IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 9, September 2024

DOI: 10.17148/IARJSET.2024.11913

Support Tool for Fractions Concepts in Basic Education

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Abstract*:* Mathematics in basic education contributes to the development of critical and reflective thinking that allows students to make a hypothesis before solving a mathematical enigma, as well as to pose and solve challenges using procedures for their solution. Considering that technology has impacted the education of children and adolescents, providing online educational resources, learning platforms and interactive tools, the work presented here aims to develop an educational software to provide a tool for students in the area of fractions. As a result, it was developed in the Visual Basic programming language the Fractions and Conquest software, which provides an interactive learning environment where students can practice and reinforce their knowledge about fractions through playful activities. During the tests conducted on the software, users expressed their satisfaction with its ease of use, as well as indicated that it is very useful for understanding concepts related to fractions. In conclusion, it can be said that it is important to have this type of educational software because it helps the teaching-learning process in the search for the understanding of topics that some students consider abstract, such as fractions. It is intended in the medium term to implement additional features to the software, such as a system to track student progress and personalized evaluation modules, making the learning process more attractive and motivating.

Keywords: educational software, fractions, basic education, mathematics**.**

I. INTRODUCTION

Mathematics education at the basic level (elementary school, and lower secondary or middle school) in Mexico has several challenges pending to be overcome. In 2022, in the evaluation of academic competences of the Program for International Student Assessment (PISA), that evaluates with international parameters the average performance of students in the areas of mathematics, science and reading, Mexico showed worse results than in the previous edition of 2018, and also had a lower performance than similar economies.

In results of this test, it was found that 66% of the students who took the test registered low performance in mathematics, 51% in science and 47% in the reading comprehension part. It is important to note that the COVID-19 pandemic affected these results [1-2], however, it is not the only cause; it must be recognized that mathematical literacy in basic school has historically presented severe weaknesses and unfortunately many of these have to do with the performance of teachers in the area [3].

According to [4], 2 out of 3 students who took the test cannot represent simple operations mathematically. In view of this, given the importance, it should be considered that mathematical thinking is indispensable to develop other skills such as creative, critical and systemic thinking; in addition to that, it helps us with the mastery of the use of information and generates research skills, among others. Thinking mathematically goes beyond just solving simple problems, mathematical thinking allows us to decompose problems, find patterns, abstract important information, among others; it is a skill that is developed since childhood [4-5].

Taking these approaches into account, attempts to provide support and accompaniment to students in the various topics that mathematics includes cannot be overlooked. With this in mind, the objective of this research was the development of an educational software with the idea of providing a tool that helps students in the area of fractions.

According to [6], students present difficulties when they deal with fractions through traditional teaching, which hinders the deep understanding of concepts; teachers teach in a mechanical way, focusing on the resolution of exercises and consequently students often memorize these processes, and can solve the exercises with them, but do not come to understand them enough to later be able to solve similar types of problems. A new approach is needed where students do not do things mechanically but because they have already understood them.

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From the above is that the proposal presented consisted in the creation of an educational software, the use of technology breaks the traditional scheme of education and supports both the teacher and the student. The use of educational software according to the needs of students can generate a precise knowledge in them, and it is observed that students are more concentrated, generating a more dynamic and attractive learning for them, since leaving the traditional scheme has in impact on improving the teaching and learning process [7]. However, it is important not to lose sight of the fact that educational software can be a pedagogical tool to support the processes, but everything will depend on the way it is designed and used [8].

Learning fractions is a fundamental part of the mathematics curriculum in the early stages of education, as well as in the most diverse contexts of use in everyday life; in addition, they represent one of the first approximations that students have of more abstract mathematical concepts, and their understanding is essential to progress in more advanced topics of more specific areas such as algebra and arithmetic.

II. RELATED WORKS

In the literature review on the topic of interest, several papers were found, some of these are discussed in the following lines.

[9] describes an experiment performed studying fractions from two perspectives: pencil and paper, and with interactive resources. At the beginning an analysis of the difficulties presented by the students was performed, among which the following were found: fractions of discrete quantities, equivalence of fractions, and location of proper and improper fractions on a number line. After the experiment, it was reevaluated and it was determined that progress was made in equivalence of fractions, and in fractions of discrete quantities.

[10] mentions that fractions are one of the concepts that generate the greatest difficulties in the learning of students; it is worth mentioning that [9] also raises this fact as a problem, hence these authors present an extensive state of the art of this problem, which can be used as support for researchers interested in the area. On the other hand, [11] indicates that the main problem that afflicts students is the lack of conceptual understanding, that traditional teaching in the student of the 21st century is no longer sufficient.

[12] focuses on providing support to students in the topic of fractions through problem-based learning; students had to build their own didactic material to specifically understand the concepts related to homogeneous and heterogeneous fractions; the authors conclude that they achieved significant and collaborative learning that could be transferred to other problems related to fractions such as additions and subtractions of homogeneous and heterogeneous fractions.

