FRACZONES: A SUPPLEMENTAL TOOL IN TEACHING FRACTIONS

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ABSTRACT

This project sought to create a digital resource or supplemental tool for teaching fractions to grade 5 students. It was anchored on the constructivist theory of Jerome Bruner (1960), which focuses on how individuals learn through observation and research. A pure research design was used as its methodology. The researcher created a tool called FRACZONES that teachers can use and edit to augment lessons on the four fundamental fractional operations. The tool is accessible on a PC and a smartphone. After the conversations, the students can use this if they want to continue their education independently. This add-on tool is intended to increase the enjoyment and engagement of teaching and learning. The researcher created the aforementioned technology using PPT or PowerPoint Presentation.

Keyword: *Fraczones, Fractions, Gamification, Supplemental tool*

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1. INTRODUCTION

Mathematics is one of the most feared topics in school (Fritz et al., 2019), despite the fact that it is a subject that pupils will require throughout their life (Li and Schoenfeld, 2019). Math is a complex subject for students, and teachers have long sought more effective ways to teach it (Mink, 2004). Although Mathematics occupies a critical position in the school curriculum, most pupils find it challenging to pass the subject. Many reasons have been attributed to the causes of poor academic performance in Mathematics. Amongst the causes of poor academic performance in Mathematics which the researchers have noted are learners' attitudes towards the subject, lack of teaching experiences, economic conditions, lack of appropriate teaching methods, and low motivation of teachers and attitudes (Makondo and Makondo, 2020).

Fractions have been around for millennia and are utilized in a wide range of circumstances in both everyday life and mathematics. Yet, it is difficult for students to learn and master (Gabriel et al., 2013). Many teachers, for different reasons, recognize the teaching of fractions as a challenge (Ubah, 2021). Because it is one of their first experiences with a math subject beyond the basic skills of addition, subtraction, multiplication, and division, fraction is frequently the first hurdle faced by primary school students when learning mathematics (Chinnappan 2006).

As computers and other types of technology are becoming more common in our culture, technology has impacted almost every aspect of life today, and education is no exception (Purdue University Online, 2022). Digital learning increases access to education and knowledge while empowering students with a mindset and capabilities that sets them up for success in their present and future (Bonnor, 2022). Digital learning integrates multiple digital tools into a larger project or overarching concept wherein nowadays teachers are well aware that using games in mathematics motivates students. Teachers of successful games frequently share ideas with one another (Wink, 2004). He added that, in the classroom, mathematical games can be employed in a more formal way. They can be used to reinforce topics, improve information memory, and give pupils tailored exercise.

Since children generally perform poorly in algebraic equations involving fractions ye that knowledge of fractions is crucial for success in algebra (Booth, Newton, and Twiss-Garrity (2014), this study aimed to develop a digital resource or supplemental tool for teaching fractions for grade 5 pupils to develop students' learning in fractions.

2. REVIEW OF RELATED LITERATURE

This chapter is devoted to review of the literature and other related studies with which the current investigation is connected or shares certain similarities.

2.1 Students Performance in Mathematics and Learning Fraction

Fractions are one of the most interesting and challenging topics in mathematics education. The acquisitions linked to fractions take place from the first year of primary school through the sixth grade of secondary school on this topic (Alacaci, 2010). Furthermore, it is well recognized that fractions play a significant role in the teaching of advanced mathematics such as algebra (Redmond, 2009). However, creating and understanding the notion of fractions takes time, and teaching fractions is considered tough (Smith, 2002). As a result, fractions are one of the most challenging mathematics courses for both teachers and pupils.

Furthermore, research shows that pupils struggle with the idea of fractions at every grade level (Chan, Leu & Chen, 2007; Isik & Kar, 2012; Moss & Case, 1999; Ni & Zhou, 2005; Olkun & Toluk, 2003; Olkun & Toluk-Ucar, 2012; Soylu & Soylu, 2005; Soylu, 2008; Stafylidou & Vosniadou, 2004; Unlu & Ertekin, 2012). The fundamental cause of these challenges may be traced back to the structure of fractions and the way they are taught (Birgin & Gurbuz, 2009; Soylu & Soylu, 2005; Streefland, 1991; Yilmaz & Yenilmez, 2008). When teaching fractions, more operational learning is done rather than conceptual learning. That is, pupils have been asked to do calculations since the beginning by being given the rules (Aksu, 1997). As a result, kids learn how to operate fractions every year and then forget how to operate them the next year (Siap & Duru, 2004).

Many learners can easily solve division with fractions, but they cannot explain why the second fraction is inverted and multiplied while doing so, according to Arcavi (2003) and Olkun (2004). Students should be taught the meanings behind these operations rather than being forced to memorize the rules. As a result, the concept of fractions must be taught conceptually, and the teaching process must be structured accordingly.

According to Pesen (2007), the part-whole relationship must be emphasized initially when introducing the notion of fractions. Half-quarter principles should be understood utilizing geometrical forms such as bread, apple, and cardboard, followed by triangles, rectangles, and circles, and finally the symbolic representation of fraction numbers should be introduced. Models and shapes should be used in fraction operations in the same way they are in natural numbers. The created forms and models will make the question more solid and understandable in this way (Kocaoglu, 2010).

Another reason fractions are forgotten in a short amount of time is that they are not connected to daily living (Albayrak, 2000). As a result, it is required to develop and concretize fractional number problem statements that are relevant to daily life. As a result, the students' previously abstract concept of fractions will be understood as a part, a requirement of daily life, resulting in meaningful and enduring learning (Kocaoglu, 2010).

In order to overcome weaknesses in the teaching of fractions, teachers must be aware of the errors that students may make, take care to prevent these errors, and set up the teaching environment appropriately (Soylu & Soylu, 2005). As a result, it is critical to identify the students' friction-related errors as well as the reasons of these errors. Students' blunders are frequently attributed to a lack of information, carelessness, and misunderstandings. It's very critical to concentrate on pupils' misunderstandings (Yenilmez & Yasa, 2008). Because these misunderstandings have a detrimental impact on students' learning, they also have a bad impact on their future learning (Baki, 2008). As a result of the literature review, some studies have been found which analyze the student errors in fractions at all levels of education and the misunderstandings that are the source of these mistakes (Alacaci, 2012; Biber, Tuna & Aktas, 2013; Demiri, 2013; Devika, 2016; Haser & Ubuz, 2002; Jigyel & Afamasaga-Fuata, 2007; Karaagac & Kose, 2015; Kocaoglu & Yenilmez, 2010; Meert, Grégoire & Noël, 2010; Okur & Cakmak-Gurel, 2016; Pesen, 2007; Pesen, 2008; Soylu & Soylu, 2005; Stafylidou & Vosniadou, 2004; Taskın & Yildiz, 2011; Yilmaz & Yenilmez, 2007).

Students' fractional computing abilities are superior to their ability to answer word problems involving fractions (Kepner, 2000). The basis of the problem could be a student's lack of comprehension of several operations (Aksu M., 2012). Handiman (2000) found that the role of fractions in word problems, rather than the number of fractions in the problem, determines difficulty. He went on to say that the challenges of remedial pupils stemmed from their understanding of multiplication rather than their application of the concept. As a result, both the operations required and how they are presented in the problem affect performance when dealing with fractions (Aksu, 2012). Students' psychological and mathematical issues stem from their lack of knowledge of fractions and multiplication. According to Krutetsi and Silver (2000), professional problem solvers focus on the problem's structure, whereas less skilled problem solvers focus on the problem's surface aspects.

2.2 Teaching Fractions in Primary Education

The study of primary teacher students' knowledge of fractions is critical, according to Kolar, Cadez, and Vula (2018), since fractions are a key and extremely complex set of concepts and skills in mathematics. Understanding mathematics is critical to solving mathematical problems and other issues that arise in our daily lives (Dini et al., 2018). Ordinary, mixed, and decimal fractions can be used to explain and solve problems in everyday life (Wijaya et al, 2018).

Within mathematics, fractions reflect a complex set of notions (Behr, Post, Harel, & Lesh, 1993; Charalambous & Pitta-Pantazi, 2007; Hallett, Nunes & Bryant, 2010; Van Steenbrugge, Valcke, & Desoete, 2014). They are an important topic in elementary mathematics since comprehending fractions is necessary for understanding other mathematical concepts such as algebra and probability (Clarke, Roche, & Mitchell, 2007). However, understanding fractions remains a difficult topic to master and teach (Ma 1999; National Mathematics Advisory Panel 2008; Newton, 2008). Children have a poor conceptual comprehension of fractions and decimal numbers, according to research (Clarke, Roche, & Mitchell, 2007; Pantziara & Philippou, 2012). This is especially troublesome given that children have many everyday experiences with fractions before being taught and learning about them in a formal setting (Steffe & Olive, 2010).

Several studies have found that teachers' knowledge has a direct impact on pupils' ability to absorb fractions (Ball, 1990; Barmby, Harries, Higgins, & Suggate, 2009; Hill, Rowan, & Ball, 2005; Lin, Becker, Byun, & Ko, 2013; Son & Lee, 2016; Van Steenbrugge et al., 2014). As a result, international educational discussion has emphasized the need of high-quality teaching as a critical component of educational system quality (OECD, 2016). Because the primary teacher education curriculum should be linked to the primary education curriculum, a brief summary of the Slovenian and Kosovar primary school curriculum for teaching and learning fractions is provided below (Kolar, CadezStudents in both countries begin learning about fractions in second grade (age seven), when they are exposed to the concept of dividing a whole into two, three, or four equal pieces. The entire is represented by a model of pizza or chocolate in all of these early situations, and the pieces are congruent. As a result, the students are shown how to share equal parts of certain objects with two, three, or four other people (Kolar, Cadez, and Vula, 2018).

