study in the second semester of the 2018/2019 academic year, to explore the impact of static infographics (SIs) versus animated infographics

(AIs) on the development of e-learning and computer skills. The study aimed to determine whether achievement motivation increased among students taking e-learning and computer literacy courses at Ha'il University. A total of 80 male and female students were divided into four experimental groups for the investigation. The subject was examined by 40 students in groups 1 and 2, while the remaining 40 students in groups 3 and 4 used AIs. The independent factors in this study were SIs and AIs embedded learning material, whereas the dependent variables were e-learning and computer skill attainment and achievement motivation.

2.2.8. Islah and Alshobaki:

(Islah & Al-Shobaki, 2020) Mohammed conducted a study to investigate how infographics affect the development of visual thinking abilities among eleventh-grade physics students. The researcher used an experimental strategy in this investigation. The researchers selected (67) eleventh graders. Dalal Al Moghrabi Secondary School students were separated into two groups: experimental (33) and control (34) students. The researchers created a teaching guide about labor and energy based on a Scientific eleventh-grade book, as well as a visual thinking exam with (30) multiple-choice problems, The researcher used the Independent Sample T-test to compare the experimental and control groups. The results indicated statistically significant differences between the experimental and control groups in terms of visual thinking post-test.

2.2.9. Rana Al-Bishi:

(Al-Bishi, 2019) conducted a study to determine how interactive infographics affect the development of visual thinking skills among female educational supervisors in the city of Tabuk. The research relied on the experimental method. The research tool consisted of testing visual thinking skills, which was applied to a sample of 25 female educational supervisors in various disciplines in the Educational Supervision Department of the General Administration of Education in Tabuk. The research findings showed that there were significant differences between the average scores of the "interactive infographic" experimental group in the visual thinking skills test before and after the application. These differences were in favor of the post-application for each visual thinking skill individually, as well as for the overall score of the thinking skills test. The research suggested offering specialized training courses for teachers and supervisors to equip them with the necessary skills to effectively incorporate interactive infographics in the educational or supervisory process.

2.2.10. Said and others:

(Said, Ibrahem, & Kamel, 2019) conducted a study geared at strengthening visual thinking abilities in the computer Subject of the kids of the (1st) grade by employing static infographics. In conducting the study experiment, the researcher employed the semi-empirical technique. The research group included 25 students. The first grade was. The experimental processing material is multimedia software designed according to the general model of teaching design in static infographics, and the measurement tool is a visual reasoning ability test to measure the ability of the research group, and the experimental group used the static infographic type. The results of the study indicated that the use of static infographics led to an enhancement in the cognitive level of the first unit of the computer curriculum and information technology, as well as an improvement in the visual thinking skills of the experimental group.

2.2.11. Al-Khafaji:

(Al-Khafaji, 2021) conducted a study to investigate the influence of figurative representations on reflective thinking among middle school students in science. To test this, the researcher formulated a hypothesis and applied her methodology during the first course of the academic year (2017-2018). As the number of the research sample reached (64) middle school students in Babylon High School for Boys, and they were randomly distributed into two divisions, with (32) students in each division, the two research divisions were equivalent in the following variables: (ages, intelligence variable, past biological experiences). In the light of the opinions of the judges, meditation skills were chosen, as they included the following: visual vision - detecting errors - giving convincing explanations - reaching conclusions - developing suggested solutions. A test was built that included (20) questions of the chosen type, four questions for each skill, and (4) alternatives were developed. For each paragraph, the researcher made sure of the statistical analysis of the meditation questions. After conducting research for a duration of 8 weeks, a reflection test was administered to both divisions. The t-test was used for statistical analysis to determine the significance of the change between the two groups. The results indicated that students in the experimental group, who studied in visual organizations, outperformed the control group who studied in the traditional way in reflection questions related to science.

2.2.12. Abdel Aziz:

(Abdel Aziz, 2018) conducted a study to investigate the impact of using infographics in scientific instruction on fifth-grade students' achievement, development of visual thinking abilities, and orientation toward science in Kuwait. The study employed a semi-experimental design, with

a sample of 64 students divided into two groups: an experimental group of 34 students who learned using infographics and a control group of 30 students who studied using traditional techniques. The research instruments included an accomplishment exam, a visual thinking test, and a measure of scientific orientation. The results showed statistically significant differences at the level of ($\alpha \leq 0.05$) between the averages of the experimental and control groups in the post-application of study tools in favor of the experimental group.

3. Methodology:

3.1: Introduction:

This study was designed to determine how infographics used in math instruction foster reflective thinking in fifth-grade students studying the Fractional numbers unit. In addition to the research instruments, this chapter describes a community, the methodology, and a table of the intervention plan utilized to carry out the study.

3.2: Research Questions:

- The main question is: How does the use of infographics in teaching mathematics develop reflective thinking among fifth-grade students?
- The first sub-question is: How does using infographics motivate students toward learning mathematics?

  I will assess this through teacher observation and teacher memos.

- The second sub-question is: What is the effect of using infographics in teaching mathematics on the development of fifth-grade students' observations?

  a) I will assess this by quiz questions (1, 3, 5)

  b) I will assess this by interview questions (1,2,5,6)

- The third sub-question is: What is the effect of using infographics in teaching mathematics on the development of judgment among fifth-grade students?

  a) I will assess this by quiz questions (2, 4)

  b) I will assess this by interview questions (3,4,7,8)

3.3: The Research Design:

3.3.1: Description of the action plan:

I will conduct a field study to evaluate changes in students' reflective thinking following a methodological shift in teaching and the usage of infographics, the students comprised a heterogeneous sample. As a result, I've written my action plan in this chapter to outline the phases of my intervention. I will begin my intervention with an interview, the students will answer questions about their attitudes toward mathematics as well as questions about their understanding of rational numbers.

Then I will use a pre-test to check students' past comprehension before beginning the intervention. Then I began my new strategy of utilizing infographics to describe this phase in the work plan. Post-class observations, an interview with the same sample of students, and a post-test will be used to collect data. The data then will be examined.

3.3.2: The Intervention

This study was planned to be carried out according the following work plan, which can be found in the appendices. The intervention planned to take 18 classes to complete. In summary, it will take three weeks to complete all of the study's phases. But unfortunately, Due to the social conditions that occurred at the time of applying the study, such as a strike by government teachers and other circumstances, the study sample was reduced to one student (case study).

Here are all of the actions I followed to carry out this action research. All assessments were created before the intervention's start and can be found in the appendices.

1. I interviewed the student before the intervention.
2. I assessed my student understanding and achievement using a pre-test.
3. I started my lessons as written in the action plan.
4. I interviewed the same student and I asked him the same questions including a question about his feelings during the intervention.
5. I assessed my student understanding and achievement using a post-test.
6. I analyzed the collected data and discussed it.
7. Finally, I wrote the conclusions of this study. (Rayian, 2014)

3.4: The Research Population:

This research will be carried out at the Al-Surra Secondary School for Boys in the town of Dura, which is part of the Hebron Governorate, in the village of Al-Surra. The school stands out for having a small student body, which this year totaled roughly 215 pupils in grades fifth through twelfth. The majority of students come from the village, and just a few students have parents who are from neighboring communities (Imrish and Kharsa). All of the school's students are part of a community whose education-promoting rituals and traditions are governed by an Arab-Islamic culture that predominates. The majority of the pupils come from wealthy backgrounds.

The thirty-eight students in the fifth grade at Al-Surra Secondary School who were between the ages of 10 and 11 made up the study's sample. The students' level of achievement is good, they exhibit a cooperative spirit by working together with their teachers and one another to ensure the

success of any initiative that would benefit them, they possess strong abilities that allow them to advance in their personal development, and they exhibit a positive outlook on learning.

When conducting focus groups with them, they expressed a need for change and a need for strategies that foster reflective practice. I sensed their desire to play a part in their learning process, that they needed to experiment with their own hands, and that they were tired of the indoctrination process.

All of this inspired me to employ new techniques and approaches that enhance my students' capacity for introspective thought. The fifth-grade students in this class served as the research sample for the study on how employing infographics in the fractions unit of the mathematics textbook might foster reflective thinking in students.

Due to the social conditions that occurred at the time of applying the study, such as a strike by government teachers and other circumstances, the study sample was reduced to one student (case study).

This reduction in the study sample size to just one student can have both positive and negative implications. On the one hand, it allows for a more in-depth analysis of the individual case and can provide valuable insights into specific behaviors or experiences. On the other hand, it limits the generalizability of the findings to a larger population, as the results may not be representative of other students or contexts.

Additionally, relying on a single case study may increase the risk of bias or subjectivity in interpreting the data. Therefore, I will attempt to acknowledge these limitations and consider them when concluding the study.

3.5: The tools:

The focus and foundation of action research is the process of gathering data and information because we cannot validate the research's findings without it. Consequently, specific tools must be used for data collection. I'll use the following tools to gather data for this study:

3.5.1: Observation:

is a systematic process of closely examining and studying the behavior of various phenomena, problems, and events, along with their physical and environmental components, and then following their course, trends, and relationships in a structured, planned, and purposeful scientific manner with the aim of interpreting, figuring out how variables relate to one another, and predicting the behavior of the phenomenon.

By using this method, phenomena are seen and observed in their unaided, natural states, without the researcher interfering with the phenomenon's equation, language, or the nature of the interactions that develop between its elements.

In order to gather precise information about a certain issue, it is an interaction and exchange between two or more people, one of which is the researcher and the other the respondent or the respondent, during which the researcher watches the respondent's reactions. (Al-Duraij, 2004)

As it pertains to the tiniest details, the facts and data the researcher collected here are deep and correct to a great degree. I will therefore create a note card to write down all the details and observations I make while doing my research. Additionally, I'll try to take notes right away so I don't miss anything.

3.5.2: Interview

The interview serves as an oral questionnaire for the researcher to immediately gather data verbally. An interview varies from a questionnaire in that the respondent of a questionnaire records their own responses, whereas in an interview, the researcher records the examinee's responses. It is seen as a guided discussion between the researcher and a person or people to discover a certain fact or circumstance that the researcher intends to identify in order to meet the study's objectives. (Haidar, 2004)

3.5.3: Exams:

Tests are an important and accurate way to collect information and data about a phenomenon, as it has become a tool for calibration, measurement, and examination with different forms that are commensurate in their methodology, form, and content with the nature and field of the phenomenon. It is a set of calibrated questions with multiple shapes (forms) that aim to measure a degree or phenomenon quantitatively or qualitatively. Tests are a commonly used method, and they are either written, oral, or practical.

The exam has several goals, including assessing performance and achievement, knowledge and achievement, growth rate prediction and measurement, and diagnosing and recognizing skills and talents. (Al-Mousa, 2017). I'll create a test after the unit that covers all the goals and looks at how conducting surveys affects the growth of higher-order thinking abilities like deduction, analysis, and other ones. (Ibrahim, 2010, p. 2)

4. Results

In this chapter, I reported the data which I collected. Data was collected and analyzed in order to clarify this study and its results. I am going to present data according to the tools by which it was collected.

4.1. Results of Interviews:

Interviews were applied two times, before and after the intervention. I asked the same student the same questions. I analyzed every question separately and I wrote a description of answers before and after the intervention to compare between results and to clarify this change in chapter five.

4.1.1. Analyzing answers of the question no. 1:

Q1- What is the mixed number that represents the following image? 

4.1.1.1. Before intervention:

the interviewed student answered "$2\frac{1}{2}$", Which is a correct answer.

4.1.1.2. After intervention:

the interviewed student answered the same answer in the pre-interview.

4.1.2. Analyzing answers of question no. 2:

Q2- Which fraction is the largest of the following represented fractions? with stating the reason. 

4.1.2.1. Before intervention:

the interviewed student answered "The first is because it has the largest area", Which is a logical explanation.

4.1.2.2. After intervention:

the interviewed student answered the same answer in the pre-interview.

4.1.3. Analyzing answers of question no. 3:

Q3- The fraction denoting the second representation in the previous question is 1/3 with an explanation.

4.1.3.1. Before intervention:

the interviewed student answered “No, because it is more than half”, Which is a logical explanation.

4.1.3.2. After intervention:

the interviewed student answered “It is not true because it is half and a third is less than half”, Which is a logical explanation.

4.1.4. Analyzing answers of question no. 4:

Q4- The fraction reciprocal used in the operation (multiplication/ division/ addition/ subtraction) of mixed numbers? Can it be used in another process? Explain your answer

4.1.4.1. Before intervention:

the interviewed student answered “division”, With no explanation.

4.1.4.2. After intervention:

the interviewed student answered “It is used only in the division when converting division into multiplication”, Which is a logical explanation.

4.1.5. Analyzing answers of question no. 5:

Q5- Which process is represented in this way by the characteristics that you observe from the representation? Why?

4.1.5.1. Before intervention:

the interviewed student answered “division because he divided the squares”, Which is wrong.

4.1.5.2. After intervention:

the interviewed student answered “Multiply a mixed number by an ordinary fraction which $1\frac{1}{2} \times \frac{1}{2}$”, Which is a logical explanation.

4.1.6. Analyzing answers of question no. 6:

Q6- What is the denominator of the mixed number $2\frac{3}{[\ ]}$ if you know that the equivalent improper fraction is $\frac{11}{4}$?

4.1.6.1. Before intervention:

the interviewed student answered “4 because the denominator does not change”, Which is a good explanation.

4.1.6.2. After intervention:

the interviewed student answered “4, Because the denominator does not change by converting a mixed number into an improper fraction”, Which is a logical explanation.

4.1.7. Analyzing answers of question no. 7:

Q7- Is it possible to multiply two mixed numbers without converting the mixed numbers into improper fractions with an explanation?

4.1.7.1. Before intervention:

the interviewed student had no answer to the question.

4.1.7.2. After intervention:

the interviewed student answered “By drawing and geometric shapes, the same as in question No.5”, Which is a logical explanation.