ICT can be a valuable tool in educational processes, [13] mentions that from the teaching perspective, ICT is an important resource to improve teaching and learning processes in diverse contents.

III. FRACTIONS AND CONQUEST

This section describes the main aspects of the software created.

The software created is called Fractions and Conquest and was designed with the objective of addressing educational challenges in an interactive and engaging way. This software is aimed primarily at students of basic education (elementary and middle school) but can also be used by teachers as a didactic resource in the classroom.

The tool provides an interactive learning environment where students can practice and reinforce their knowledge about fractions through playful activities. Fractions are a fundamental concept that is used in numerous contexts, both academic and everyday. Figure 1 shows the main screen of the software.

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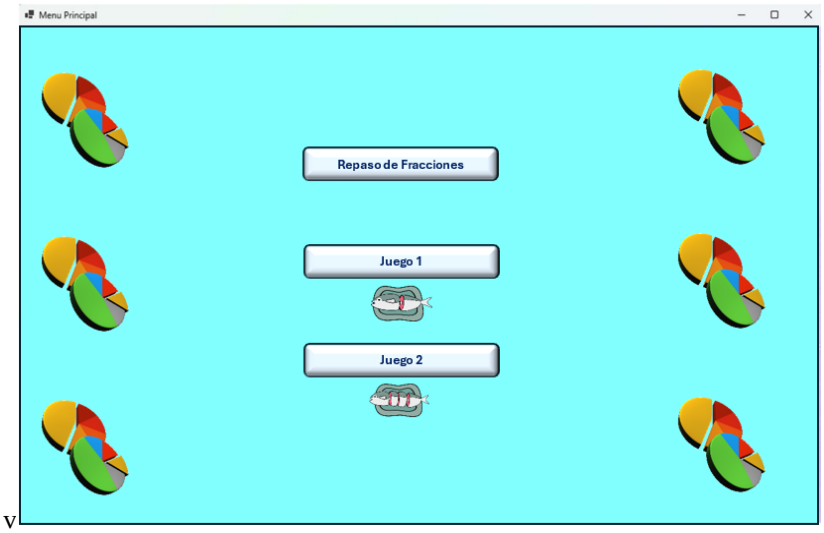

Fig. 1 Main screen "*Fractions and Conquest*".

When starting the software, a menu with three options is presented: "Repaso de fracciones" (Fractions review), "Juego 1" (Game 1), and "Juego 2" (Game 2). Each of them is described in the following paragraphs.

Fractions review: displays theoretical information about concepts related to fractions, including visual examples. Students can read and review the information to reinforce their knowledge. Figure 2 presents an example of this content.

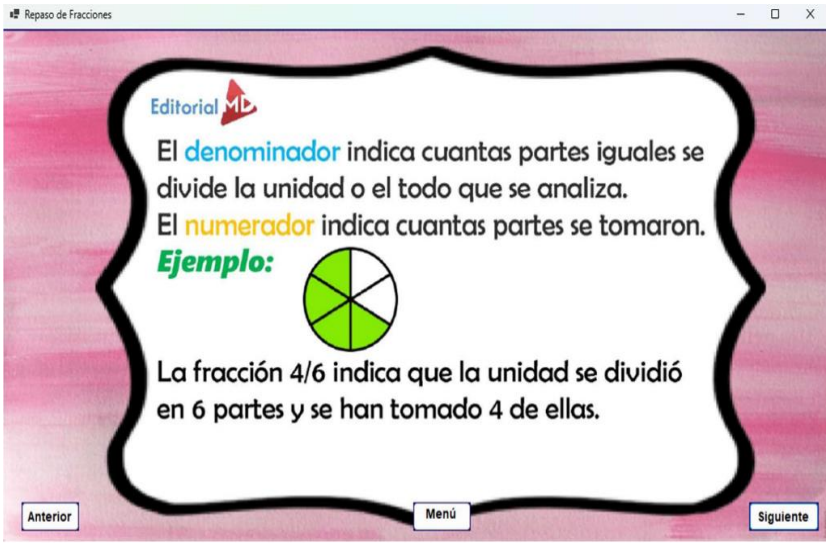

Fig. 2 *Fractions and Conquest:* Fractions Review.

Game 1 is about Fraction Identification. In this game students are presented with an image of a fraction and consequently they must enter the correct numbers in both the numerator and denominator spaces and then verify their answer. The images are displayed randomly to ensure variety and avoid repetition of the exercise. Figure 3 presents an example of this content.