According to the Slovenian curriculum, students begin to learn about other parts (such as sixths and eighths) in third grade, but only with one part of a given whole (not, for example, 3/8). Fractions that display equal parts of the total (1/2, 1/3, 2/3, 3/4, 4/4) are taught in Kosovo, as are fractions that show the same number (1/2, 2/4, 3/6) and the representation of fractions on a number line, based on third-grade curriculum content (Kolar, Cadez, and Vula, 2018).

In Slovenia, students begin working with calculations like 1/5 of x = or 1/5 of 35 = x in fourth grade, and in fifth grade, these exercises are expanded to include numerically defining additional parts of a given whole or finding a whole if the value of the parts is supplied. In Kosovo, the fourth-grade program involves a review of the third-grade knowledge of fractions as well as fraction comparison (with the same denominator and with the same numerator). The Kosovo curriculum teaches fractions as part of a number (2/3 of 12), as well as fraction operations, such as adding and subtracting fractions with the same denominator and with various denominators, in fifth grade (Kolar, Cadez, and Vula, 2018).

Thus, fractions are presented in both nations' primary school curricula in largely comparable methods, with the exception of the fifth-grade program, where Kosovar students must also complete addition and subtraction with fractions (Kolar, Cadez, and Vula, 2018). Because the part-whole subconstruct is the most common representation of fractions in primary school (Alajmi, 2012; Kieren, 1993), as well as the representation in which children consistently perform better than the other representations (Charalambous & Pitta-Pantazi, 2007), the current study focuses on the knowledge of fraction representation in relation to part-whole interpretation among Slovenian and Kosovar primary teacher students. Furthermore, considering fractions as measures was critical due to the role that gradually splitting the unit in a number line plays in other fraction interpretations (Lamon, 2012).

According to Chinnappan and Forrester (2014), fractions require a lot of attention because it is difficult for pupils to apply their understanding of the whole to a new but related category of numbers. Because fractions serve as a foundation for other mathematical skills such as algebra, it is critical that students feel comfortable and secure in their comprehension of the idea (Ubah, 2021). According to Fuchs et al. (2013), the part–whole and the fraction measurement and conceptual interpretation significant junctures in the creation of knowledge of the fraction.

2.3 Difficulties Encountered in Teaching

"Three out of two individuals have trouble with fractions," as the saying goes. Fractions have been known since ancient civilizations, but they still pose considerable challenges while learning mathematics (Gabriel et. al., 2013). Fractions were used by Babylonian culture and Egyptians 4000 years ago. Fraction processing is a component of our daily lives, and it is employed in scenarios like estimating rebates, following a recipe, and reading a map. Fractions are also important in mathematics since they are used in probabilistic, proportional, and algebraic reasoning (Gabriel et. al., 2013).

Fractions have been around for millennia and are utilized in a wide range of circumstances in both everyday life and mathematics, yet they are difficult for students to learn and master. Gabriel and colleagues al. (2013) attempted to shed light on the obstacles that children face when learning fractions. Primary school children have been known to struggle with fractions (Behr et al., 1983; Moss and Case, 1999; Grégoire and Meert, 2005; Charalambous and Pitta-Pantazi, 2007). Understanding fractional issues appears to be critical, as they might lead to mathematics anxiety and limit prospects for further math and scientific participation.

Whole number bias

Fractions are numbers that are rational. A rational number is defined as a number expressed by the quotient a/b of integers with a non-zero denominator. Children who have not yet learnt fractions assume that the features of whole numbers are the same for all numbers, according to a contemporary theory of numerical development (Siegler et al., 2011). Indeed, one of the most difficult aspects of learning fractions is the use of natural number features to make inferences on rational numbers, a phenomenon known as the "whole numbers bias," which causes problems understanding whole numbers as decomposable units.

There are basic differences between those two types of numbers from a mathematical standpoint. To begin with, rational numbers are part of a tightly ordered set, whereas whole numbers are part of a discrete set. There are an infinite amount of other rational numbers between two rational numbers, but there is no other natural number between two natural numbers (Vamvakoussi and Vosniadou, 2004). Second, rational numbers have the ability to be written from an infinite number of fractions. This is the same as the concept of equal fractions. Finally, faction symbols are classified as a/b types. Numerator and denominator are frequently treated as two different whole numbers by students (Pitkethly and Hunting, 1996). They use processes that are only applicable to entire numbers (Nunes and Bryant, 1996). As a result, common mistakes emerge in addition and subtraction problems (e.g., 1/4 + 1/2 = 2/6), as well as fraction comparison tests (e.g., 1/5 >1/3). In this situation, the thinking of the students can be summarized as follows: if the number is larger, the magnitude it represents is larger. When it comes to fractions, however, a greater denominator does not always imply a larger magnitude, but rather a smaller one. Multiplication problems present another challenge. When you multiply natural numbers, you always get a bigger result, but not with fractions (e.g., 8 1/4 = 2).

The incorrect generalization of natural number knowledge is considerably more resistant, as it is widely prior to that of rational numbers (Vamvakoussi and Vosniadou, 2004). To avoid making these errors, students may need to execute a mental reorganization that includes rational numbers as a new category of numbers with their own rules and functions (Stafylidou and Vosniadou, 2004). Furthermore, even in adults, natural number knowledge is frequently dominant while processing fractions (Bonato et al., 2007; Kallai and Tzelgov, 2009).

Different Meanings of Fractions

Another key stumbling block is the complex concept of fractions (Kieren, 1993; Brousseau et al., 2004; Grégoire and Meert, 2005). Kieren (1976) was the first to classify fractions into four groups: ratio, operator, quotient, and measure. When there are three boys for every four girls in a group, the ratio category provides the idea of a comparison between two quantities. In this scenario, the boy-to-girl ratio is 3:4, with boys accounting for 3/7 of the group and girls accounting for 4/7. Fractions are regarded functions applied to objects, numbers, or sets in the operator category (Behr et al., 1983). A quantity can be enlarged or shrunk to a new value using the fraction operator. Finding 3/4 of a number, for example, can be a function involving multiplying by 3 divided by 4, or dividing by 4 and then multiplying by 3. The outcome of a division is referred to as the quotient category. The fraction 3/4, for example, can be thought of as a quotient. Fractions are associated with two interrelated concepts in the measure category. To begin with, they are regarded as integers that indicate the size of the fractions. Second, they are related with interval measurement. The part-whole notion of fractions is implicated in these four categories, according to Kieren (1976). That is why he did not categorize it as a fifth category.
Following that, Behr et al. (1983) provided a theoretical model that linked the various fraction types. They suggest that part-whole be considered as a separate category. They also linked partitioning to the concept of

part-whole. The part-whole category can then be characterized as a case in which a continuous quantity is divided into equal parts (e.g., dividing a cake into equal parts), and partitioning a set of discrete items would be the same (e.g., distributing the same amount of sweets among a group of children).

Other models for describing the different meanings of fractions have been developed (Brissiaud, 1998; Rouche, 1998; Mamede et al., 2005). These models partially overlap, although they are not identical. According to Mamede et al. (2005), fractions can be used to quantify a part-whole connection, a quotient, an operator, or a relation between numbers. Meanwhile, Grégoire (2008) proposes a new paradigm in which three categories correspond to three stages of acquisition. The fraction is viewed as an operator in the first stage. This concept alludes to situations where people must share. The ratio stage, on the other hand, necessitates a high level of abstraction due to the fact that distinct fractions might express the same ratio. This has to do with the concept of equal fractions. The third and final level is concerned with the numerical interpretation of fractions. Fractions are treated as a separate number category with their own set of rules and features.

Conceptual and procedural understanding

The articulation of conceptual and procedural information is another factor for children's difficulty in learning fractions. According to previous research, youngsters frequently complete computations without understanding why (Kerslake, 1986).

The explicit or implicit grasp of the principles governing a domain, as well as the interrelationships between the many parts of knowledge in a domain, is referred to as conceptual knowledge (Rittle-Johnson and Alibali, 1999). It can also be defined as the understanding of essential concepts and principles, as well as their interrelationships, in a specific topic (Schneider and Stern, 2005). Conceptual information is assumed to be stored in the brain through relational representations like semantic networks (Hiebert, 1986). It is not limited to a single problem, but can be applied to a group of issues (Hiebert, 1986; Schneider and Stern, 2010).

Procedural knowledge is described as a set of steps that can be used to solve a problem (Rittle-Johnson and Alibali, 1999).

Procedural knowledge is defined by some writers as the understanding of symbolic representations, algorithms, and rules (Byrnes and Wasik, 1991). Furthermore, procedural knowledge can simply be automated, allowing people to address problems quickly and effectively (Schneider and Stern, 2010). As a result, it can be used with very few cognitive resources (Schneider and Stern, 2010). Procedural knowledge, on the other hand, is less adaptable than conceptual knowledge and is frequently tied to certain problem types (Baroody, 2003).

These two categories of knowledge may not develop in parallel. The generation of processes, according to many theories on knowledge acquisition, is founded on conceptual comprehension (Halford, 1993; Gelman and Williams, 1997). They contend that children use their conceptual understanding to refine their discovery techniques and adapt them to new activities. According to this theory, children's struggles with fractions could be attributed to their usage of mathematical symbols without understanding their meaning. Conceptual comprehension may be influenced by procedural knowledge. The use of procedures would improve conceptual understanding. However, only a few research back this up. For example, according to Byrnes and Wasik (1991), many children learn the correct processes for multiplying fractions but never seem to grasp the underlying principles. A third point of view is supported by other authors. Both types of knowledge might progress in an iterative and interactive way (Rittle-Johnson et al., 2001). Conceptual and procedural knowledge might continually and incrementally stimulate each other. Neither would necessarily precede the other.