4.1.8. Analyzing answers of question no. 8:

Q8- Is the statement true or false with the explanation (the improper fraction representing the mixed number $1\frac{2}{3}$ is $\frac{5}{3}$)?

4.1.8.1. Before intervention:

the interviewed student answered “True”, With no explanation.

4.1.8.2. After intervention:

the interviewed student answered “Correct because an improper fraction has the same denominator as a mixed number”, Which is a logical explanation.

4.2 Results of Tests:

Tests were applied two times, before and after the intervention. I asked the student questions which are in appendices.

4.2.1. Analysis of the first question:

Q1. Complete the following?

The first question contains four sub-questions which were:

A) $2\frac{[\ ]}{6} \times 1\frac{4}{[\ ]} = \frac{13}{[\ ]} \times \frac{[\ ]}{5} = \frac{[\ ]\times[\ ]}{[\ ]\times[\ ]} = \frac{[\ ]}{[\ ]}$

4.2.1.A1. Before intervention:

The student answered this question correctly.

4.2.1.A2. After intervention:

The student answered this question correctly as in the pre-test

B) $2\frac{[\ ]}{4} \div \frac{1}{[\ ]} = \frac{9}{[\ ]} \div \frac{[\ ]}{2} = \frac{9}{[\ ]} \times \frac{2}{[\ ]} = \frac{[\ ]\times[\ ]}{[\ ]\times[\ ]} = \frac{[\ ]}{[\ ]}$

4.2.1.B1. Before intervention:

The student answered this question correctly.

4.2.1.B2. After intervention:

The student answered this question correctly as in the pre-test

C) $\frac{[\ ]}{8} \div 1\frac{1}{[\ ]} = \frac{1}{[\ ]} \div \frac{[\ ]}{4} = \frac{1}{[\ ]} \times \frac{4}{[\ ]} = \frac{[\ ]\times[\ ]}{[\ ]\times[\ ]} = \frac{[\ ]}{[\ ]}$

4.2.1.C1. Before intervention:

The student answered this question correctly.

4.2.1.C2. After intervention:

The student answered this question correctly as in the pre-test

D) $2\frac{1}{[\ ]} \times \frac{[\ ]}{7} = \frac{[\ ]}{5} \times \frac{2}{[\ ]} = \frac{[\ ]\times[\ ]}{[\ ]\times[\ ]} = \frac{[\ ]}{[\ ]}$

4.2.1.D1. Before intervention:

The student did not answer this question correctly, his mistake was in the simple calculation when he multiplied the denominator by the whole number, then added the numerator.

4.2.1.D2. After intervention:

The student answered this question correctly.

4.2.2. Analysis of the second question:

Q2. Which of the following fractional numbers is correct with the correct approximation?

The second question contains four sub-questions which were:

A) $2\frac{6}{7} \approx 3$

4.2.2.A1. Before intervention:

The student answered this question correctly.

4.2.2.A2. After intervention:

The student answered this question correctly as in the pre-test

B) $9\frac{1}{5} \approx 10$

4.2.2.B1. Before intervention:

The student did not answer this question correctly, the mistake was because of a misunderstanding.

4.2.2.B2. After intervention:

The student answered this question correctly.

C) $4\frac{6}{7} \approx 4$

4.2.2.C1. Before intervention:

The student did not answer this question correctly, the mistake was because of a misunderstanding.

4.2.2.C2. After intervention:

The student answered this question correctly.

D) $5\frac{2}{6} \approx 5$

4.2.2.D1. Before intervention:

The student answered this question correctly.

4.2.2.D2. After intervention:

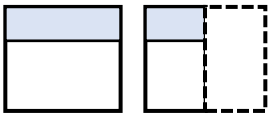
The student answered this question correctly as in the pre-test.

4.2.3. Analysis of the third question:

Q3. From the shown diagram, find the following?

The third question contains three sub-questions which were:

A) What process is represented by the drawing?



4.2.3.A1. Before intervention:

The student did not answer this question.

4.2.3.A2. After intervention:

The student answered this question correctly, and his answer was “multiplication”.

B) Write the operation represented?

4.2.3.B1. Before intervention:

The student did not answer this question.

4.2.3.B2. After intervention:

The student answered this question correctly, and his answer was “ $1\frac{1}{2} \times \frac{1}{3}$ ”.

C) What is the product of the process?

4.2.3.C1. Before intervention:

The student did not answer this question.

4.2.3.C2. After intervention:

The student answered this question correctly, and his answer was "$\frac{3}{2} \times \frac{1}{3} = \frac{3}{6}$".

4.2.4. Analysis of the fourth question:

Q4. Both Ahmed and Ezz rounded the mixed number to $8\frac{3}{5}$, where Ahmed rounded the mixed number to 8 and Ezz rounded it to the number 9. Which rounding is correct with the interpretation?

4.2.4. Before intervention:

The student did not answer this question.

4.2.4. After intervention:

The student answered this question correctly, and his answer was "Ezz has the right solution", with an explanation as " $\frac{2}{4} \approx 1$ ", which is logical reasoning.

4.2.5. Analysis of the fourth question:

Q5. Complete the following pattern.

$12\frac{1}{6}$ ، $10\frac{1}{12}$ ، $8\frac{1}{24}$ ، _____ ، _____ .

4.2.5. Before intervention:

The student answered this question partially corrected, the mistakes were because of wrong calculations or because of misunderstanding the pattern.

4.2.5. After intervention:

The student answered this question correctly.

4.3 Results of Teacher Observations:

Reading what I wrote in my notebook during and after the 18 classes time, I noted that the student accepted the intervention from the start but began to actively participate after the first lesson.

From the beginning of the meetings, the student was enthusiastic about the study, as he expressed this directly in the first meeting. As the meetings progressed, the student's enthusiasm for the study only grew stronger. He actively participated in discussions and asked insightful questions that demonstrated his eagerness to learn more. The student's dedication to understanding the material was evident in his consistent effort to review and apply what he had learned in previous sessions.

The student did not have the slightest idea about the method of presentation and how to deal with it at the beginning, but after explaining it during the first lesson, he reached the concept and method and was able to deal with it later in a critical analytical way that reflects deep understanding.

This is a great example of how effective teaching can make a huge difference in a student's learning experience. It also highlights the importance of clear communication and guidance in helping students grasp new concepts and skills.

As the student progressed, he was able to apply his newfound knowledge and skills in a more sophisticated way, demonstrating a deeper understanding of the material. This shows that with the right support and guidance, even complex or challenging topics can be mastered.

4.4 Results of Quizzes:

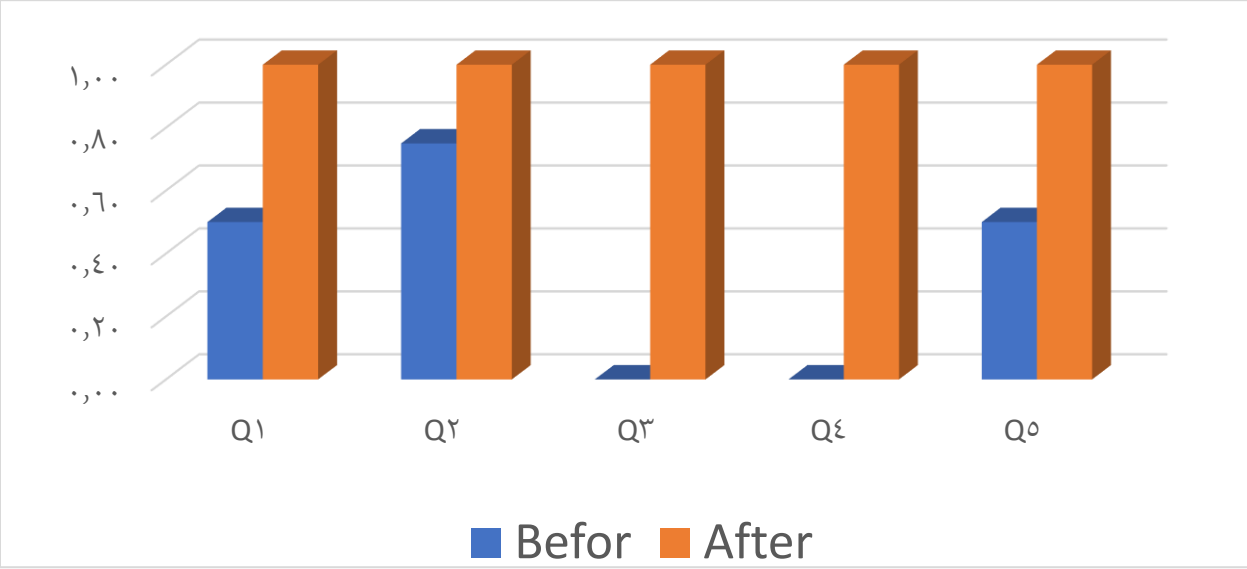
I made several quizzes to assess the student progress. I kept track of his grades and found that his scores increased in each quiz. In the open-ended questions, I also saw his rational and reasoning thinking.

The student showed that he understood what he did, and this was clearly shown in the questions that needed clarifications and classification. For example, the student answers of the problems demonstrating deep understanding, in Test No. 2 (Q2) shows that the student deeply understands the meaning of multiplication and understands the relationship between multiplication and other operations such as division.

The same thing happened in all similar questions in the quizzes after I taught him the lessons that consist of direct numerical problems and daily events, such as in quiz No. 6, which indicates a clear perception of the issue, the method of dealing with it, and its relationship to other operations.

Some of the student responses in the quizzes were incorrect, such as in quizzes 4 and 6, and after careful consideration, I concluded that these errors were the consequence of being rushed and unfocused when taking the questions.

I can summarize the student achievements in the tests in the following chart:



5. Discussion and Conclusion:

This chapter provides a comprehensive analysis of the research findings and their implications. The literature review served as a foundation for understanding the research problem and provided a framework for interpreting the results. By answering the sub-questions, I was able to conclude the research problem and its significance.

However, it is critical to recognize the study's shortcomings. For example, the sample size was relatively small and may not be representative of the larger population. Additionally, there may have been biases in data collection or analysis that could have influenced the results.

Despite these limitations, this study provides valuable insights into the research problem and lays a foundation for future research in this area. By highlighting both the strengths and weaknesses of this study, we can better understand its contributions to the field and identify areas for improvement in future studies.

5.1. Discussion:

In this section, I will examine the specific ways in which infographics impacted student learning outcomes. The use of infographics in educational settings can enhance the learning experience by providing students with visual representations of complex information that are easy to understand and remember. The positive influence of infographics on student knowledge, accomplishment, motivation, and reflective thinking is a significant finding that has important implications for educators and instructional designers. So that, I will discuss the results by answering the research sub-questions as follows:

5.1.1: The first sub-question:

How does using infographics motivate students toward learning mathematics?

I assessed this through teacher observation and teacher memos. By presenting information in a visually engaging and easy-to-understand way, infographics capture the attention of learners and encourage them to delve deeper into the topic at hand. Overall, infographics represent an exciting frontier in education – one that inspires curiosity, fosters creativity and encourages active learning among students.

I am thrilled to report that the student has shown tremendous motivation and enthusiasm toward the intervention. It's so exciting to see my hard work paying off and witness first-hand the impact I am making on this young mind.

The dedication he has demonstrated is nothing short of inspiring and reinforces the importance of investing in educational initiatives like this. His willingness to embrace change and active participation speaks volumes about his commitment to learning and personal growth.

The student's motivation has improved and risen, as seen by his grades and conduct. Also, throughout implementation, I observed him racing to do what was wanted and racing to complete his tests, which is a solid indication that student motivation has been positively improved.

The student motivation has been fluctuated in the second part of the study's execution due to social circumstances such as the teacher's crisis. It is important to recognize that external factors, such as the teacher's crisis, can have a significant impact on student motivation. When students are faced with uncertainty and instability in their learning environment, it can be difficult for them to stay focused and engaged. By acknowledging the impact of social circumstances on student motivation and taking proactive steps to address these challenges, we can help ensure that all students have the opportunity to succeed.

5.1.2: The second sub-question:

What is the effect of using infographics in teaching mathematics on the development of fifth-grade students' observations?

I assessed this by test and interview. An infographic that breaks down the steps of solving a math problem into clear and concise visuals can help students see the process more clearly and make connections between different parts of the problem. Similarly, an infographic that presents data in a visually appealing way can help students identify patterns and trends more easily. This appeared clearly in the interview questions in the fifth and sixth questions, and the test questions in the first, third, and fifth questions.

By using infographics in their teaching, educators can also encourage students to think reflectively about the information presented. Students may be prompted to ask questions about the data or to consider alternative ways of presenting it. This type of reflective thinking can help students develop their observational skills and become more engaged learners.

Overall, infographics have the potential to enhance the learning experience for fifth-grade students by making math concepts more accessible and engaging. By incorporating infographics into their teaching strategies, educators can help students develop stronger observational.

5.1.3: The third sub-question:

What is the effect of using infographics in teaching mathematics on the development of judgment among fifth-grade students?

I assessed this by test and interview. I am beyond excited to share with you the amazing impact that using infographics can have on the development of judgment. Infographics are a visually appealing and engaging way to convey complex information and data in a simplified manner.

By incorporating creative graphics, colours, and text, infographics can help individuals better understand and interpret information presented to them, which is essential for building judgment skills. They can help individuals to quickly grasp the key points of a message, making it easier for them to make informed judgment.

Moreover, through increased engagement and retention of knowledge gained from infographic use over time, an individual's ability to make informed judgments improves significantly. This appeared clearly in the interview questions in the third, fourth, and seventh questions, and the test questions in the second and fourth questions.

5.2. Conclusion:

Overall, conclusion is not the end, rather it is a new beginning where one can reflect on the journey so far, learn from it, and make decisions that pave the way for a better future. My findings in this action research showed that using infographics affected positively fifth graders' learning of Multiply and divide mixed numbers by improving their motivation, observation, and judgment and that in turn improved students' reflective thinking.