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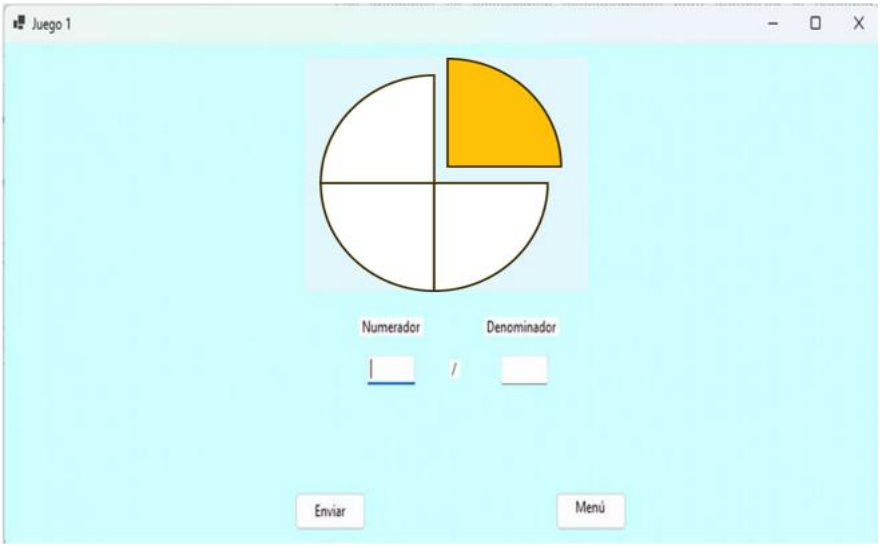

Fig. 3 *Fractions and Conquest:* Game 1.

Game 2 is about Fraction Selection. In this game students are presented with an image of a fraction accompanied by four possible answers options and consequently they must select the box that represents the correct option. The fractions and its answer options are displayed randomly to ensure variety and avoid repetition of the exercise. Figure 4 presents an example of this content.

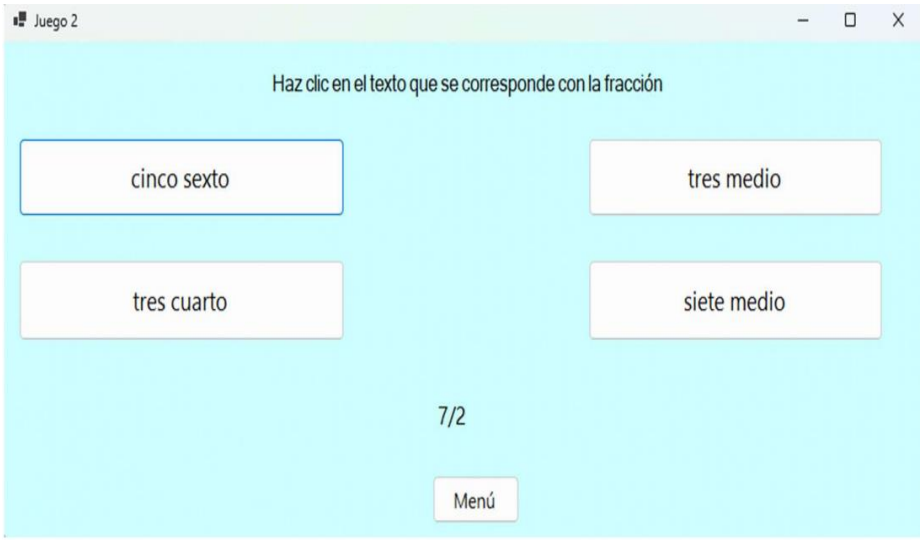

Fig. 4 *Fractions and Conquest:* Game 2.

The software presented here was developed in Visual Basic, and in early releases it was found that in terms of user interaction students found it very easy to use and quickly understood how to interact with it; in terms of satisfaction, the students rated the program as a useful and effective tool for understanding basic fraction concepts.

IV. CONCLUSIONS

Fractions and Conquest is an educational tool that can be used to support the teaching and learning process in basic education, specifically in the environment where the project was developed; it can be used by students to practice and by teachers to graphically show basic concepts of fractions.

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In the assessments conducted, participants indicated that the interactive games provide a fun way to practice, which helps students consolidate their knowledge effectively; on the side of the teachers, they valued the tool as a useful complement to traditional teaching methodologies. In terms of ease of use, the design is intuitive, and the user interface allowed students, even those with little experience in using educational software, to use the program without difficulty. The immediate feedback and visual presentation of concepts contributed significantly to the learning experience.

Regarding the impact on students, they were happy and participative with the use of the software; however, in order to effectively assess the impact on the performance of students, which is what it is intended to achieve, it should be evaluated after a longer period of use.

Fractions and Conquest has achieved its first objective, to develop an educational software with the idea of providing a tool for students in the area of fractions. By combining technology with education, enriching learning experiences are created that not only improve the insight of students, but also make the learning process more engaging and motivating. This project underscores the importance and potential of technology in education and establishes a solid foundation for future innovations in this field.

As future work, we can evaluate the performance of students who have used the software for a long period of time and compare it with those who have not used the software. Besides that, the software was designed to have flexibility of content, allowing for the addition of new features and levels of difficulty in the future, which opens the possibility of expanding the scope of the program to include more topics related to fractions, as well as other mathematical concepts. Furthermore, additional features can be implemented, such as a student progress tracking system and customized assessment modules.

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