Teachers in mathematics appear to place a greater emphasis on procedural rather than conceptual knowledge. Children learn rote procedures in a consistent manner. As a result, mathematical symbols are misunderstood (Byrnes and Wasik, 1991). Many computational errors are caused by a lack of conceptual comprehension. Fraction conceptions, according to Kieren (1980), are one of the most important foundational concepts in mathematics. According to numerous research, many kids struggle to understand fractions. The techniques for forming concepts in fractions learning have little obvious basis in students' daily activities. Furthermore, the multiple rational number interpretations make fractions even more difficult to comprehend. Fractions have many more implications than the commonly held part-whole concept. It can be interpreted as a number of measure, quotient, or ratio, as well as operators or mapping numbers.

Students meet fractions as one of the most difficult topics in primary mathematics education. This is due to the fact that prior knowledge of natural numbers must be enlarged and reconciled with knowledge of rational numbers, among other things (Stafylidou and Vosniadou, 2004).

Students meet fractions as one of the most difficult topics in primary mathematics education. This is due to the fact that prior knowledge of natural numbers must be enlarged and reconciled with knowledge of rational numbers, among other things (Stafylidou and Vosniadou 2004). Fractional proficiency is frequently an issue for students. Many pupils in Grade 5 in the Netherlands, for example, struggle to solve problems involving improper fractions and mixed numbers, as well as addition and subtraction with fractions, despite receiving training on these topics (Bruin-Muurling 2010).

All of the instructor knowledge factors studied had an impact on students' fraction proficiency development. Teachers' SMK and the quality of the idea maps they created – which represented their conceptual knowledge – had a detrimental impact on students' fraction proficiency, whereas the amount of PCK had a beneficial impact. The relationship we discovered with PCK is consistent with what other research have discovered to be successful (see e.g. Hill, Rowan, and Ball 2005; Baumert et al. 2009; Shechtman et al. 2010; Hill, Kapitula, and Umland 2011; Campbell et al. 2014). The negative impact of the other two dimensions of teacher knowledge is a less common finding (see e.g. Hill et al. 2012). Analyses of the nature of the relation between SMK or concept map and post-test scores revealed curvilinear relations, suggesting that a certain threshold level of knowledge is necessary. In contrast with for example Askew et al. (1997), we found those teachers' conceptions about mathematics and mathematics teaching and learning did not affect student outcomes regarding fractions. Finally, multilevel analyses revealed that some MQI characteristics, such as richness and student participation, had an effect on student percent proficiency development, with relatively high effects, which was consistent with our expectations. Surprisingly, none of the common educational tactics worked.

Teachers appeared to need a balanced knowledge base for efficient fraction instruction, such as a minimum (but not excessive) degree of subject matter and conceptual understanding about fractions, as well as as much PCK as possible. It also seems that teachers must strike a balance between offering rich courses, which were found to be less effective in our study, and engaging students in reasoning and meaning-making activities (see e.g. Muijs and Reynolds 2000; Houtveen, van de Grift, and Creemers 2004; Slavin and Lake 2008; Ing et al. 2015). Perhaps richness has a disadvantage: incorporating all aspects of the richness dimension – which all have virtues – into each lesson may be too difficult for some students. The complexity of the relationships discovered was especially noteworthy in classrooms where students had poor pre-test fraction proficiency ratings on average. Much SMK about fractions, conceptual fraction knowledge, and richness of instruction seemed to complicate student learning in these classes, preventing them from performing well on the fraction post-test, despite the fact that these classes appeared to benefit from a high level of student participation. It seemed to matter less how much knowledge their instructor had and what their instruction looked like in classrooms where the students scored highly on the pre-test, yet these courses did seem to benefit much from their professors having a lot of PCK (Stafylidou and Vosniadou 2004).

While all three viewpoints appeared to be important, teacher behavior had the biggest effect sizes when compared to the other two. This is consistent with the findings of Brophy (1986) and Kyriakides, Christoforou, and Charalambous (2013), who found that classroom level variation in students' mathematics achievement can be explained primarily by conglomerates of teaching behaviors rather than students' beliefs or personal characteristics.

Variables from all three perspectives were included in the current investigation, and the reported effects only occur in combination with other effects. When solely instructor behavior is taken into consideration, some of the effects reverse (i.e. become negative instead of positive), according to some data analysis. That is, in a multilevel model including only the effects of mathematical richness and student engagement (plus a correction for students' pre-test scores), richness had a positive influence on students' post-test scores, whereas student participation had a negative effect. Only in combination with relevant variables from the other perspectives these effects reversed, suggesting that the interplay between teacher knowledge and behaviour diminishes the positive effect of richness per se. Therefore, besides multilevel analysis, the complex picture we found demands different statistical techniques to better grasp possible patterns in teacher knowledge and behaviour or causality of possible indirect relations and/or interactions between variables.

We suspect, for example, that a teacher's experience in the upper grades might have had both a direct and an indirect effect on student proficiency as it may overlap with their knowledge and behaviour. Also, PCK might serve as a precondition for effective fraction teaching. A larger sample size would be necessary to investigate latent profiles or create structural models in which such relations and interactions could be included (Stafylidou and Vosniadou 2004). It was not able to look into the effects of specialized programs like Montessori or Steiner school systems, or the specific ways in which these programs teach fractions. The unanticipated negative consequences of wealth are also worth investigating. We also did not include variables at the student level, save for their fraction proficiency, as previously stated (Stafylidou and Vosniadou 2004). This was due to the study's focus on the function of teachers, but introducing more student variables, such as gender or class size, could help explain more variance at the student level.

Finally, this study only used fraction proficiency as an outcome measure. Other student outcome indicators, such as motivation for mathematics or (reduction of) mathematics anxiety, are not affected by teacher background traits, knowledge, concepts, or behaviors. More than just desire for cognitive accomplishment may be linked to effective teaching. It could be interesting to look at teacher variables that contribute to better affective outcomes in future studies (Stafylidou and Vosniadou 2004).

The significance of PCK in fraction instruction, when considering the implications of teacher age and experience, is critical for teachers to establish PCK early in their careers. As a result, obtaining this type of knowledge should be a priority in teacher education. Teachers must, of course, have some SMK on fractions. Still, we believe that having a lot of SMK about fractions may have an impact on the quantity of teaching a teacher delivers and, as a result, the depth of the mathematics evident in a lesson. Teachers with a lot of SMK, for example, could include more of their knowledge into their education – for example, in terms of linking topics or describing multiple methodologies – resulting in rich instruction. More study is needed to back up this assertion, and teachers must strike a balance in their use of mathematical quality for teaching dimensions in their classes. As a result, focus should be devoted in teacher training to how student teachers might supplement their courses in a comprehensible way, such as by utilizing models to explain fractions to their pupils. In addition, student teachers must learn how to fully engage their pupils in mathematics sessions (Stafylidou and Vosniadou 2004).

2.4 Strategies in Teaching Fractions

Many students struggle with fractions, which they must master before moving on to higher-level math (Spangler, 2011). "Effective Mathematics teaching requires understanding what students know and need to learn, then challenging and supporting them to learn it well" (NCTM, 2000, p. 16). David B. Spangler, a veteran educator, describes effective error analysis diagnostic methods that identify specific student misconceptions and provide specific intervention strategies and activities for each error. Reproducibles for diagnostic tests, Practice pages for exercises keyed to the diagnostic tests and error patterns, Pages for practicing alternative algorithms and estimating, and Teacher resources for hands-on activities, game sheets and pieces, and more are included in the practical materials (Spangler, 2011).

Teaching style is an important part of fraction lessons. Teachers, according to Fotoples (2000), must be aware that pupils learn in diverse ways. Students can arrive at the same answer in a variety of ways. One of the most difficult aspects of teaching fractions is convincing students that fractions are made up of whole numbers. Manipulatives help to mediate these various learning needs (Spangler, 2011). Cooperative learning strategies have been shown to be quite effective in the classroom, according to Kewley (2001), although data indicate that cooperative. Students should comprehend that because fractions are constructed on whole numbers, they can convert fraction values into various comparable representations of the same number, according to CORE (2022). Any quantity can be represented in a variety of ways in mathematics, and this is an important concept for students to grasp as they progress through middle school, high school, and even college mathematics. When multiplying fractions, the result may not always appear as expected; this is an area where employing tangible visual representations when teaching fractions can assist a student relate to the idea that numbers can have various equal representations and can be represented in many different ways. Effective fractions instruction will help students grasp fundamental maths concepts that they will use throughout their schooling.

A good strategy to introduce fractions is to connect to prior knowledge. In this strategy, you explain that we use fractions throughout our day, sometimes without realizing it! For example, ask students to think about dividing up a cake to understand what a fraction means (Study, 2022). There's one cake. We cut that cake into pieces or parts. We can describe how big our piece of cake is in relationship to the whole cake using a fraction. The fraction tells how many pieces we have out of all the pieces in the whole cake. In fractions, the pieces are usually the same size or cut into equal parts. This gives us an idea of how big our piece of cake is (Study, 2022).

The fraction's denominator, or bottom number, indicates how many total equal pieces there are. The denominator, for example, would be 5 if the cake was split into 5 pieces. We must decide how many pieces of cake to distribute after we have sliced up the cake. The numerator, or top half of the percentage, would be the number of pieces we want to distribute. If we give out two pieces of cake, for example, our fraction is 2/5 since we only gave out two of the five available pieces of cake (Study, 2022).