Infographics were very effective as they increased students' motivation. The student interacted completely with the activities as he was interested in what he was doing. This increased engagement and interest can lead to better retention of information and improved learning outcomes. This is confirmed by studies of (Kousa, 2019), (Al-Shamrani & Al-Zahrani, 2021), (Syed, 2020), and (Ibrahem & Alamro, 2021).

The student was able to take note of all the images and retain them for later use. He also took time to check the information in the infographic and then checked his understanding by answering questions based on it.

The student was able to relate the information in the infographic to his own life. He was able to see how he could apply what he learned from these infographics in his own life and that helped him understand better. The student also found it easy and fun to use infographics as a learning tool.

Infographics can be used to convey complex mathematical concepts such as fractions, decimals, and geometric shapes. By presenting these concepts in a visually engaging manner, students can grasp these concepts more easily. For instance, using infographics to display different types of polygons or showing how fractions can be converted into decimals can help students better understand these mathematical concepts and their relationships.

Apart from helping students understand complex mathematical concepts, infographics can also help students develop their observational skills. Infographics can be used to present data, such as graphs and charts, which require an understanding of numerical values and trends. By Analyzing infographics, students learn how to interpret data and make inferences from them. This skill is particularly useful in mathematics, as students need to be able to read and analyze data. This is confirmed by studies by (Siddiq, 2018), (Francis, 2022), (Barakat, 2022), and (Islah & Al-Shobaki, 2020).

One of the remarkable impacts of using infographics is the development of judgment. Essentially, the judgment refers to the ability to form opinions or decisions based on careful consideration and analysis of available information. Infographics enable people to comprehend complex information quickly and effectively, leading to informed decision-making. By presenting information in a concise and visually engaging manner, infographics make it easier for the student to understand the relationships between different concepts, leading to more comprehensive insight and better judgment. This is confirmed by studies by (Abdel Aziz, 2018), (Al-Khafaji, 2021), (Said, Ibrahem, & Kamel, 2019), and (Al-Bishi, 2019).

Moreover, infographics have the potential to increase emotional engagement and interest in the audience. Because of their visual nature, they capture the viewer's attention and arouse curiosity, which can lead to deeper learning and retention of information. Infographics can also be

used to challenge people's assumptions or biases, leading to personal growth and the development of more critical thinking skills.

In conclusion, the use of infographics has an amazing impact on the development of reflective thinking. They provide a unique and engaging way of presenting information that can help students better comprehend complex concepts and relationships. Infographics promote better judgment and enhance emotional engagement, and observation, all of which lead to personal and professional reflective thinking.

By using infographics, individuals can easily digest and understand data, which leads to deeper reflection and analysis. Infographics allow people to see patterns, connections, and relationships that may not be immediately apparent in raw data.

Moreover, infographics encourage reflective thinking by forcing individuals to evaluate the accuracy and relevance of the information presented. They also promote creativity by allowing people to explore different ways of presenting data visually.

Overall, the use of infographics has revolutionized the way we process and analyze information. It has made reflective thinking more accessible and engaging for everyone, regardless of their background or expertise. As such, it is essential that we continue to embrace this powerful tool as we navigate an increasingly complex world. Therefore, it is essential to recognize the value of infographics and incorporate them into our teaching processes.

6. Recommendations:

Based on the study's findings, the following recommendations for further research and practices are made:

- Generalizing the experience of using educational infographics, which was applied to fifth-grade students, to other schools in other educational regions.
- Publication of the teacher's guide for teaching aids for mathematics teachers, given that it is a reference for infographics for the fifth grade in mathematics.
- Encourage teachers to use infographic-based learning and benefit from it when teaching mathematics.
- Designing educational programs based on infographics and using them continuously by private and public-school teachers, may contribute to the development of achievement and reflective thinking skills.
- Undertaking novel research studies utilizing distinct designs and measurement tools from those employed in the current study.

7. Reflection:

7.1: Methodological reflections:

Undertaking a research project on the use of infographics in teaching mathematics to fifth graders was an enlightening experience. The project required a significant amount of planning, data collection, and analysis to investigate the effectiveness of using infographics as a tool to develop reflective thinking skills among students.

Throughout the research process, I came to appreciate the importance of creating a well-structured research plan that included clear research questions, a detailed methodology, and appropriate data analysis techniques. It was essential to ensure that the data collected was valid and reliable, and the results obtained were robust enough to support the research findings.

The ability to interact with a new fifth-grade student and observe his learning process firsthand, and more importantly how he responded to the use of infographics in their math lessons, was one of the most thrilling components of this research. It was satisfying to me to see how the use of infographics in mathematics lessons encouraged my student to think critically and reflectively about the concepts he was learning. The use of visual aids and graphical representations helped to make abstract concepts more accessible and understandable, which, in turn, led to a deeper understanding of the material.

7.2: Theoretical Reflections:

The research project also highlighted the importance of effective communication and collaboration between teachers and students. Therefore, the use of infographics in the classroom requires clear communication between the teacher and the students to ensure that the information presented is understood correctly.

Overall, this research project provided valuable insights into the potential benefits of using infographics as a teaching tool in mathematics. The findings suggest that infographics can be an effective tool for developing reflective thinking skills among fifth graders, and can help to make mathematics lessons more engaging and accessible. The experience of conducting this research project has been a valuable learning experience, and I hope that the findings can contribute to the ongoing conversation about how to improve mathematics education.

Teaching mathematics with infographics can be a great way to engage students and make the subject more interesting. However, preparing these materials can take a significant amount of

time and effort. This is because creating a good infographic involves finding the right information, selecting appropriate visuals, and effectively designing the layout. It allowed me to explore the potential of infographics as a tool for enhancing learning and engagement in mathematics.

7.3: Field Reflections:

Despite the effort involved, I found that using infographics was worth it because they helped to make mathematical concepts more accessible to students. By presenting information in a visual format, the student was able to understand complex ideas more easily and see how different concepts were connected. This made the learning process more enjoyable and helped to build students' confidence in their ability to understand and apply mathematical concepts.

In addition, using infographics also encouraged students to think more creatively about the subject. By exploring different ways of presenting information and visualizing data, students were able to develop their ideas and approaches to problem-solving. This helped to foster a culture of innovation and creativity in the classroom and encouraged students to think more deeply about the underlying principles of mathematics.

7.4: Personal Reflections:

Overall, teaching mathematics with infographics was a valuable experience that helped me to develop new teaching strategies and innovatively engage my students. While it was certainly a lot of work, the results were well worth it, and I would recommend this approach to other educators looking to make math more accessible and engaging for their students. According to Alberto Cairo, the Knight Chair in Visual Journalism at the School of Communication of the University of Miami, “The life of a visual communicator should be one of systematic and exciting intellectual chaos.” (Cairo, 2012)

After conducting this study, I made sure of the importance of the guide that I composed, and therefore this will be the motivation for me to write new guide books for the other school levels and publish them to achieve maximum benefit.

I believe that this guide can be a valuable resource for students who struggle with the subject matter. By publishing it, I hope to reach a wider audience and help more students succeed in their studies. I also plan to continue conducting research and gathering other instructors’ feedbacks to improve the guide book and make it even more effective.

Ultimately, my goal is to create a comprehensive resource that empowers students to take control of their learning and achieve their full potential. With hard work and dedication, I am confident that we can make this vision a reality.

The research project helped me to appreciate the importance of incorporating technology into teaching practices. With technology's growing significance in our everyday routines, it is essential that we explore ways of integrating it into education in a way that enhances learning outcomes. Infographics are just one example of how technology can be used to improve the way we teach mathematics and other subjects.

8. References

Abdel Aziz, S. H. (2018). The Effect of Using Infographic in Teaching Science on Achievement, Development of Visual Thinking Skills and Orientation Towards Science of Primary School Students in the State of Kuwait. *Concepts for in-depth psychological, philosophical and human studies Journal, 2*, 42-63.

Abdul Maqsoud, M. J. (2018). Studying the Role of Info Graphic Designs to Simplify the Media Message and Facilitate the Transfer of Information and Targeted Data to the Public. *The Arab Society for Islamic Civilization and Arts*, 513 - 537.

Abdulwahab, F. M. (2005). The effectiveness of using some metacognitive strategies in the achievement of physics and the development of reflective thinking and the trend towards using them among the students of the second year of secondary school Al-Azhar. *Egyptian Journal of Science Education*, 159 - 212.

Al-Bishi, R. Z. (2019). The Effect of Interactive Infographics on Developing Visual Thinking Skills of The Educational Female Supervisors in Tabuk City. *Scientific Journal of the Faculty of Education at Assiut University, 35*(3), 186 - 213. doi:10.21608/mfes.2019.104207

Al-Dhuwaikh, N. S. (2016). *Learning styles VARK model.* Retrieved from noor-book.com/3jesmx

Al-Duraij, M. (2004). *Introduction to the science of teaching.* Al-Ain: Dar Al-Kitab University.

Al-Ghamdi , M. S. (2018). The impact of demographic variables on the level of awareness of mathematics teachers in Riyadh city with the infographic technology and the degree of possess its design skills. *The Islamic University Journal of Educational and Psychology Studies*, 128-158.

Al-Jariwi, S. (2014). The effectiveness of a proposed training program in developing the skills of designing electronic mental maps through infographic technology and visual thinking skills among pre-service female teachers. *Arab Studies in Education and Psychology - Saudi Arabia, 4*(45), 13-47.

Al-Khafaji, I. J. (2021). The Effect of Advance Organizer in Reflective Thinking Skills for the Second Year Student in Science. *Journal of the College of Basic Education for Educational and Human Sciences, 51*, 349-367.

Al-Mousa, A. A. (2017). *Scientific research methodology.* Beirut: Arab Renaissance House.

Al-Sawaei, O. N. (2010). Mathematical representation skills and conducting mathematical operations for sixth grade students. *Journal of Educational and Psychological Sciences - University of Bahrain - Scientific Publishing Center*, 139 - 163.

Al-Shamrani, A. A., & Al-Zahrani, F. A. (2021). The effect of using educational infographics on the development of academic achievement in physics among secondary school students in Jeddah, and their attitudes towards it. *The Arab Journal of Specific Education, 5*(17), 237-270. Retrieved from http://search.shamaa.org/FullRecord?ID=280602

Badawi, R. M. (2007). *Teaching effective mathematics from kindergarten to sixth grade.* Amman: Dar Al-Fikr for publication and distribution.

Baglama, B., Yücesoy, Y., Uzunboylu, H., & Ozcan, D. (2017). Can Infographics Facilitate the Learning of Individuals with Mathematical Learning Difficulties? *International Journal of Scientific Study, 5*(7), 25-31. doi:10.17354/ijssOct/2017/4

Barakat, k. k. (2022). The effect of using infographics in teaching mathematics on achievement and developing reflective thinking among fourth-grade students in Jordan. *Amman Arab University Journal of Research - Educational and Psychological Research Series, 7*(1), 340-361. Retrieved from http://search.mandumah.com/Record/1220842

Barrett, T. (2021, October 28). *From Awareness to Action: A Complete Guide to Reflective Practice Cycles for Teachers*. Retrieved from Tom Barrett Create the space for dialogue: https://edte.ch/blog/2021/10/25/reflective-practice-cycles/?v=3a1ed7090bfa

beers, s. (2014). *21st Century Skills: Tools for Action.* Doha: Arab Bureau of Education for the Gulf States.

Boud, D. (1999). Avoiding the Traps: Seeking Good Practice in the Use of Self-Assessment and Reflection in Professional Courses. *Social Work Education, 18*(2), 121-132. doi:10.1080/02615479911220131

Boud, D., Walkr, D., & Kogh, R. (1985). *Reflection Turning Experience into Learning.* London: Routledge.

Buckley, B. (2000). Interactive multimedia and model-based learning in biology. *International Journal of Science Education*, 895–935.

Cairo, A. (2012). *Functional Art, The: An introduction to information graphics and visualization.* miami: New Riders.

Darwish, A., & Al-Dakhni, A. (2015). The two styles of presenting infographics (fixed and moving) via the web and their impact on developing visual thinking skills of children with autism and their attitudes towards it. *Education technology - Egypt, 2*(25), 265-364.

Francis, A. (2022). Understanding Visual Literacy, Mathematical Literacy and The Teaching Potential of Infographics with Mathematical Representation: A Review of Literature. Retrieved from https://hdl.handle.net/10155/1483

Gibbs, G. (1988). *Learning by Doing, A Guide to Teaching and Learning Methods.* Oxford: Oxford Centre for Staff and Learning Development.

Haidar, A. (2004). *Action research between reflection and improvement in professional practice.* Dubai: Dar Al Qalam for Publishing and Distribution.

Hancock, H. (1964). *Development of the Minkowski geometry of numbers.* New York: Dover Publications.

Ibrahem, U. M., & Alamro, A. R. (2021, January). Effects of Infographics on Developing Computer Knowledge, Skills andAchievement Motivation among Hail University Students. *International Journal of Instruction, 14*(1), 907-926. doi:https://doi.org/10.29333/iji.2021.14154a

Ibrahim, m. (2010). *Educational Research Skills.* Amman: Dar Al-Fikr.

Islah, H. B., & Al-Shobaki, F. M. (2020). Employing infographics in developing visual thinking skills among eleventh grade students in physics. *Journal of Al-Aqsa University for Educational and Psychological Sciences, 3*(1), 71-150.

Jasper, M. (2003). *Beginning Reflective Practice: Foundations in Nursing and Health Care Series.* Cheltenham: Nelson Thornes Ltd.

Kember, D., Leung, D. Y., Jones, A., Loke, A. Y., McKay, J., Sinclair, K., . . . Yeung, E. (2000). Development of a Questionnaire to Measure the Level of Reflective Thinking. *Assessment & Evaluation in Higher Education, 4*(25), 381-395. doi:https://doi.org/10.1080/713611442

Kolb, D. A. (2014). *Experiential Learning: Experience as the Source of Learning and Development* (2nd ed.). (A. Neidlinger, Ed.) New Jersey: Pearson FT Press.