Another technique to introduce fractions is to jot and share (Study, 2022) where students will write the fraction and ask them where they see the fraction because students have likely had experiences with fractions in their daily lives. Some students may have seen fractions on measuring cups or on a measuring tape. If they haven't, they'll hear about their peers' experiences and/or teachers create a hands-on experience later in the lesson.

Elementary students are naturally concerned with fairness and getting the same size, or equal size, of a treat. This is an excellent place to start (Study, 2022). Break a piece of food or candy into two unequal (one large, one small) pieces. Hershey candy bars work well but you can use any food that is easily broken into pieces of the same size then ask if it is a fair share and how to know why it's fair? " Teacher must make sure to not answer their own question instead accept and record what students say. Let some of the students try to break the item into a fair share while the others watch. Ask, "Do you agree that it is fair? How do we know it's fair now?" (It has to be the same size.) Lastly, directly explain and write that "fair" or "same" means "equal." A fair share is an equal part or a piece that is the same size as the others. If you have a fraction of a cake, you have an equal part of the cake. The numbers in the fraction tell how big your piece is and how many other pieces of cake are on the plate.

Using Literature

Another technique to introduce fractions is to use children's literature. There are many children's books that explore the concept of fractions. Students can choose which books they'd like to read with you. You can read one or all of the books with your students (Study, 2022).

Make it Fair

The use of hands-on materials is a good way to teach fractions. Food, especially candy, is fun to use while exploring fractions. Make sure the food can easily be broken into equal or same size pieces. You can also use food that is already broken into equal pieces (M&M, Hershey kisses, beans, noodles, cereal, etc.).

Use pattern blocks to explore fractions or make a shape is another strategy in teaching fraction (Study, 2022). One way to do this is to play the game, *Make a Shape strategy allows students to use equal parts* (all triangles or all trapezoids) to make a larger shape. In addition, students can look at fraction strips and physically cut them apart and put them back together.

2.4 Implementation of Gamification in Teaching Fractions

Gamification is a hot topic in a variety of fields, including education, psychology, game theory and design, human-computer interaction, digital information systems, business, and medical science (Mora et al., 2017). Teachers have been using games and gaming tactics since the dawn of time. Play is how humans and non-humans alike gain basic information and survival skills (Seaborn & Fels, 2015). Through role-playing and game-based activities, children develop social skills, foundational knowledge, and conceptual techniques. People's competitive natures have also been formed by societal conditioning, such as announcing the first-born baby in January of each year, sporting competitions, the top schools, and neighborhoods, to name a few examples (Seaborn & Fels, 2015). Collectively, every facet of Western society has been gamified from Electoral College's votes to law and order.

Properties of an interactive system that uses game mechanics and aspects to encourage and engage users in non-game scenarios (Seaborn & Fels, 2015). Gamification, according to Gerber (2014), is "the use of game mechanics and ideas to engage audiences and solve problems" (p. 45). Gamification features can induce "feel-good physiological reactions, modify human responses to stimuli-increasing reaction times, and boost learning, engagement, and motivation in particular scenarios" (Anderson & Rainie, 2012, p.1). While gaming or full-fledged games are immersive environments most often engulfed in a fantasy setting with the sole purpose of entertaining, gamification incorporates game mechanics such as levels, badges, points, leaderboards, and rules to invoke the physiology and behavioral impulse similar to a full-fledged game to perform serious actions (Gerber, 2014).

Because of rising initiatives to drive academic rigor, declining finances, and a shortage of instructional designers to implement gamification, education has been sluggish to adopt the concept of using gaming and gamification to offer instruction (Bruder, 2014). However, gamification has been a "trending notion in online courses" in the previous 15 years, and gamification usage has expanded as online learning technology have improved (Sturges et al., 2015, p. 23). With aspects such as levels, badges, accolades, and points, as well as the ability to personalize learning, incorporating game mechanics into instruction can encourage and engage disenfranchised learners and fire cognition (Cohen, 2011). Given the benefits of gamification, Cohen (2011) suggests that math and science are more gamifiable than other curriculum areas, such as essay-based tasks in English Language Arts (ELA). Georgia recently launched a gamified assessment program with first and second graders ("How Digital Games Take the Stress Out of Formative Tests," 2019), in which the student was at the heart of design and implementation, a crucial component in the development process. The students were initially unaware that they were being assessed, yet they were able to interact with the experience while simultaneously demonstrating mastery in the ideas. The student was also at the focus of the present study's design and implementation of

Fractionville, an eLearning arithmetic program. The main author (the school's Assistant Principal) created the Fractionville math software to interest and motivate third-grade children to study fractions, which has been a difficult task for teachers and students at this urban elementary school.

Buljan M. claims that Gamification is the process of incorporating game aspects into non-game contexts (2021). It has numerous advantages over traditional teaching methods, including: Increasing learner motivation levels, Improving knowledge retention and Better learner engagement through social mechanisms like badges, points, or leaderboards.

Technology is a natural driving force behind learning and curriculum development in our modern environment. Today's educators are progressively using cutting-edge digital technologies and strategies into their teaching methods in order to gain better results from students. One of these tactics, gamification for learning, is becoming increasingly popular among teachers around the world. The use of gamified components can improve student engagement and teamwork, helping students to learn more effectively (Buljan, 2021).

Gamification is the use of game tactics to improve and make learning more engaging for individuals because games build lifelong skills such as problem-solving, critical thinking, social awareness, teamwork, and collaboration, gamification for learning can be useful. Games also motivate individuals, which boost interest in certain disciplines, minimize attrition among students, improve grades, and improve cognitive capacities (Buljan, 2021).

Gamification vs. Games

Games are integrated into the learning process in game-based learning. It's a teaching style in which students gain certain skills or knowledge through playing a game. This method of instruction turns educational knowledge into a game that students can play. Gamification, on the other hand, solely employs game aspects in non-game contexts to improve material understanding and information retention. Although the primary goal remains to increase student engagement, gamification does not always try to teach them something new (Buljan, 2021). Gamification can help students learn more effectively in a variety of settings, including academic, industrial, and business settings. We'll look at a few of the most practical approaches to gamify learning in this part (Buljan, 2021).

Gamification in Education

Buljan (2021) cites numerous excellent examples of gamification in education that can assist you in developing your own gamified teaching technique. But, before we get into specific instances, let's take a look at some game features to consider in a classroom situation: Narrative, Immediate feedback, Fun, “Scaffolded learning” with challenges that increase, Progress indicators (e.g., points, badges, leaderboards), Social connection, and Player control. Using technology in this manner helps increase student engagement and motivation, which are both essential for supporting effective learning (Buljan, 2021). Some examples could be the following: Khan Academy is a non-profit Next-Generation education organization that offers students 100% free online schooling. It frequently uses gamification techniques to aid in the evaluation of progress and successes, as well as to allow students to compete via badges, leaderboards, and other means (Buljan, 2021). Quizlet is a newly popular tool that uses gamification to create simple, effective study material quizzes. Quizlet users study more effectively and with greater engagement than students who utilize traditional flash-card methods (Buljan, 2021). Duolingo is a learning software that uses gamification. It is a platform where users can practice and play languages. To keep engaged in the learning process, learners can earn points, level up, and compete with others (Buljan, 2021).

Kahoot! is an educational game-based learning platform that teachers can utilize in the classroom, yet it incorporates several gamification-inspired game aspects. It contains a "ghost mode" where students can challenge themselves to beat their previous scores, as well as leaderboards where students can compete against one another. Anybody design their own games and quizzes, which they then share with other teachers, students, or users who want to play them at any time during the day (Buljan, 2021).

Gamification in education is well-exemplified by the Google Read-Along app. It incorporates gamified elements like as points and badges to help young learners who are just getting started with books improve their reading experience. This can be utilized in both primary and secondary schools, especially to encourage pupils to work toward literacy goals and improve their overall reading abilities (Buljan, 2021).

The Internet has provided an outlet for information collecting, data exchange, and gaming experiences at amazing speeds since its creation in 1994. New educational pursuits, such as online learning and gamification, have been made possible by the Internet (Anderson & Rainie, 2012). This has resulted in the growth of educational technology innovation, as well as the acceptance of online learning as a significant competitor to traditional education (Erenli, 2013). The "nationalization" of 21st-century education has heightened the need for K-12 institutions to think "digitally" about student learning and academic success, thanks to the Common Core Standards and online examinations. This is especially true in light of the current pandemic scenario and the discussion over online schooling for K-12 pupils.

Because of the widespread acceptance of online learning, new approaches to bring technology into the classroom have emerged. Incorporating gaming into training and learning is one such method. Online learning, when combined with gamification mechanisms, has evolved into a multi-faceted complex platform that is based on student academic accomplishment, instructional design, and game mechanics. The term "gamification" has become popular in recent years to describe interactive online design that taps into people's competitive instincts and frequently employs the use of rewards to motivate action–these elements include virtual rewards such as points, payments, badges, discounts, and gifts; and status indicators such as friend counts, retweets, leaderboards, achievement data, progress bars, and the ability to progress to the next level (Anderson & Rainie, 2012; Nac, 2012). There have been numerous research studies on the gamification of instruction regarding post-secondary, professional institutions and industries; however, few research studies have been conducted to apply the principles of gamification in an eLearning environment on an elementary level (Anderson & Rainie, 2012). Despite this fact, training through gamification is an evident reality in primary education (Marín et al., 2015).

The competitive modern era emphasizes the value of mathematics in almost every part of one's life, including tests, higher education, and public life. Youngsters, however, sometimes struggle to grasp even the most fundamental concepts due to their fear of arithmetic, and another reality is that, thanks to technological advancements, children now spend more time on their cellphones than reading books. It can be put to good use by developing applications that teach mathematical concepts in a fun way. This would not only assist the children in learning, but also in overcoming their fear of mathematics (Singh & Pathania, 2022). As a result of the introduction of new technology, new areas for dealing with diverse difficulties have evolved. Gamification is one of the most promising fields. Gamification is the use of game-like environments (game mechanics) to raise motivation for learning and problem solving, and it has aroused a lot of attention in educational circles because of its ability to improve the learning process among students. In the future, gamification is likely to supersede traditional learning methods, posing issues such as scalability and learning module upgrades (Hakak et al, 2019).

Examining the impact of fraction gamification on lower-performing third-grade pupils' mastery of fraction abilities revealed that the lowest-performing kids gained the most from this eLearning math program. It's even more important and gratifying to observe that gamification assisted children in the Low-RTI class who were identified as having special needs, as these students typically fail to understand this hard mathematical subject. These findings are consistent with the literature, which suggests that students who engage in a gamified learning experience perform better academically and are more engaged (Light & Pierson, 2014). Gamification also encourages students to be active learners by providing opportunities for problem solving, decision-making, and inquiry (Arnab et al., 2012).

Buttons in Games

A button is a key component of the user interface that has a significant impact on how you design interactions. Users can be forced to convert or do an action by using buttons. In order to maintain communication between the user and the product, buttons act as a mediator between the two parties (Justinmind, 2022).

Basic guidelines for button design were provided by Justinmind (2022). Make it appear clickable first. Every time a user interacts with a product, they have to figure out what each interface piece means and how it works. Similar to all other parts, you don't want consumers to have to spend much time understanding and decoding any of the elements they encounter because the longer it takes them, the poorer your usability is.

Second, make it simple to locate and anticipate. Users have expectations about where buttons should be placed on a given screen, much as we are all accustomed to a particular kind of button design in terms of shapes. When we open a webpage, we anticipate finding the button right away; no user has ever enjoyed searching for a button to press.

Tell consumers what each button performs in step three. Keep them from speculating. Never take somebody at their word when they say that microcopy isn't significant. Even while a writer would argue that each word is important in conveying a message, that doesn't make it any less true. Without the appropriate microcopy to go with it, your button design would fall short. Have buttons that users can really click on.

Size matters, fourth. Choosing the exact size of each button is another aspect of button design. Even while it looks like a minor element, it is anything but insignificant. For mobile designs, the button size is especially crucial. Making a button too huge will result in a visually stimulating screen, while making a button too small will prevent a typical finger from being able to click on it. Most fingertips are 8–10mm wide, according to a 2003 study by MIT's Touch Lab.

Fifth, don't make every action a button. It may seem like a smart idea to provide users access to every feature on a single screen, but that's a trap. People seem to desire to have all the options at their disposal, but in truth, we don't value the onslaught of choices that must be made. Giving consumers too many alternatives will cause them to freeze and feel overwhelmed, as seen in both the paradox of choice and Hick's law.

Sixth, always give feedback to avoid angering users. The machine, unlike a real person, won't provide feedback unless you ask for it to. In a real-world conversation, people's body language constantly indicates whether they are paying attention and comprehending what we are saying. This makes conversing lot simpler, which is what customers do when they use your product. It resembles a dialogue between a person and computer software (Justinmind, 2022).

There are five guidelines to follow when selecting the appropriate phrases for button labels according to UX Movement (2019). Use action verbs as your first rule since button labels should motivate users to act. Users are aware of what the button will accomplish when they read an action verb. Without reading any accompanying language, such as a confirmation window, they can act. Rule 2 is to speak clearly. You have a particular connotation for each action verb you utilize. Users may misinterpret what the button will perform if your language is imprecise. Use task-specific language is rule three. Users become uncertain when a button's label is ambiguous and generic. Because the label is vague, they are unsure of what the button will do. Users require feedback on their activities, and task-specific language is the only language that can provide this. Use the active imperative form according to Rule 4. A button label with too many words encourages readers to read more. Reduce the number of words and make the button label easier to scan by using the imperative form in the active voice. Verb tenses become commands when expressed in the active imperative form. With this form, you can omit the topic and extraneous articles to create a button label that is shorter. All you need to include on your button label is a verb with an adverb or direct object. Rule 5 states to capitalize in the sentence-style. Your button label's capitalization scheme conveys your tone to users. Not what you say but how you say it sets the tone. Users' emotional responses to this statement can engage or repel them.

3. METHODOLOGY

3.1 Research Design

The research design used in this study was a pure research design. According to Famunyam (2020), pure research is driven by a desire to learn more and acquire knowledge solely, for the fundamental goal of this research method is to collect data to increase understanding.

3.2 Research Procedure

From the conception of the study, extensive search and collection of the relevant studies and literatures about students' performance in mathematics and learning fraction, teaching fractions in primary education, difficulties encountered in teaching fractions, strategies in teaching fractions, implementation of gamification in teaching fractions and buttons in games were done. From the collected literatures, extensive reading and understanding were done to formulate basic concepts needed for the study. The researcher arrived at the study "A Gamified Approach for Learning the Concept of Mathematical Fraction" by Singh & Pathania (2022), which helped formulate the general idea for the tool. To ensure compliance, personal consultations were done with teachers who have experienced teaching mathematics subjects to validate Singh & Pathania's claim about how to teach mathematics. Other related concepts essential to the study are also provided. Moreover, basic concepts and related studies were then collected and presented in the review of related literature. Afterward, the researcher underwent validation of the tool developed through intensive checking by a Master Teacher in Mathematics. Finally, the researcher created and discussed steps on how to manipulate the tool.

4. RESULTS AND DISCUSSION

The following are the thorough explanation of how to manipulate the supplemental tool FRACZONES made by the researcher.

The teacher can use FRACZONES as a supplemental tool developed by the researcher as a support material for teaching four fundamental operations involving fractions. The tool has three main parts, namely: LEARN, PRACTICE and PLAY. The teacher can use LEARN for lecturing purposes, PRACTICE for initial testing of the knowledge learned by the pupils during the lecture, and PLAY if the pupils are ready for an activity or game based on the topic, which is the four fundamental operations involving fractions.

Objectives

At the end of the lesson, the pupils will be able to:

- Learn addition of fractions (M5NS-If-87.2)
- Learn subtraction of fractions (M5NS-If-87.2)
- Learn multiplication of fractions (M5NS-Ig-89)
- Learn division of fractions (M5NS-Ii-95)

4.1 Fraczones Main Page

FRACZONES MAIN PAGE

(Below is the picture of the main page)

Figure 1. Main Page of FRACZONES

This will be the first page that users will see if they open the tool. There are three (3) clickable buttons on this page, namely: LEARN, PRACTICE and PLAY. Users can open this tool using a laptop or a cellphone. According to Justinmind (2022), the button must look clickable, and UX Movement (2019) mentioned using action verbs in buttons because button labels with action verbs inspire users to act.

4.2 Learn Button **LEARN BUTTON**

(Below is the main page of LEARN Button)

Figure 2. Main Page of LEARN Button

This will be the next one that will appear if the teacher clickss the “LEARN" button. The teacher can use this for lecturing purposes. The button located in the upper left is "HOME". if the teacher clickss that button, it will return automatically to the main page of FRACZONES. The same with the other proceeding slides; if the teacher clickss that button, the same thing will happen.

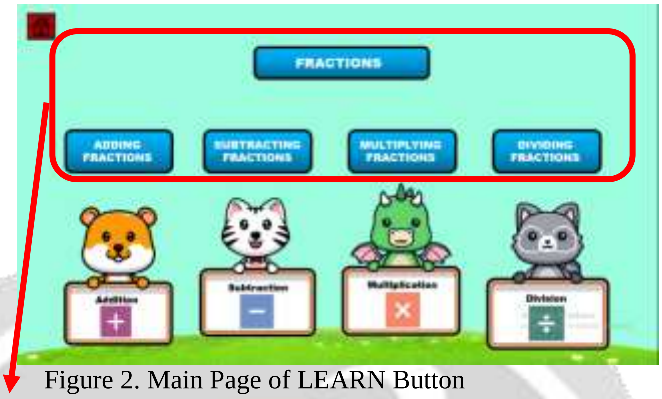

Figure 2. Main Page of LEARN Button

These five buttons contain different videos. The button "FRACTIONS” contains stories about fractions, what fractions are, parts of a fraction, and other examples about fractions. The button "ADDING FRACTIONS" includes a video on how to add fractions. The button “SUBTRACTING FRACTIONS” contains a video about how to subtract fractions. The button “MULTIPLYING FRACTIONS” contains a video about how to multiply fractions. The button “DIVIDING FRACTIONS” includes a video on how to divide fractions.

(Below is the picture of ADDING FRACTIONS)

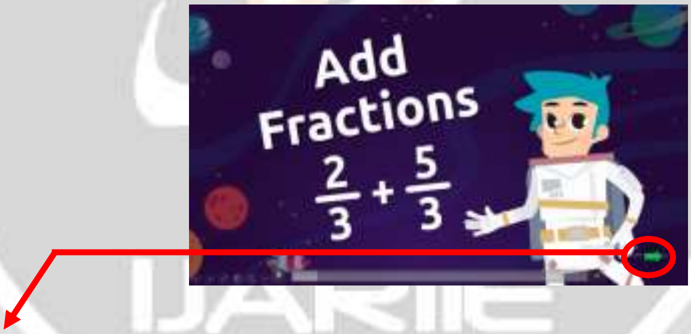

Figure 3. Picture from the video of ADDING FRACTIONS

Every video has a green arrow button on the lower part and right side of the screen. By clicking the button, it will return to slide No. 2. Example above is a video of “ADDING FRACTIONS”.