Kousa, S. b. (2019, 9). The effect of using infographics on mathematics teaching to develop conceptual comprehension and attitude towards mathematics among sixth graders. *Journal of Educational and Psychological Sciences, 13*(1), 56-88.

Krum, R. (2013). *Cool Infographics: Effective Communication with Data Visualization and Design.* Indiana: John Wiley & Sons, Inc.

Lamas, H. A. (2015). School Performance. *Propósitos y Representaciones, 3*, 313-386.

Mageed, A. H., & Hasan, M. M. (2021). Teaching Effectiveness by the Infographic Technique in the First-grade Intermediate Students Achievement and Visual Thinking in the Science Subject. *Journal of the University of Babylon for Humanities, 29*(11), 165-185.

Mahzry, A. (2016). The Effect of Using Mathematical Representations on Achievement and Tendencies Towards Mathematics Among Students at Basic Stage in Hajjah Governorate. *Journal of the Faculty of Education, Assiut University - Faculty of Education*, 38 - 78.

Mann, K., Gordon, J., & MacLeod, A. (2009). Reflection and reflective practice in health professions education: a systematic review. *Advances in Health Sciences Education, 14*, 595–621. doi:https://doi.org/10.1007/s10459-007-9090-2

Medina, J. (2009). *Brain Rules: 12 Principles for Surviving and Thriving at Work, Home, and School.* Seattle: Pear Press.

Mirzaei, F., Phang, F. A., & Kashefi, H. (2014). Measuring Teachers Reflective Thinking Skills. *Procedia - Social and Behavioral Sciences*, 640 – 647.

Nassar, A. (2019). The Reality of Teacher Competencies in Light of Educational Technology Developments from The Viewpoint of Teachers in Government Schools in Ramallah and Al-Bireh Governorate. *The Arab Journal of Educational and Psychological*, 269 - 295.

Pont, B., Nusche, D., & Moorman, H. (2008). *Improving School Leadership.* Finland: OECD .

Qarni, Z. M. (2013). *Recent trends for research in teaching science and science education, future issues and visions.* Cairo: The modern library of publications.

Rayian, A. (2014). *What is the effect of using active learning on eighth graders' learning of integers?* Jarusalem: Al-lquds Bard.

Said, M., Ibrahem, M., & Kamel, A. (2019). The Effect of The Infographic Pattern on Developing Visual Thinking Skills in A material Computer for First-Grade Students. *Journal of research in the fields of specific education, 22*, 165-216.

Schon, D. (1984). *The Reflective Practitioner: How Professionals Think In Action.* London: Temple Smith.

Siddiq, R. K. (2018). The Effect of the Use of Envografic in Teaching Mathematics on Academic Achievement and the Development of Visual Thinking Skills in the Sixth Grade Female Students in Mecca. *Journal of Scientific Research in Education, 19*(8), 307-368. doi:10.21608/JSRE.2018.19750

Smiciklas, M. (2012). *The Power of Infographics.* Indiana: Pearson Education Inc.

Syed, H. M. (2020). The Use of Infographics in Teaching the Mathematics Course for Muslims and its Effect on the Development of Achievement both Now and Deferred and the Skill of Designing Optics for Mathematics Students. *Journal of Scientific Research in Education, 21*(8), 376 - 409. doi:10.21608/JSRE.2020.114257

9. Appendixes

9.1 The Action Plan

<table>
<tr><th>Step no.</th><th>Date</th><th colspan="4">Description</th></tr>
<tr><td>1</td><td>19/3</td><td colspan="4">Pre- interviews</td></tr>
<tr><td>2</td><td>19/3</td><td colspan="4">Pre-test</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">20/3</td><td>Math goals and objectives</td><td>Students' activities</td><td>Teacher's role</td><td>Assessment tools</td></tr>
<tr><td>• The student will know how to correctly multiply a mixed number by an integer</td><td>Using dialogue and discussion, students carry out the first activity and then discuss it on the board, then using the (think-pair-share) strategy, students carry out the second activity and then discuss it on the board.</td><td>Presenting the infographic (1) which clarifies the concept and the mechanism of its implementation and ask the students the following questions:
1) How do you multiply a mixed number by an integer?</td><td>• Teacher observation.</td></tr>
<tr><td>• The student finds that the mixed number is correctly multiplied by an integer</td><td>Using the (Think-Pair-Share) strategy, the students carry out the third activity and then discuss it on the board.</td><td>2) Find the product of the multiplication
3 1/2 x 5?</td><td>• quiz</td></tr>
</table>

		• That the student use multiplying a mixed number by an integer number to correctly solve life problems?	Then individually, the students carry out the fourth activity and then discuss it on the board. Using the (Think-Pair-Share) strategy, the students carry out the fifth activity and then discuss it on the board	3) Solve the third question, on page 8 of the book?	
5	21/3	• The student will be able to correctly multiply a mixed number by an ordinary fraction • The student must correctly	Using dialogue and discussion, students carry out the first activity in pairs and then discuss it on the board Using the (Think-Pair-Share)	Presenting the infographic (2) which clarifies the concept and the mechanism of its implementation and ask the students the following questions: 1) How can a mixed number be multiplied by an ordinary fraction?	• Teacher observation. • Quiz

		multiply a mixed number by an ordinary fraction • The student will correctly represent the multiplication of a mixed number by an ordinary fraction • That the student use multiplying a mixed number by an ordinary fraction to correctly solve life problems?	strategy, students carry out the second activity and then discuss it on the board. Using the (Think-Pair-Share) strategy, students carry out the third activity and then discuss it on the board. Using the (Think-Pair-Share) strategy, the students carry out the fourth activity and then discuss it on the board	2) Find the product of the multiplication 3 1/2 x 5/6? 3) Represent the above multiplication with the graph? 4) Solve the fourth question, on page 12 of the book?	
6	22/3	• The student will know how to multiply two rational	• Using dialogue and discussion, students carry out the first	Presenting the infographic (3) which clarifies the concept and the mechanism of its implementation	• Teacher observation.

		numbers correctly • The student finds multiplying two rational numbers correctly • The student will correctly round a mixed number to the largest whole number • The student will correctly use the distributive property over the two mixed numbers	activity and then discuss it on the board • Individually, the students carry out the second activity and then discuss it on the board. • Using the (Think-Pair-Share) strategy, students carry out the third activity and then discuss it on the board. • Using dialogue and discussion, the students carry out the fourth activity and then discuss it on the board	and ask the students the following questions: 1) How can two mixed numbers be multiplied? 2) Find the product of the multiplication 3 1/2 x 5/6 4? 3) Solve the fourth question on page 16 of the book? 4) Find the output 2 + 1/2 x 3/6 +5?	• quiz.

		• That the student uses the multiplication of two fractions to correctly solve life problems?	• Using the (Think-Pair-Share) strategy, the students carry out the fifth activity and then discuss it on the board	5) Solve the fifth question, on page 16 of the book?	
7	24/3	• The student will know how to correctly divide a fraction by a rational number • The student finds the correct division of a fraction by a mixed number.	• Using dialogue and discussion, students carry out the first activity and then discuss it on the board, then using the (think-pair-share) strategy, students carry out the second activity and then discuss it on the board • Using the (Think-Pair-Share) strategy, students carry out the third	Presenting (4) the infographic which clarifies the concept and the mechanism of its implementation and asks the students the following questions: 1) How can an ordinary fraction be divided by a mixed number? 2) Find the product of the division 2/3 ÷ 5/71?	• Teacher observation. • Quiz.

			activity and then discuss it on the board.		
8	25/3	• The student will be able to correctly divide a mixed number by an ordinary fraction • The student finds the correct division of a mixed number by an ordinary fraction • The student will correctly compare the two operations of dividing a mixed number by an ordinary fraction	Using dialogue and discussion, students carry out the first activity and then discuss it on the board Using the (Think-Pair-Share) strategy, students carry out the second activity and then discuss it on the board. Using the (Think-Pair-Share) strategy, the students carry out the third activity (Sections A and B) and then	Presenting the infographic (5) which clarifies the concept and the mechanism of its implementation and ask the students the following questions: 1) How can a mixed number be divided by an ordinary fraction? 2) Find the product of the division 1 5/7÷ 2/3? 3) Compare the operations of dividing a mixed number by an ordinary fraction in the third section of the activity?	• Teacher observation. • quiz.

			discuss it on the board.		
9	26/3	• The student will know how to divide two rational numbers correctly • The student finds the division of two rational numbers correctly	Using dialogue and discussion, students carry out the first activity and then discuss it on the board, then using the (think-pair-share) strategy, students carry out the second activity and then discuss it on the board Using the (Think-Pair-Share) strategy, students carry out the third activity and then discuss it on the board.	Presenting the infographic (6) which clarifies the concept and the mechanism of its implementation and ask the students the following questions: 1) How do you divide two fractions? 2) Find the product of the division 1 5/7÷ 2/3 1?	• Teacher observation. • quiz.
10	30/3	**Post-interviews**			
11	30/3	**Post-test**			
12	31/3	**Analyzing data**			
13	31/3	**Writing the conclusion of the study in light of the data**			

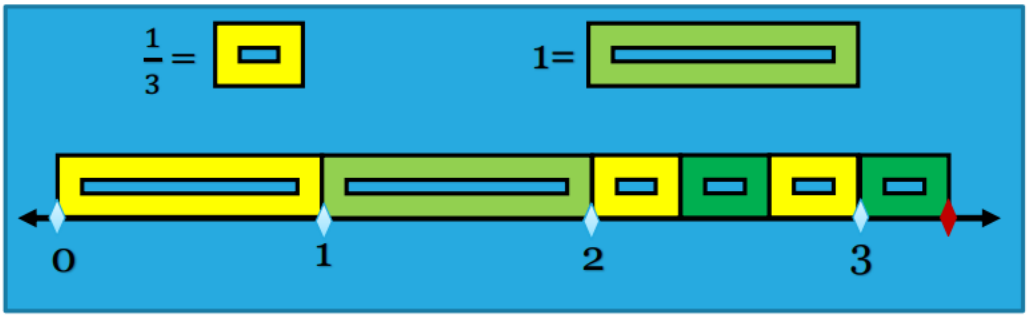
9.2 Infographic (1)

مثال: جد ناتج $2 \times 1\frac{2}{3}$ ؟

1- نمثل العدد الكسري وفي هذه الحالة $1\frac{2}{3}$.

2- نكرر التمثيل السابق بقيمة العدد الصحيح وفي هذه الحالة نكرر العدد الكسري مرتين(مفهوم الضرب بأنه جمع متكرر).

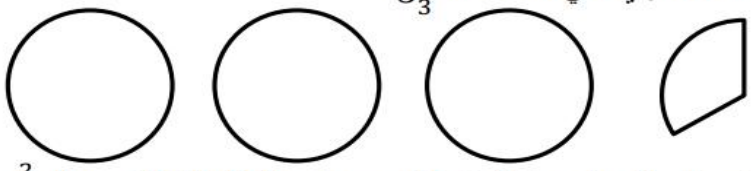
3- الناتج هو نقطة نهاية التمثيل وفي هذه الحالة تكون نقطة نهاية التمثيل (النقطة الحمراء) عند $3\frac{1}{3}$ وهذا هو الناتج.



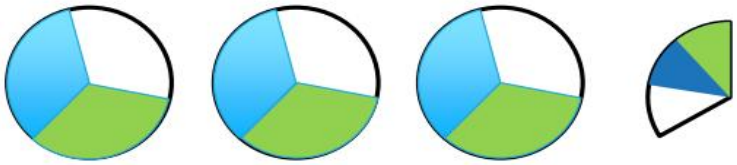
9.3 Infographic (2)

مثال: جد ناتج $\frac{1}{3} \times 3\frac{2}{3}$ ؟

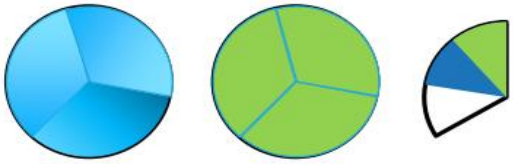
1- نمثل العدد الكسري وفي هذه الحالة $3\frac{1}{3}$.



2- نمثل الكسر في كل جزء من العدد الكسري وفي هذه الحالة الكسر يمثل $\frac{2}{3}$.



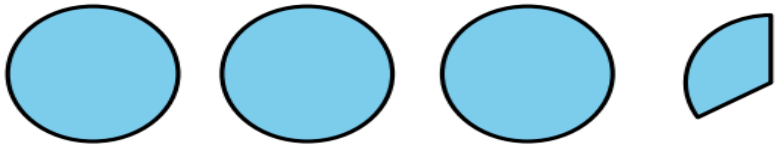
3- نجمع التمثيل السابق في نماذج جديدة لمعرفة الناتج وفي هذه الحالة $2\frac{2}{9}$.