Figure 2. Main Page of LEARN Button

These four pictures contain visual presentations of the four fundamental operations involving fractions. Visual presentation is the use of visual aids such as visual multimedia to explain ideas about certain topics. It also refers to the actual delivery of information via a visible medium such as text or images. It is done to improve clarity or for better clarity and understanding of the idea or concept. The teacher can select and click the button “Addition” if they want to discuss adding fractions with common and different denominators, "Subtraction" if the teacher wants to discuss subtracting fractions with common and different denominators, and so with the other two buttons, which are the “Multiplication” and “Division”.

4.3 Example of Addition

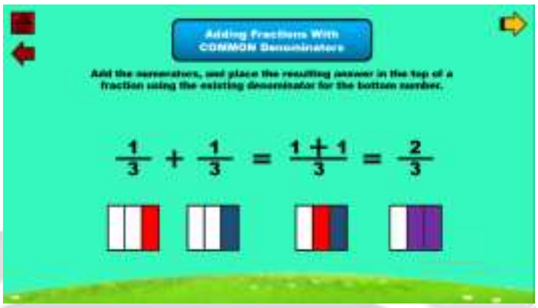

Figure 4. Adding Fractions with Common Denominators

This will be the one that will appear if the teacher will click “Addition”.

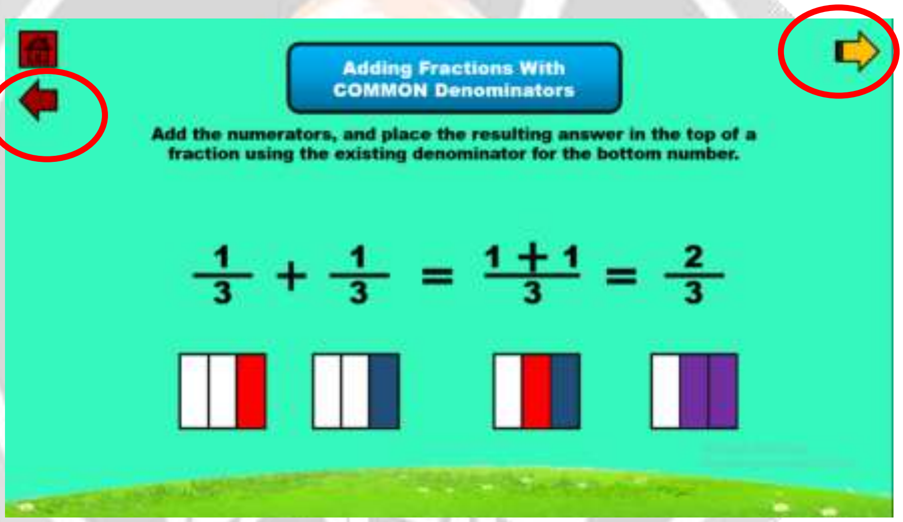

Figure 4. Adding Fractions with Common Denominators

if the teacher clickss the red arrow button on the upper left side, it will return to slide number 2, where the main menu of “LEARN” was found. The yellow arrow button in the upper right is the “Next Button" and when the teacher clicks it, it will move into the next slide where adding fractions with different denominators are found. The above picture is the slide when the teacher clicks the button “Addition”. It shows the visual presentation of how to add fractions with a common denominator.

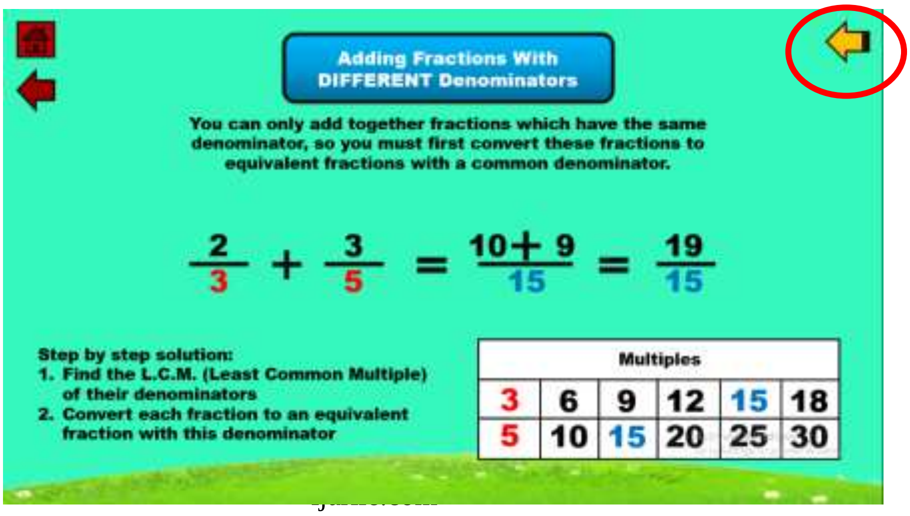

Figure 5. Adding Fractions with Different Denominators

The above slide shows a visual presentation of how to add fractions with different denominators. If the teacher wants to go back to the preview slide, they can click (Back Button) the yellow arrow button in the upper right of the screen facing the left side.

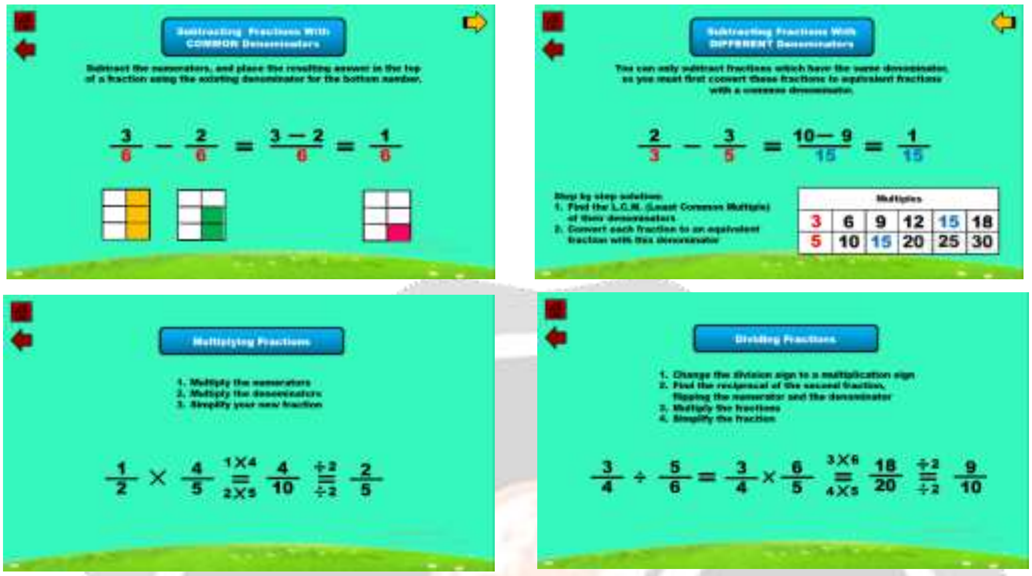

Figure 6. Subtracting, Multiplying and Dividing Fractions

The same procedure for the other operations, namely: Subtraction, Multiplication and Division.

4.4 Practice Button

(Below is the main page of PRACTICE Button)

Figure 7. Main Page of PRACTICE Button

This will be the slide that will appear if the teacher selects or clicks the PRACTICE button located from the first slide or Home. If the teacher is done lecturing and wants to try initial testing of the knowledge learned by the pupils based on discussion or in lecturing parts, they can proceed to PRACTICE or this slide. A teacher can select and click the button “Addition” if they want to test the knowledge of pupils about the addition of fractions, “Subtraction” if the teacher wants to test the knowledge of pupils about the subtraction of fractions, and so with the multiplication and division of fractions.

Example of Addition

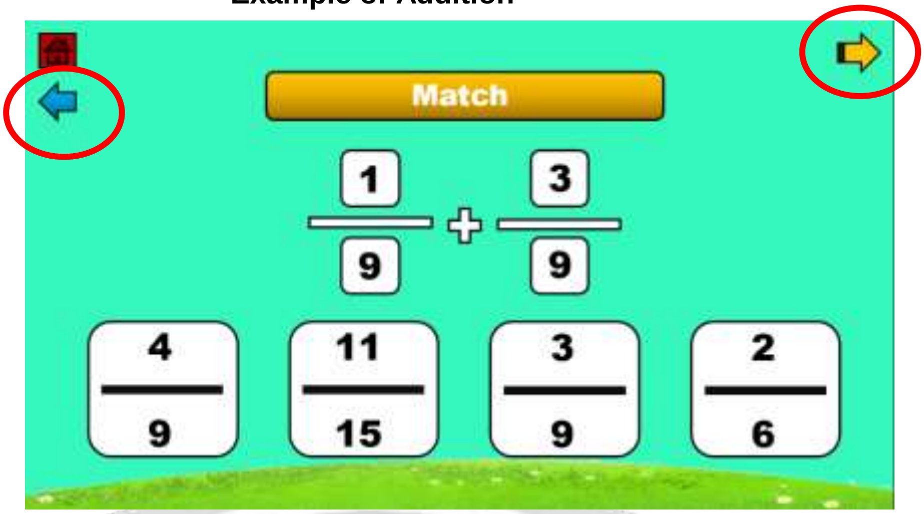

Figure 8. Picture of Addition in PRACTICE Button

This is the slide that will appear if the teacher clickss the button “Addition”. if the teacher clickss the blue arrow button on the upper left side, the slide will go back to the main menu of PRACTICE. Also, if the teacher clickss the yellow arrow button on the upper right side, the slide will move to the next slide, where there is another example of the addition of fractions. All arrow buttons that are located on the upper left side of the screen that are also facing to the left are called “Main Menu Button”. All arrow buttons on the upper right side of the screen facing to the right are called “Next Button”.

In this slide, a pupil can choose their answer from the four boxes or choices below based on the given addition of fractions. If the teacher or a pupil clicks the box which has the correct answer, a green check (ü) mark or symbol will appear inside the box with the correct sound effect, and if the teacher or a pupil clicks the box which has the wrong answer, a red X mark or symbol also will appear inside the box with wrong buzzer sound effect.

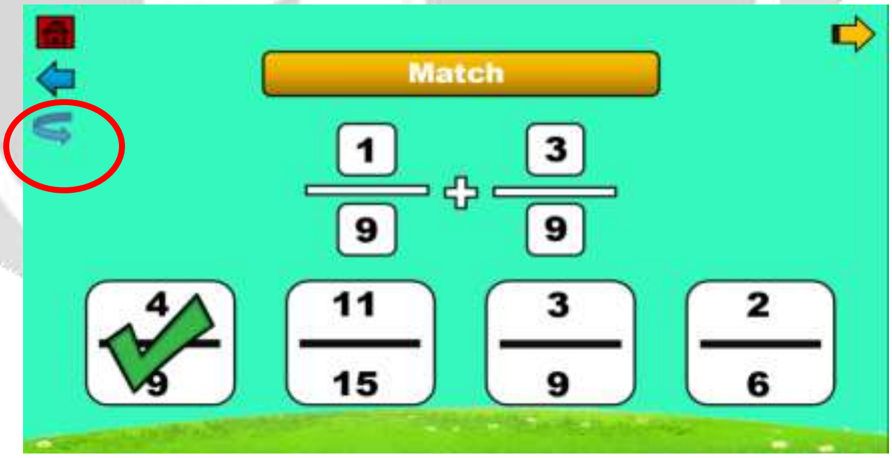

Figure 9. Addition in PRACTICE Button with Correct Answer

This will be the slide that will appear if the teacher or a pupil clicks the box with the correct answer. The blue curved right arrow on the upper left side is the “Refresh Button”. If the teacher wants to remove the check (ü) or (X) symbol, they need to click the refresh button.

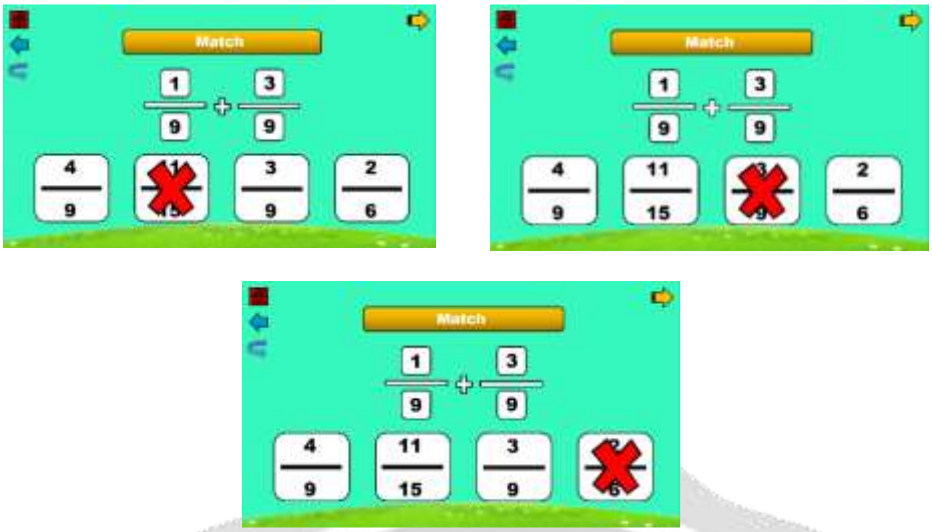

Figure 10. Addition in PRACTICE Button with Wrong Answer

Pictures above are the slides that will possibly appear if the teacher or pupil clicks the wrong answer. The following buttons in the main menu of PRACTICE namely "Subtraction, Multiplication and Division" have the same procedure with "Addition" presented above.

4.5 Play Button

(Below is the main page of PLAY Button)

Figure 11. Main Page of PLAY Button (SPACE RACE)

This will be the slide that will appear if the teacher selects or clicks the PLAY button located from the first slide or Home. The name of the game is "SPACE RACE". Two groups will be competing to reach the finish line.

4.6 How the game works?

SPACE RACE has three (3) different concepts. The first one is called "ADD, SUBTRACT, MULTIPLY & DIVIDE," where the users must solve whether it is an addition, subtraction, multiplication, or division of fractions. The second one is called "GUESS WHAT IT IS!" where the users must guess and write what fraction is being shown based on the given real-life pictures of different foods. The third one is called "FILL ME IN!," where the only thing that users need to do in this game is to draw and shade or fill in the shape with color based on what fraction is being asked.

Unlike the common concept of the game that usually happens inside the classroom when there is a contest, SPACE RACE is unique. The teacher will divide the class into two groups based on the game. Each group will be competing to reach the finish line using the rocket ship, and of course, the rocket will move upward if the group gets the correct answer. The game that usually happens inside the classroom is that if the first group gets the correct answer and the second group gets the wrong answer, the first group will automatically be given a point or points, and the teacher will proceed to the next question. In the SPACE RACE, there is balance because the group who got the wrong answer will be given another chance until they come up with the correct answer, but in the last questions or item, there will be no more chance, so there will be a winner; hence the game is still competitive.

Figure 12. Slide After Clicking One of any Game

This will be the slide that will appear if the teacher clicks the first game called “ADD, SUBTRACT, MULTIPLY & DIVIDE”. The pupils or the group will select the color of their rocket ship. For example, group 1 will be the Blue Rocket Ship and group 2 will be the Red Rocket Ship. The teacher will provide clean blank paper and a marker for each group. The teacher will then ask the pupils if they are ready for the game, and if the pupils are ready, the teacher can start the game by clicking the words “ARE YOU READY?”

Game 1

(Below is an example picture of Game 1)

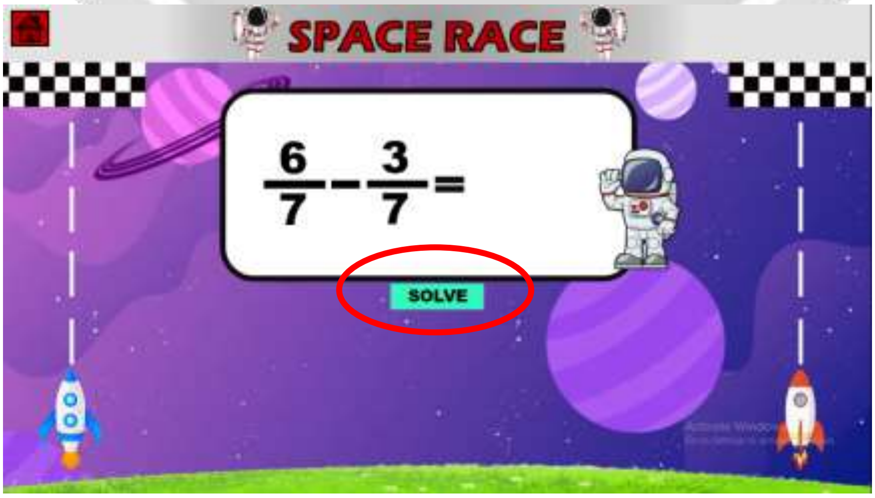

Figure 13. Space Race Game 1

This will be the one that will appear if the teacher clicks the words “ARE YOU READY?" If both groups are done answering and all got the correct answer, the teacher can click the “SOLVE” button to reveal or show the answer.

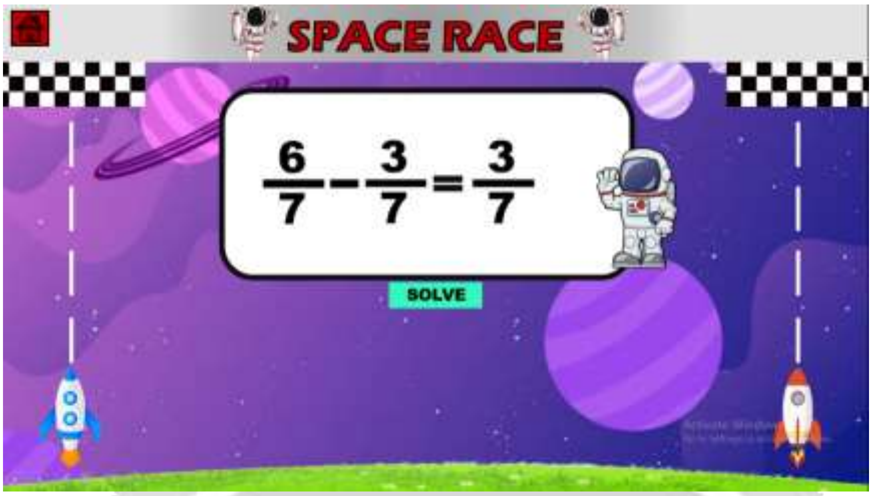

Figure 14. Picture of Subtracting Fractions with Answer

This next slide will appear after clicking the “SOLVE” button. The teacher can now click the rocket ships prioritizing the group who got the correct answer first.