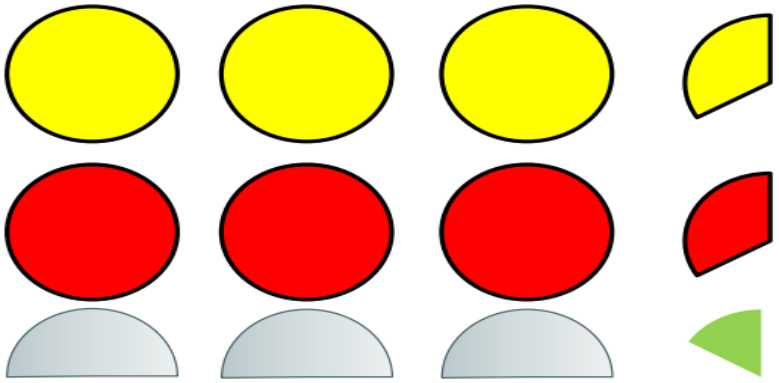
9.4 Infographic (3)

مثال: أوجد ناتج $3\frac{1}{3} \times 2\frac{1}{2}$ ؟

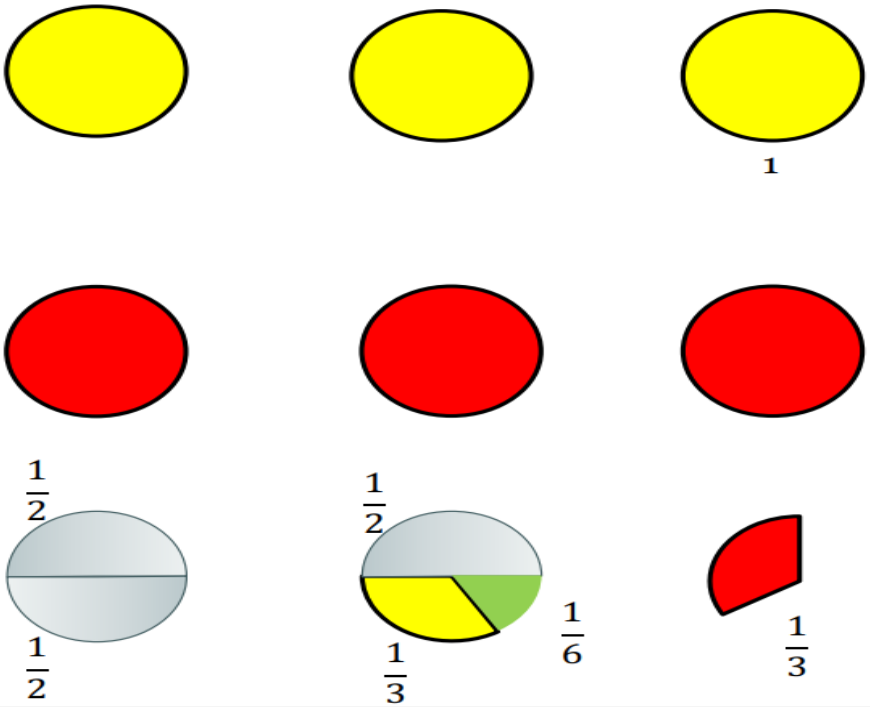
1- نمثل العدد الكسري وفي هذه الحالة $3\frac{1}{3}$.



2- نكرر العدد الكسري السابق بقيمة العدد الكسري الثاني وفي هذه الحالة مرتين ونصف.



3- ليكون الناتج مجموع الأجزاء السابقة وفي هذه الحالة $8\frac{1}{3}$.

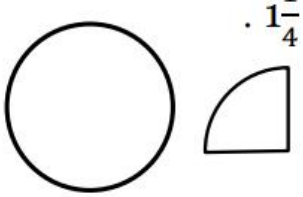


9.5 Infographic (4)

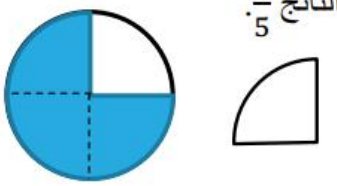
مثال : جد ناتج $1\frac{1}{4} \div \frac{3}{4}$ ؟

1- نمثل الكسر العادي وفي هذه الحالة $\frac{3}{4}$.

2- نمثل العدد الكسري بشكل مفرغ وفي هذه الحالة $1\frac{1}{4}$.



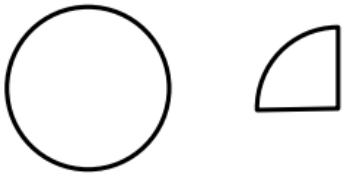
3- نغطي العدد الكسري بأجزاء الكسر العادي لنجد الكسر الذي يمثل عدد الأجزاء التي قمنا بغطائها من جميع أجزاء العدد الكسري وفي هذه الحالة قمنا بغطاء 3 أجزاء من مجمل 5 أجزاء في العدد الكسري ليكون الناتج $\frac{3}{5}$.



9.6 Infographic (5)

مثال: أوجد ناتج $1\frac{1}{4} \div \frac{1}{4}$ ؟

1- نمثل العدد الكسري وفي هذه الحالة $1\frac{1}{4}$.



2- نغطي الشكل السابق بقطع تمثل الكسر وفي هذه الحالة الكسر $\frac{1}{4}$.(وذلك لمعرفة عدد الارباع في العدد الكسري

3- الناتج هو عدد القطع المستخدمة من الكسر لتغطية العدد الكسري وفي هذه الحالة استخدمنا 5 قطع من الكسر $\frac{1}{4}$ لغطاء العدد الكسري $1\frac{1}{4}$.

9.7 Infographic (6)

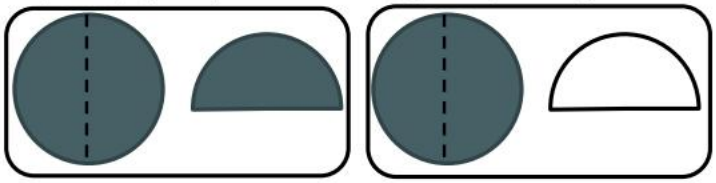
مثال: جد ناتج $2\frac{1}{2} \div 1\frac{1}{2}$؟

عندما نقسم الأول على الثاني فإننا نسأل كم جزأ من الثاني يوجد في الأول وتكون الإجابة على ذلك بأن نقوم بتجزيء الكسر الأول إلى أجزأ من الكسر الثاني ويكون ذلك باستخدام قطع النماذج.

1- نمثل العدد الكسري الأول وفي هذه الحالة $2\frac{1}{2}$.

2- نمثل العدد الكسري الثاني (المقسوم عليه) وفي هذه الحالة $1\frac{1}{2}$.

3- نوزع العدد الكسري الأول (المقسوم) على العدد الكسري الثاني (المقسوم عليه).

$1 =$  $= \frac{2}{3}$

4- يكون الناتج عدد مرات غطاء العدد الكسري الثاني (المقسوم عليه) ونسبة غطاء النماذج غير المغطية بالكامل وفي هذه الحالة الناتج هو $1\frac{2}{3}$.

9.8 The pre- and post-test:

دولـــــة فلســـــــطين
وزارة التـــربية والتعليـــم
مدرسة ذكور الصرة الثانوية
اختبـــــــار يومـــــي

الصف : الخامس
المبحث: رياضيات /المدة :حصة
التاريخ: 2023/3/
اسم الطالب:.....

(1) أكمل ما يأتي؟ (ملاحظة) (4 علامات)

- $\frac{[\ ]}{[\ ]} = \frac{[\ ]\times[\ ]}{[\ ]\times[\ ]} = \frac{13}{[\ ]} \times \frac{[\ ]}{5} = 2\frac{[\ ]}{6} \times 1\frac{4}{[\ ]}$
- $\frac{[\ ]}{[\ ]} = \frac{[\ ]\times[\ ]}{[\ ]\times[\ ]} = \frac{2}{[\ ]} \times \frac{9}{[\ ]} = \frac{[\ ]}{2} \div \frac{9}{[\ ]} = \frac{1}{[\ ]} \div 2\frac{[\ ]}{4}$
- $\frac{[\ ]}{[\ ]} = \frac{[\ ]\times[\ ]}{[\ ]\times[\ ]} = \frac{4}{[\ ]} \times \frac{1}{[\ ]} = \frac{[\ ]}{4} \div \frac{1}{[\ ]} = 1\frac{1}{[\ ]} \div \frac{[\ ]}{8}$
- $\frac{[\ ]}{[\ ]} = \frac{[\ ]\times[\ ]}{[\ ]\times[\ ]} = \frac{2}{[\ ]} \times \frac{[\ ]}{5} = \frac{[\ ]}{7} \times 2\frac{1}{[\ ]}$

(2) أي الاعداد الكسرية التالية تقريبها صائب مع تصحيح الخاطئة منها؟ (حكم) (4 علامات)

- $3 \approx 2\frac{6}{7}$
- $10 \approx 9\frac{1}{5}$
- $4 \approx 4\frac{6}{7}$
- $5 \approx 5\frac{2}{6}$

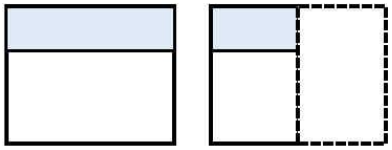
1

3) من الرسم الموضح أوجد ما يلي؟ (ملاحظة) (3 علامات)

أ) ما العملية الممثلة بالرسم؟

ب) اكتب العملية الممثلة؟

ج) ما ناتج العملية؟



4) قام كل من أحمد وعز بتقريب العدد الكسري $8\frac{3}{5}$ ، حيث قرب أحمد العدد الكسري الى 8 وقام عز بتقريبه الى العدد 9 ايهما تقريبه أصوب مع التفسير ؟ (حكم) (علامتان)

5) أكمل النمط التالي: (ملاحظة) (علامتان)

$12\frac{1}{6}$، $10\frac{1}{12}$ ، $8\frac{1}{24}$، ..... ، .....

اعداد المعلم محمد ابوعوض

9.9 The pre- and post interview:

المقابلة الشخصية للطالب (شبه مقننة):

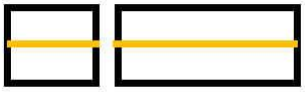
1- ما العدد الكسري الذي يمثل الصورة التالية؟ (ملاحظة)

2- ما الكسر الأكبر بين الكسور الممثلة التالية؟ مع ذكر السبب (ملاحظة \ حكم)

3- الكسر الدال على التمثيل الثاني في السؤال السابق هو $\frac{1}{3}$ مع التفسير؟ (حكم)

4- يتم استخدام مقلوب الكسر في عملية (ضرب \\ قسمة \\ جمع \\ طرح) الاعداد الكسرية؟ وهل يمكن استخدامه في عملية أخرى فسر اجابتك (حكم)

5- ما العملية التي تم تمثيلها بهذا الشكل حسب الخصائص التي تلاحظها؟



لماذا؟ (ملاحظة)

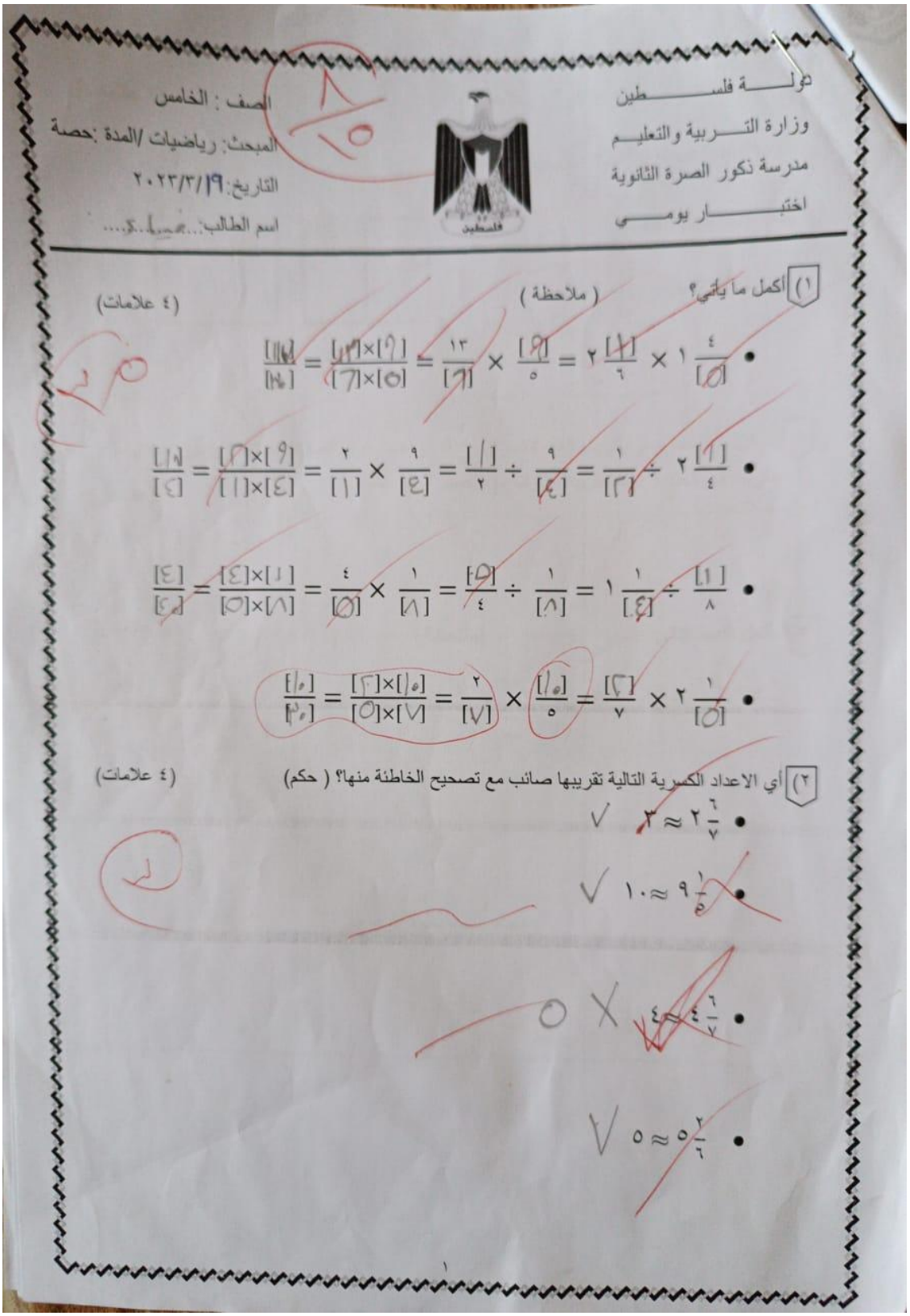
6- ما المقام في العدد الكسري $2\frac{3}{[\ ]}$ إذا علمت ان الكسر غير الحقيقي المكافئ هو $\frac{11}{4}$ ؟ (ملاحظة)

7- هل يمكن ضرب عددين كسريين دون تحويل الاعداد الكسرية الى كسور غير حقيقية مع التفسير؟ (حكم)