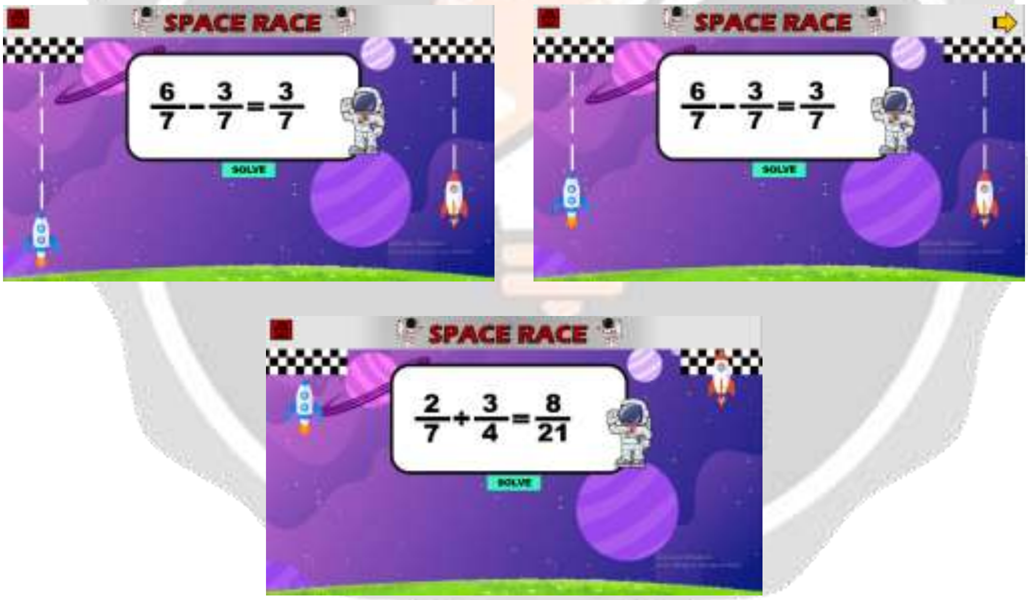

Figure 15. Pictures of Subtracting and Adding Fractions with Answer

In the same procedure with the slides above, the teacher will need to click the "Next Button" located on the upper right side to continue the slides.

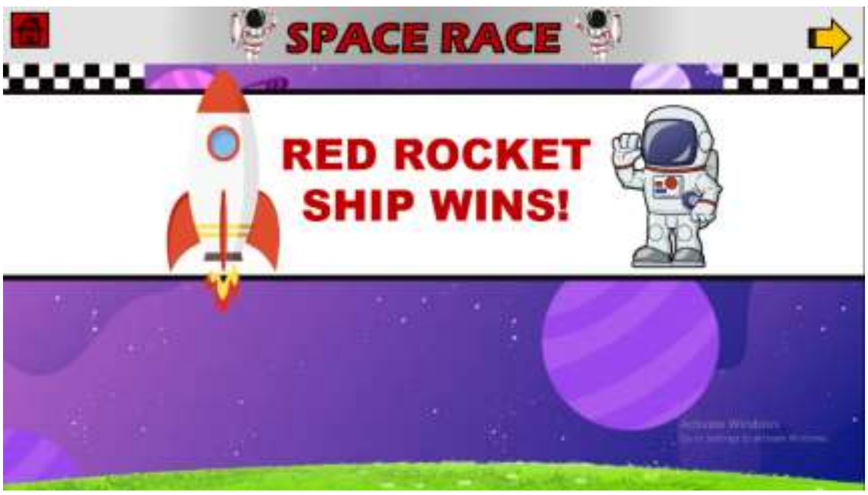

Figure 16. Red Rocket Ship Wins

Assuming that the Group 2 is the winner. This will be the slide that will appear after the game, and the winner is the Red Rocket Ship. The same procedure if the teacher clicks the "Next Button". There will be another set of questions involving four fundamental operations of fractions.

Game 2

(Below are example pictures of Game 2)

Figure 17. Space Race Game 2

The above pictures are the slides from another concept of the game SPACE RACE called "GUESS WHAT IT IS!" In this game, the pupils must guess and write what fraction is being shown based on the given real-life pictures of different foods; the same procedure from the previews on how to manipulate this game. The only difference in showing or revealing the answer is by clicking the picture and/or images of foods. The teacher will also provide blank paper or bond paper and a marker for each group. The concept of competition is the same as the previews game.

Game 3

(Below is an example picture of Game 3)

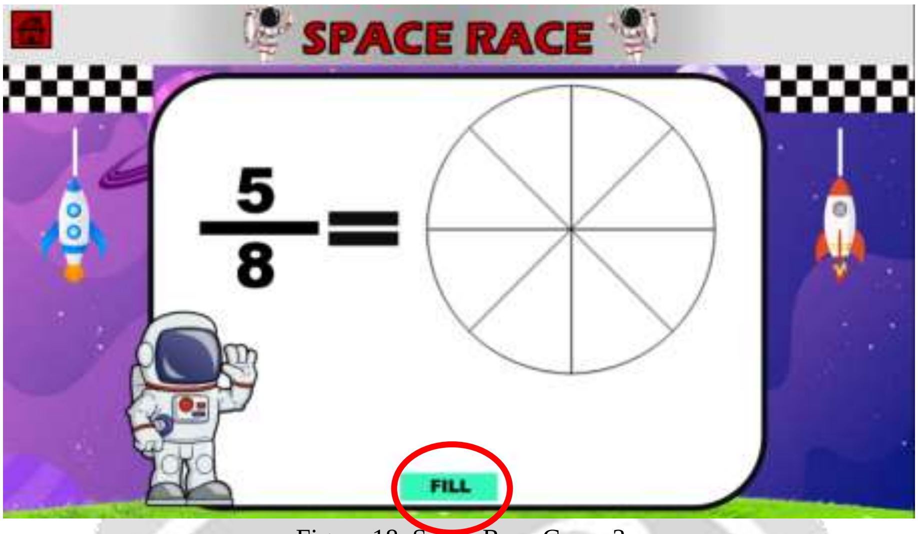

Figure 18. Space Race Game 3

If the teacher clicks the other game concept called "FILL ME IN!" this is an example of what will appear. The only thing that students need to do in this game is to draw and shade or fill in the shape with a color based on the fraction being asked. The teacher will provide all the materials needed for the game. The teacher will click the “FILL” button to show the answer.

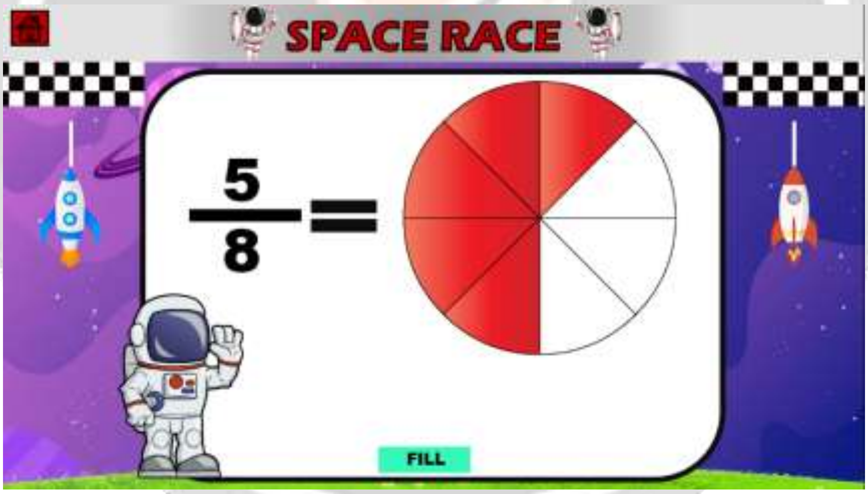

Figure 19. First Item in Game 3 with Answer

After clicking the “FILL” button, this will be the next slide that will appear. All three (3) different concepts of the game SPACE RACE have the same procedures and ways to manipulate.

5. CONCLUSION

This research focused on developing a supplemental tool for teaching fractions. It is anchored on Constructivist Theory, a theory based on observation and scientific study about how people learn. Constructivist Theory is based on the fundamental assumption that a learner actively seeks new information and is actively engaged in the process in the way they gain, assimilate, and utilize knowledge (Bruner, 1960). This study is pure research, and it was conducted in April and May 2022.

The tool named **FRACZONES** was made by the researcher that can be used and or manipulated by the teacher as supplement material for teaching four fundamental operations involving fractions. Users can open the tool on laptops and cellphones. The pupils can also use this if they want to learn on their own after the discussions. This supplemental tool is made to make teaching and learning more fun and engaging. The researcher used PPT or PowerPoint Presentation to develop the said tool.

Here are the procedures for developing the supplemental tool. First, the researcher reads some articles related to strategies for teaching fractions and using supplemental tools in teaching fractions. Second, the researcher developed a supplemental tool for teaching fractions called **FRACZONES**. Third, the researcher went to a Master Teacher in mathematics to check the validity and reliability of the supplemental tool. The following are the feedbacks according to the Master Teacher:

1. There should be game mechanics or instructions before playing the game.
2. The teacher should first present the game mechanics or instructions on how the game will work for the pupils who play it.
3. There should be another game concept aside from what is already presented to make it differentiated instruction. Differentiated instruction is the process of personalizing classes to match each student's interests, needs, and strengths.

This research also discusses the parts of the supplemental tool, how the supplemental tool works and how the teachers and students manipulate the tool. Lastly, the researcher improves the supplemental tool based on the feedback of the Master Teacher.

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