8- هل العبارة صحيحة أم خاطئة مع التفسير (الكسر غير الحقيقي الذي يمثل العدد الكسري $1\frac{2}{3}$ هو $\frac{5}{3}$)؟

(حكم)

9.10. Student work:
Pre-test:

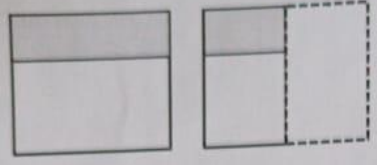


٣) من الرسم الموضح أوجد ما يلي؟ (ملاحظة) (٣ علامات)

أ) ما العملية الممثلة بالرسم؟

ب) اكتب العملية الممثلة؟

ج) ما ناتج العملية؟



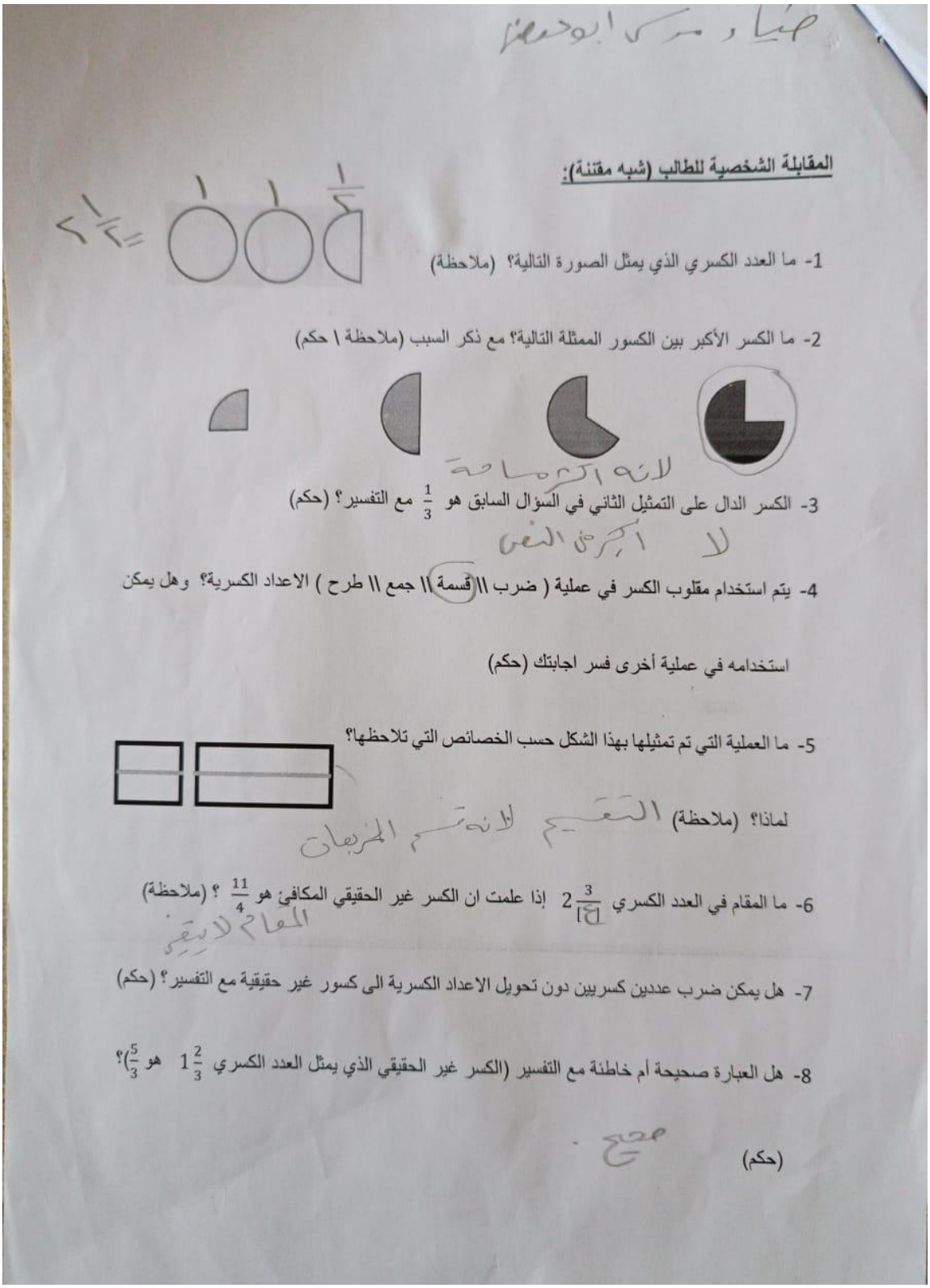
٤) قام كل من أحمد وعز بتقريب العدد الكسري $٨\frac{٣}{٥}$ ، حيث قرب أحمد العدد الكسري الى ٨ وقام عز بتقريبه الى العدد ٩ ايهما تقريبه أصوب مع التفسير ؟ (حكم) (علامتان)

٥) أكمل النمط التالي: (ملاحظة) (علامتان)

$١٢\frac{١}{٦}$ ، $١٠\frac{١}{١٢}$ ، $٨\frac{١}{٢٤}$ ، ..... ، ..... ، .....

اعداد المعلم محمد ابوعوض

Pre-interview:



المقابلة الشخصية للطالب (شبه مقننة):

1- ما العدد الكسري الذي يمثل الصورة التالية؟ (ملاحظة)

2- ما الكسر الأكبر بين الكسور الممثلة التالية؟ مع ذكر السبب (ملاحظة \ حكم)

3- الكسر الدال على التمثيل الثاني في السؤال السابق هو $\frac{1}{3}$ مع التفسير؟ (حكم)

4- يتم استخدام مقلوب الكسر في عملية (ضرب \\ قسمة \\ جمع \\ طرح) الاعداد الكسرية؟ وهل يمكن استخدامه في عملية أخرى فسر اجابتك (حكم)

5- ما العملية التي تم تمثيلها بهذا الشكل حسب الخصائص التي تلاحظها؟

لماذا؟ (ملاحظة)

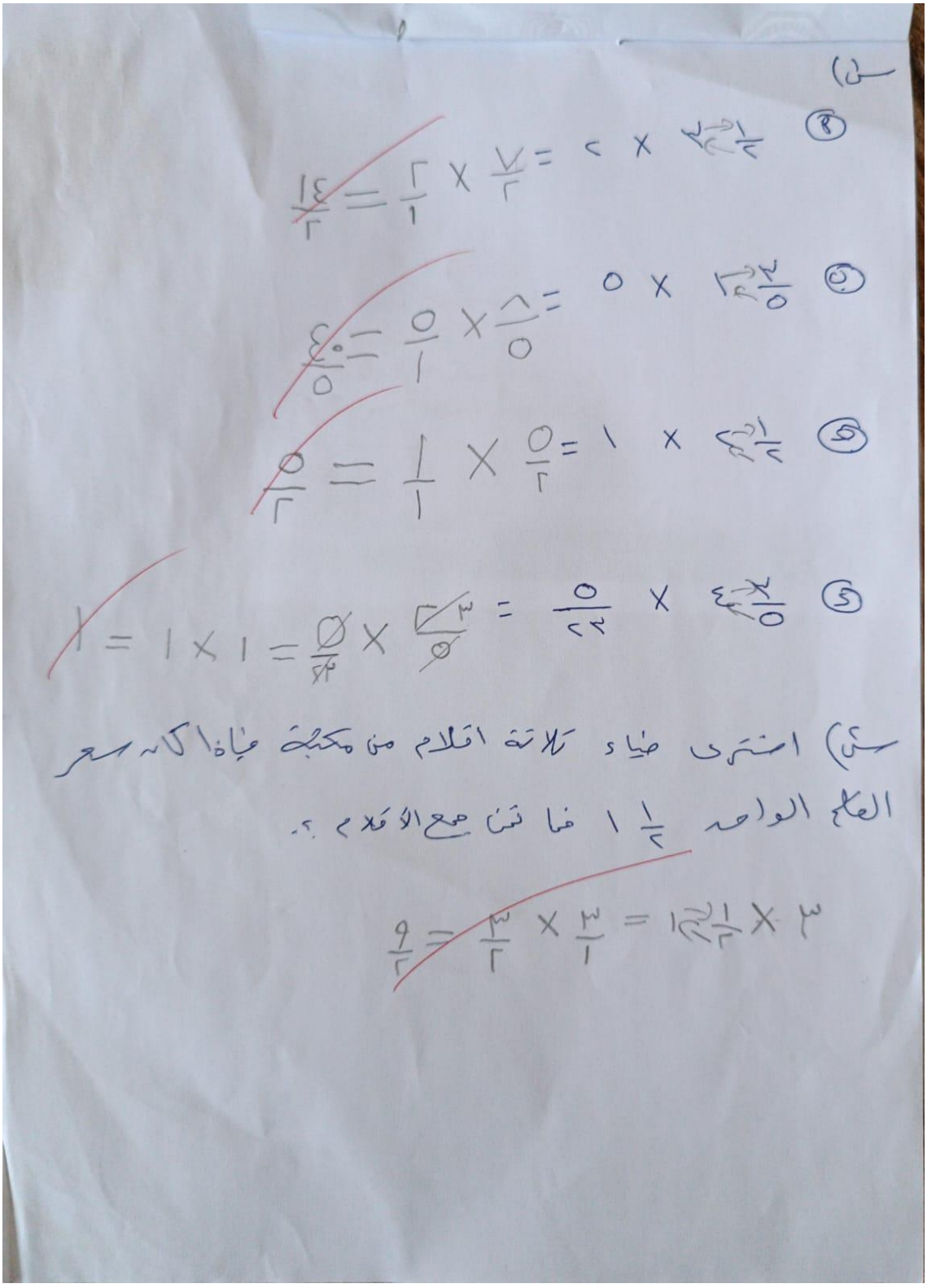
6- ما المقام في العدد الكسري $2\frac{3}{[4]}$ إذا علمت ان الكسر غير الحقيقي المكافئ هو $\frac{11}{4}$ ؟ (ملاحظة)

7- هل يمكن ضرب عددين كسريين دون تحويل الاعداد الكسرية الى كسور غير حقيقية مع التفسير؟ (حكم)

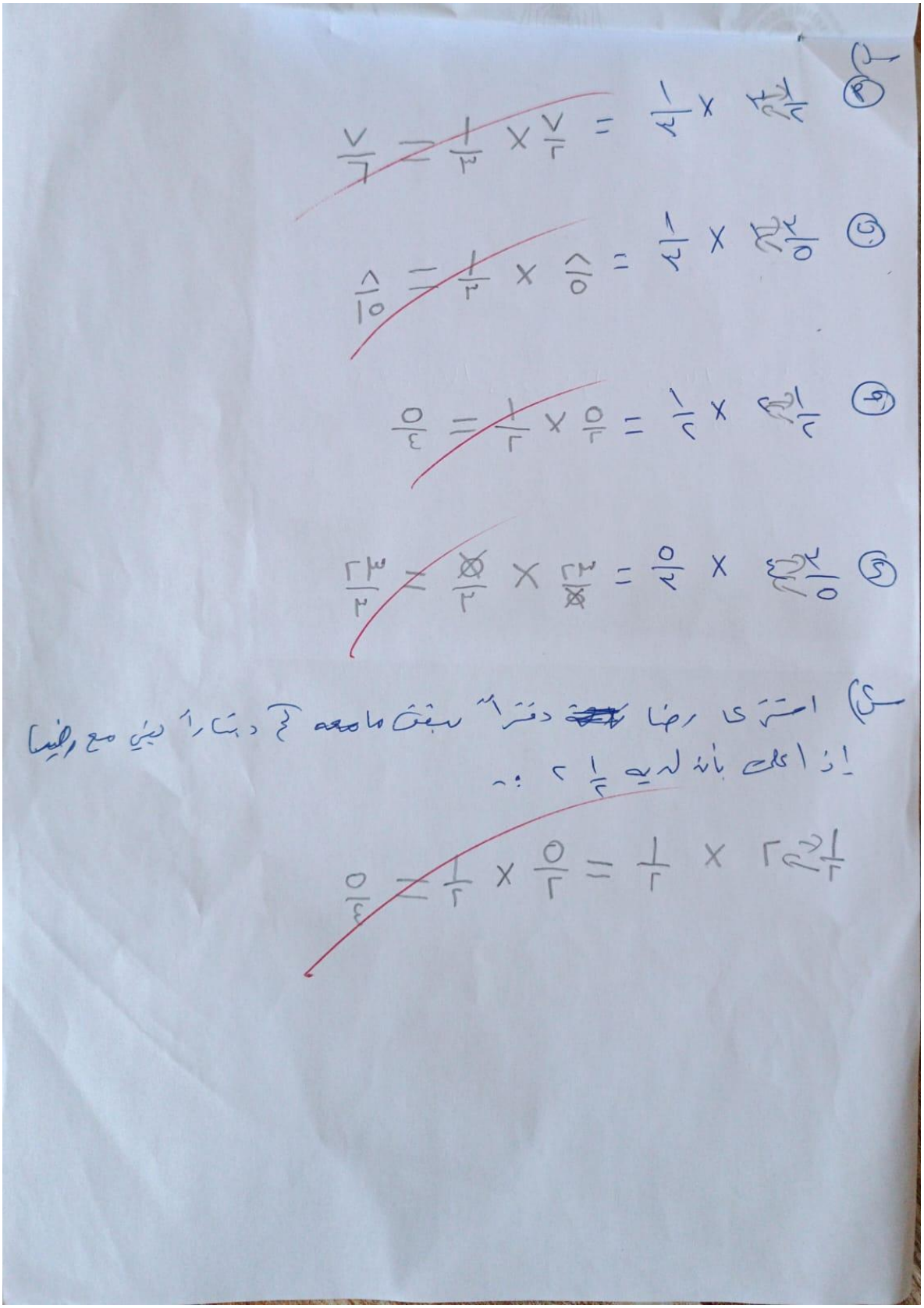
8- هل العبارة صحيحة أم خاطئة مع التفسير (الكسر غير الحقيقي الذي يمثل العدد الكسري $1\frac{2}{3}$ هو $\frac{5}{3}$)؟

(حكم)

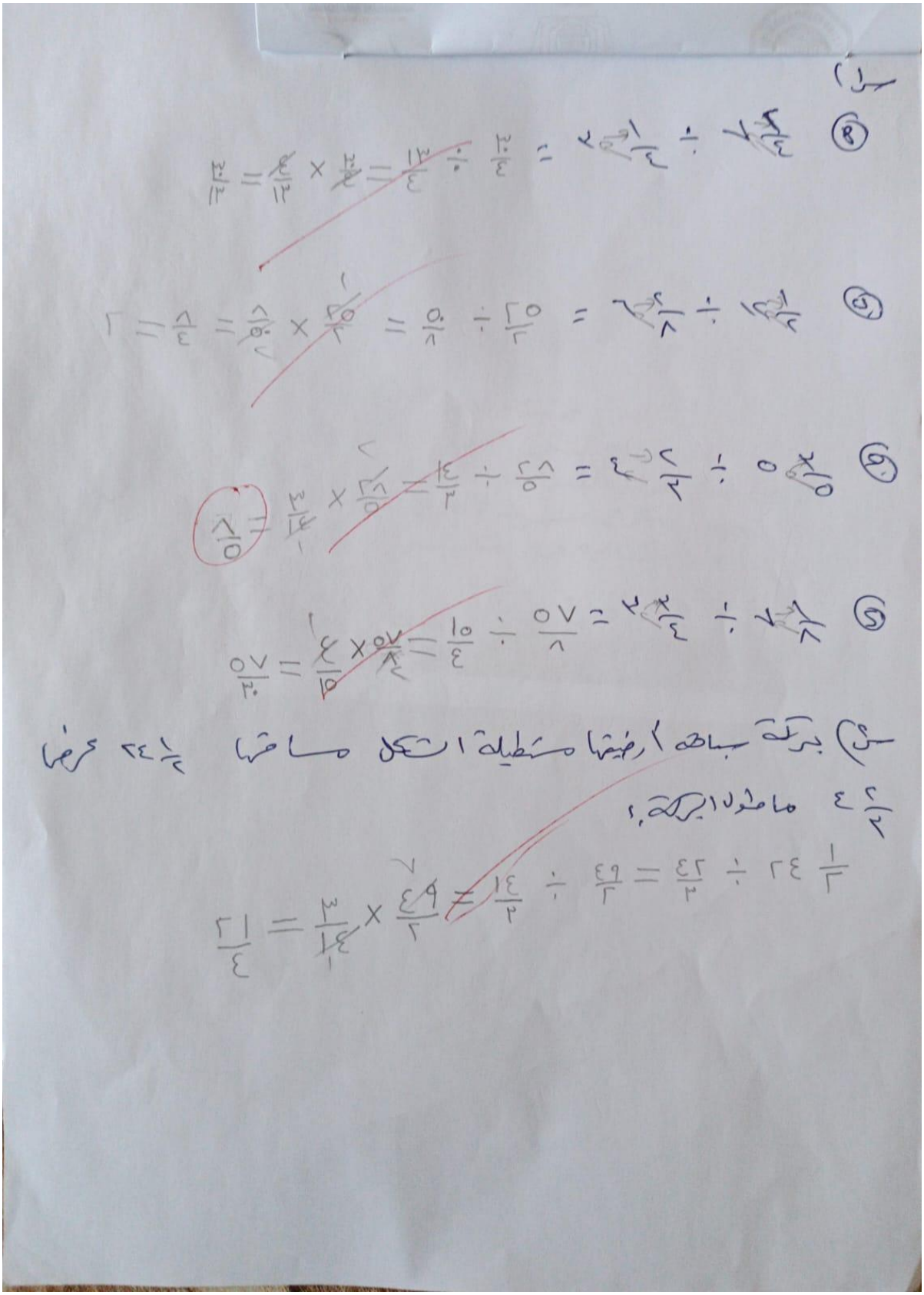
Quiz 1:



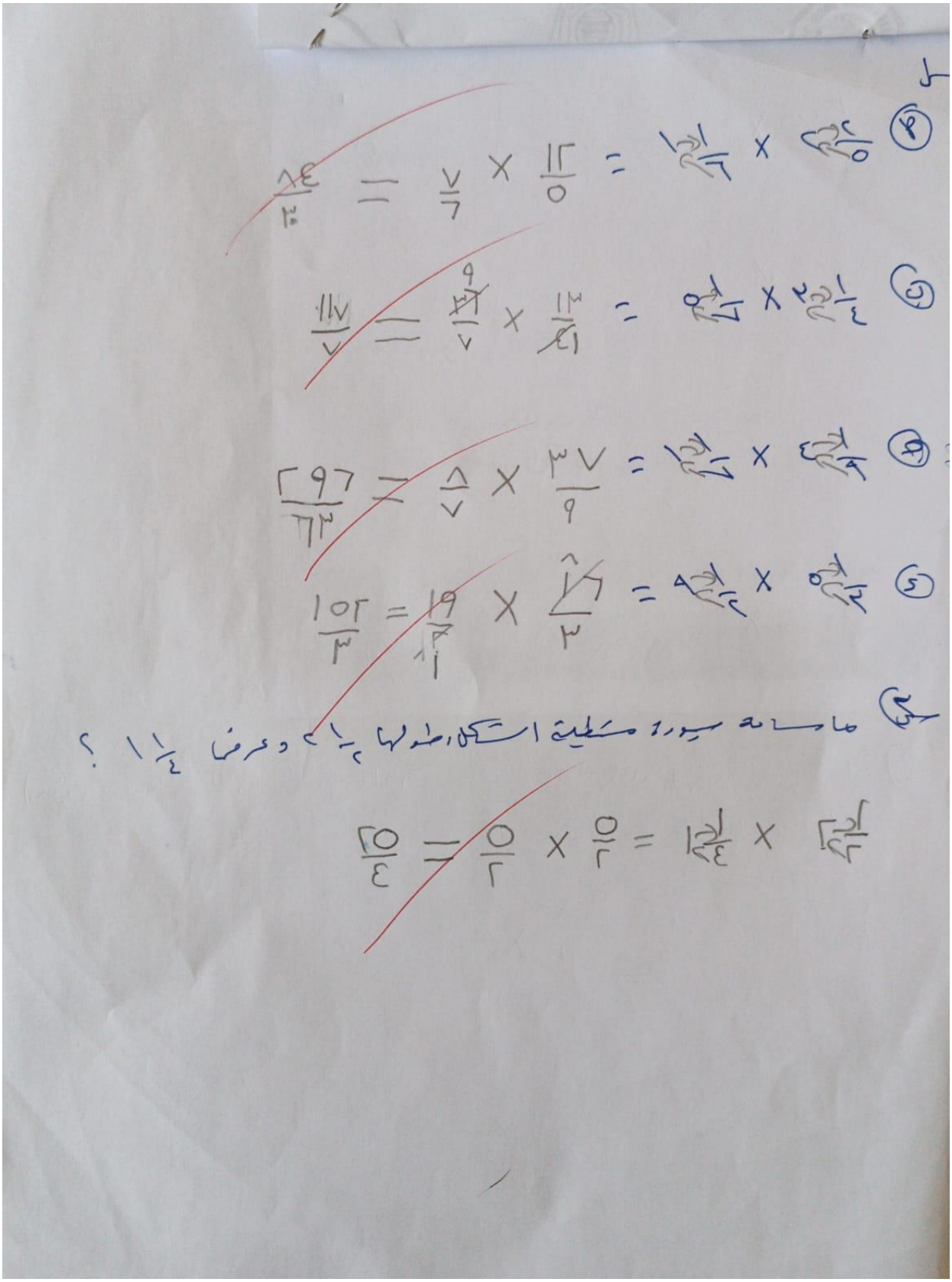
Quiz 2:



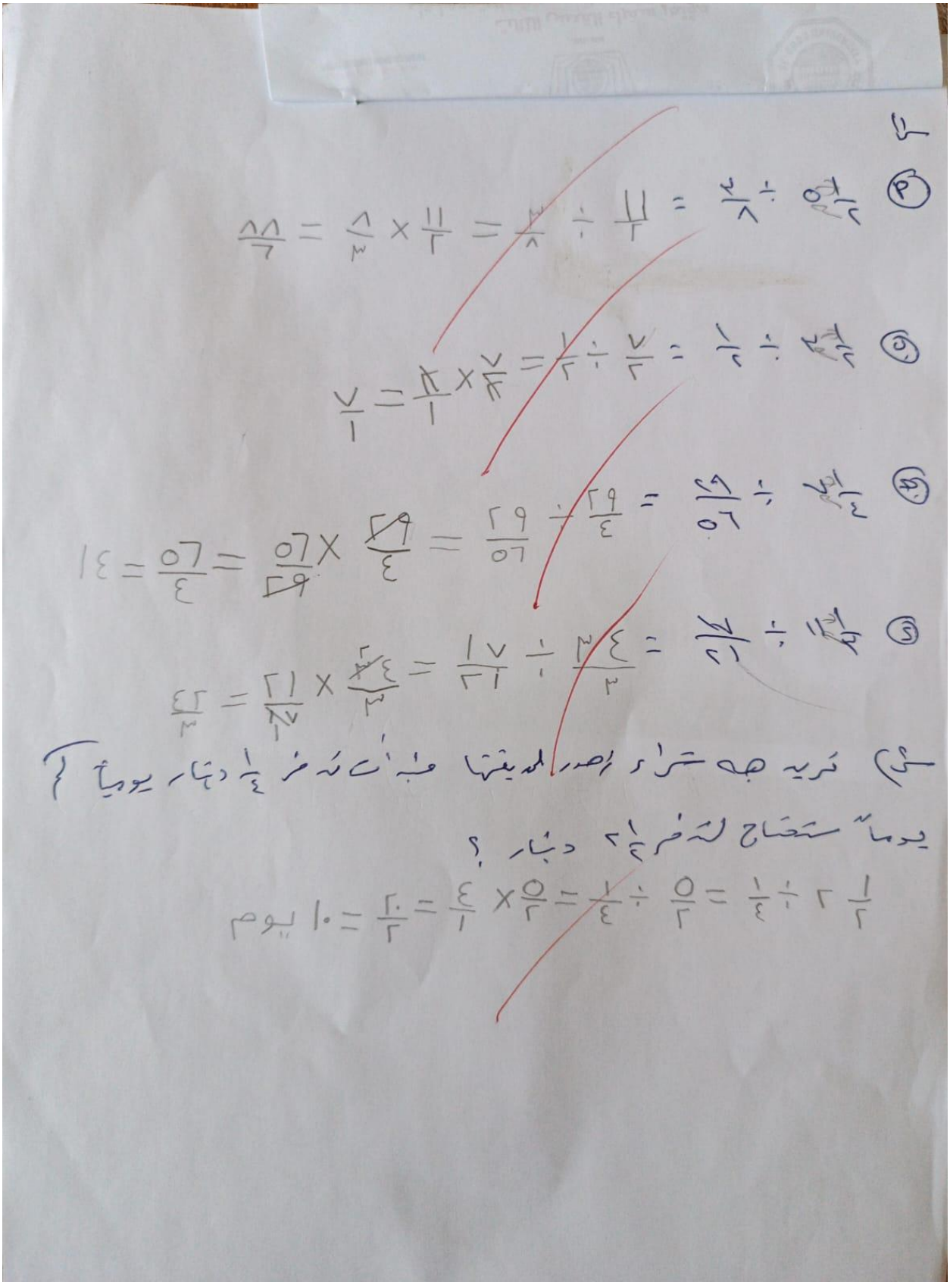
Quiz 3:



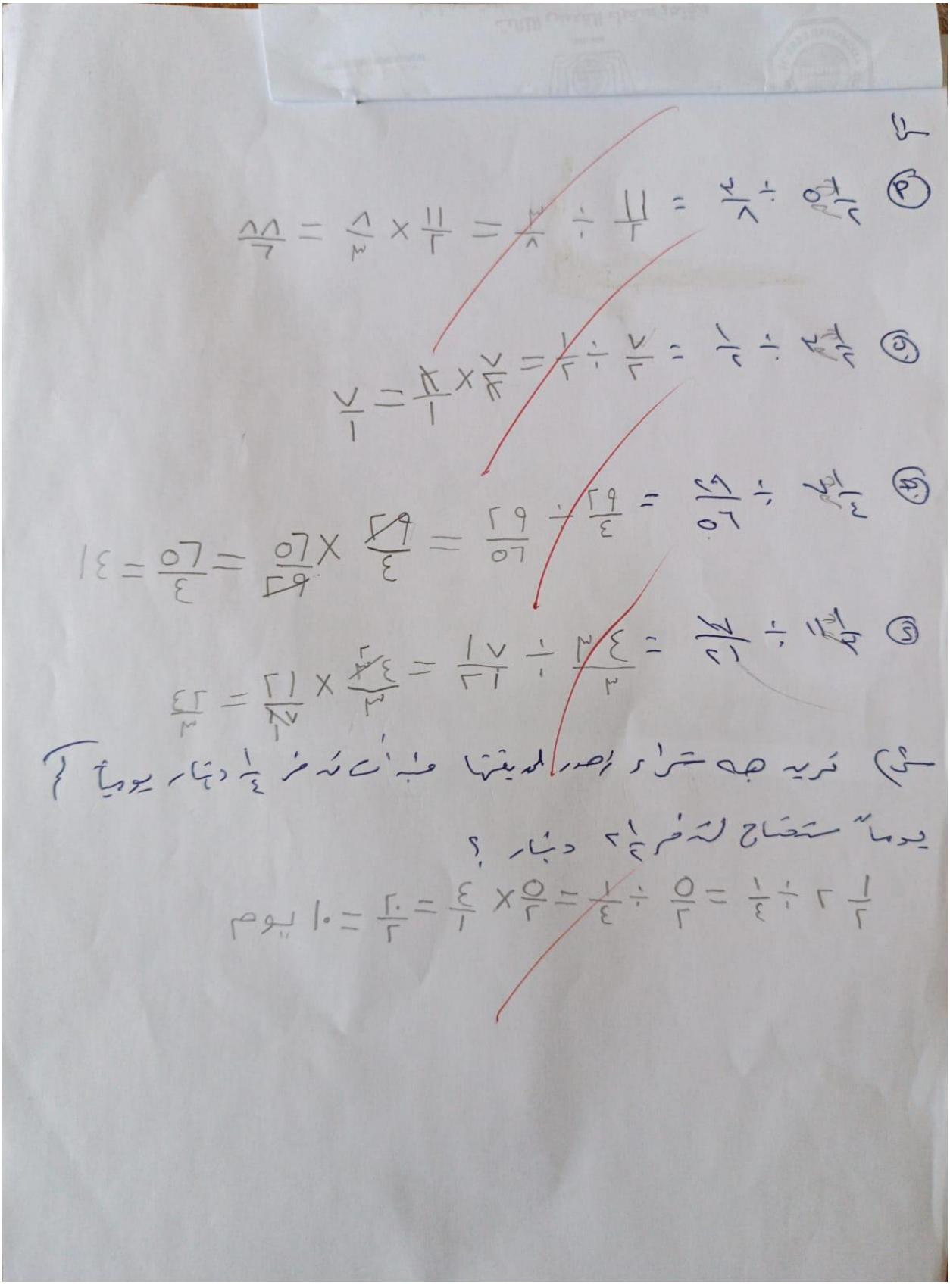
Quiz 4:



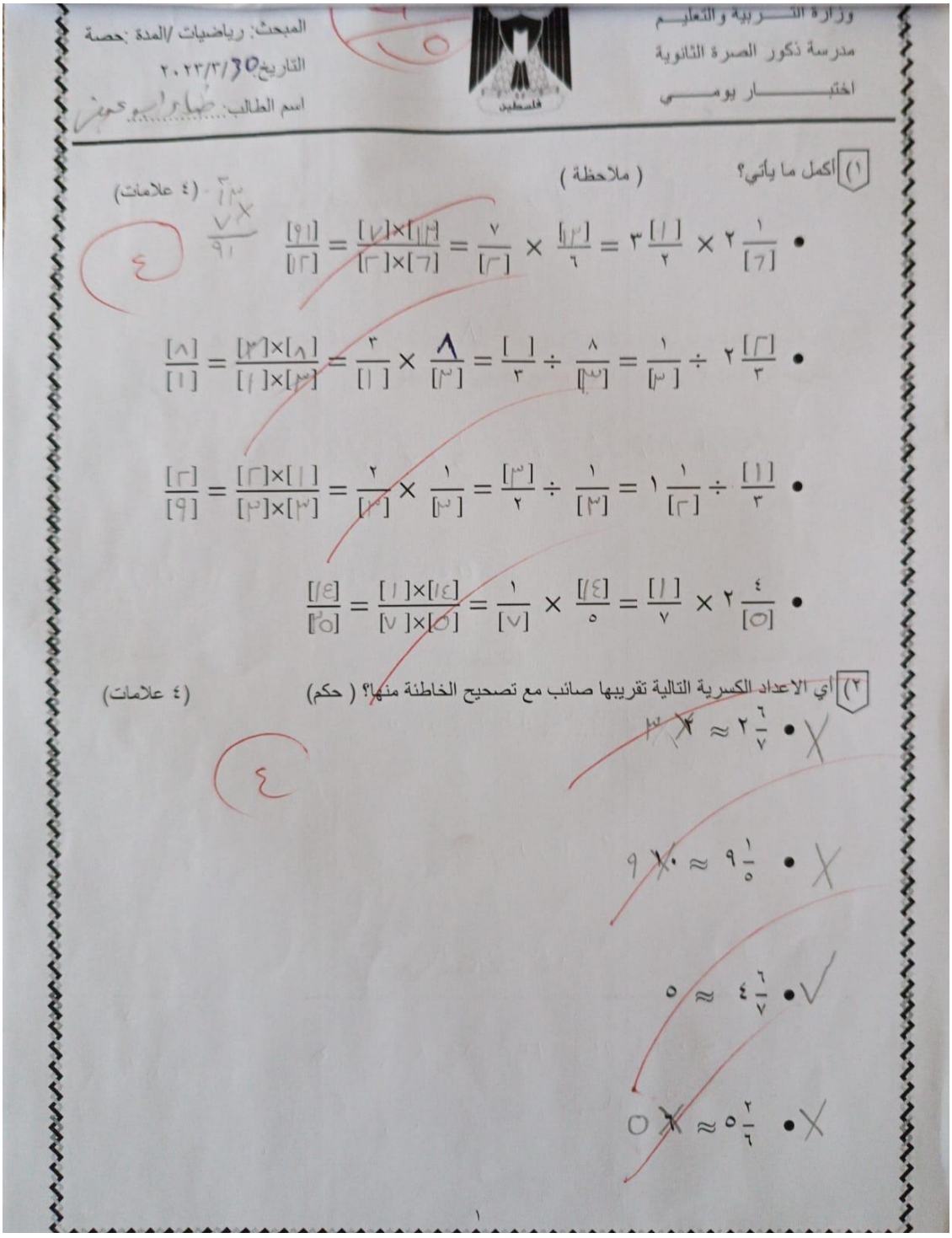
Quiz 5:



Quiz 6:



Post-test:



وزارة التربية والتعليم
مدرسة ذكور الصرة الثانوية
اختبار يومي

فلسطين

المبحث: رياضيات /المدة :حصة
التاريخ ٢٠٢٣/٣/30
اسم الطالب: طيارا سيم حمد

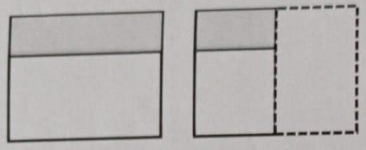
(١) أكمل ما يأتي؟ (ملاحظة) (٤ علامات)

- $\frac{[\ ]}{[٦]} \times ٢\frac{١}{٢} = ٣\frac{[\ ]}{٦} = \frac{٧}{[٢]} = \frac{[٧]\times[\ ]}{[٢]\times[٦]} = \frac{[\ ]}{[١٢]}$
- $\frac{[٢]}{٣} \div ٢\frac{[\ ]}{٣} = \frac{٨}{[\ ]} = \frac{[\ ]}{٣} = \frac{٣}{[\ ]} \times \frac{[\ ]}{[٣]} = \frac{[٣]\times[\ ]}{[\ ]\times[٣]} = \frac{[\ ]}{[٨]}$
- $\frac{[\ ]}{٣} \div ١\frac{١}{[٢]} = \frac{١}{[٣]} = \frac{[٣]}{٢} = \frac{١}{[٣]} \times \frac{٢}{[٣]} = \frac{[٢]\times[\ ]}{[٣]\times[٣]} = \frac{[٢]}{[٩]}$
- $\frac{٤}{[٥]} \times ٢\frac{[\ ]}{٧} = \frac{[\ ]}{٥} = \frac{١}{[٧]} = \frac{[\ ]\times[١٤]}{[٧]\times[٥]} = \frac{[١٤]}{[٣٥]}$

(٢) أي الاعداد الكسرية التالية تقريبها صائب مع تصحيح الخاطئة منها؟ (حكم) (٤ علامات)

- $٢\frac{٦}{٧} \approx ٣$
- $٩\frac{١}{٥} \approx ١٠$
- $٤\frac{٦}{٧} \approx ٥$
- $٥\frac{٢}{٦} \approx ٥$

١



ا) ما العملية الممثلة بالرسم؟ الضرب

ب) اكتب العملية الممثلة؟ $\frac{1}{2} \times 1\frac{1}{2}$

ج) ما ناتج العملية؟ $\frac{3}{2} \times \frac{1}{3} = \frac{3}{6}$

(٤) قام كل من أحمد وعز بتقريب العدد الكسري $٨\frac{٢}{٤}$ ، حيث قرب أحمد العدد الكسري الى ٨ وقام عز بتقريبه الى العدد ٩ ايهما تقريبه أصوب مع التفسير ؟ (حكم) (علامتان)

عز هو الصواب

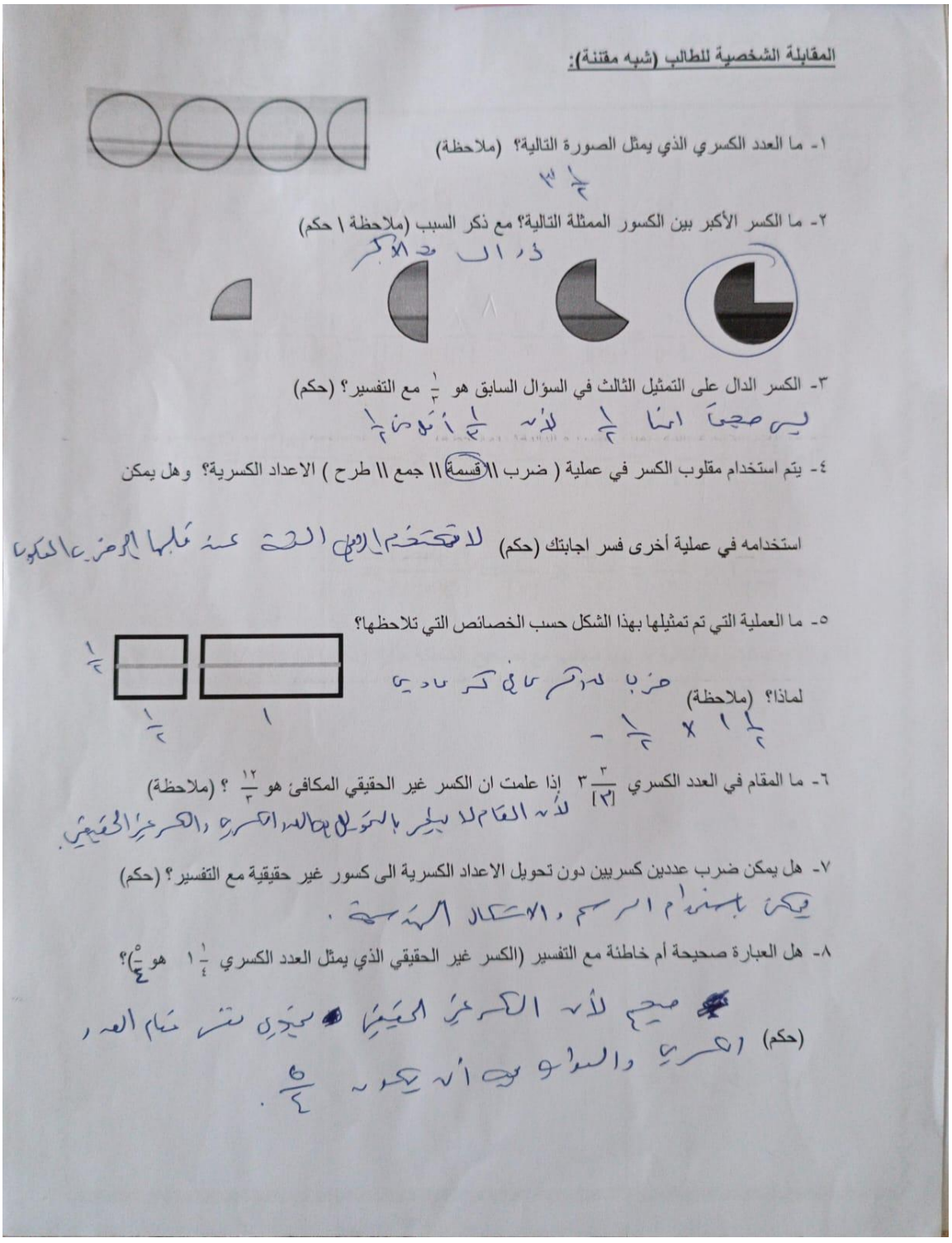
$\frac{٢}{٤} \approx 1$

(٥) أكمل النمط التالي: (ملاحظة) (علامتان)

$\frac{١}{١٨}$ ، ٤ ، $\frac{١}{١٥}$ ، ٨ ، $\frac{١}{١٢}$ ، ١٢ ، ..... ، ..... ، .....

اعداد المعلم محمد ابوعوض

Post-interview:



المقابلة الشخصية للطالب (شبه مقننة):

١- ما العدد الكسري الذي يمثل الصورة التالية؟ (ملاحظة)

٢- ما الكسر الأكبر بين الكسور الممثلة التالية؟ مع ذكر السبب (ملاحظة ا حكم)

٣- الكسر الدال على التمثيل الثالث في السؤال السابق هو $\frac{1}{2}$ مع التفسير؟ (حكم)

٤- يتم استخدام مقلوب الكسر في عملية (ضرب ا قسمة ا جمع ا طرح) الاعداد الكسرية؟ وهل يمكن استخدامه في عملية أخرى فسر اجابتك (حكم)

٥- ما العملية التي تم تمثيلها بهذا الشكل حسب الخصائص التي تلاحظها؟

لماذا؟ (ملاحظة)

٦- ما المقام في العدد الكسري $3\frac{3}{2}$ إذا علمت ان الكسر غير الحقيقي المكافئ هو $\frac{12}{3}$ ؟ (ملاحظة)

٧- هل يمكن ضرب عددين كسريين دون تحويل الاعداد الكسرية الى كسور غير حقيقية مع التفسير؟ (حكم)

٨- هل العبارة صحيحة أم خاطئة مع التفسير (الكسر غير الحقيقي الذي يمثل العدد الكسري $1\frac{1}{4}$ هو $\frac{5}{4}$)؟ (حكم)