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Original Article

The study of the facilities for virtual instruction of mathematics in Elementary school (A case study of mathsframe.co.uk)

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Abstract

The importance of mathematics is common knowledge, and teachers have always been concerned with teaching this subject correctly and efficiently. For this reason, teaching mathematics should be given special attention, and even the base and frameworks should be provided for online teaching of this subject. This study aims to introduce mathsframe.co.uk as a platform for online teaching of mathematics. The present study tried to turn the challenges facing online mathematics teaching into opportunities for better instruction. The method of research was descriptive and a case study (in-depth). The facilities and games of the website were divided into categories of Most popular free mathematics games, Tablet friendly games, Word problems, Using a calculator, Money, Sorting and classifying, National curriculum, Addition and subtraction, Fractions, decimals and percentages, Measuring and time, Partitioning, place value and rounding, Latest mathematics games, Multiplication and division, Ordering, comparing and reading numbers, Geometry, Statistics and ITPs. There are games and options in these categories which are suitable to teach and exercise subjects like money, reading and working with different types of charts, numbers divisible to a certain number and prime numbers, decimals, measuring angles, numbers axis, exercising and learning different math operations, multiplication table, comparing numbers, showing the number of shapes and categories, counting numbers, place value chart, measuring volume, ratio, possibility, fraction, the method of transferring numbers in technical addition and subtraction, symmetry, measuring mass and temperature, coordinates, clock, working with a ruler, volume and perimeter.

Many math instruction games and options complementary to teachers' teaching are free, and there is no need for signing up, entering information or paying a fee; but a basic knowledge of English is required for teaching or exercising elements of the categories.

Keywords

teaching facilities, online teaching, math subject, elementary, math frame

Introduction

Humanity has always been learning and acquiring wisdom throughout his life, and education has also benefited from technology development. Education has come step by step aligned with technologies and improved by it. Consequently, learning is one of the primary needs of humanity. One with no understanding of these changes in today's advanced society where information is changing and advancing is considered an unstable being lacking behind the society. Furthermore, society cannot provide for everyone's need of education because of population growth; thus, it is necessary to find a strategy to provide education for all at the least cost possible (Aghakasiri & Fazelian, 2006).

Distance education is a suitable answer for this need. However, online teaching through the internet or digital learning is a new industry in distance education technology; hence educational centers and institutions strive to provide instructions with a standard structure fit to our country as soon as possible (Shahbeigi & Nazari, 2012).

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Mathematics is considered to be one of the pervasive problematic subjects among students. In addition to being a crippling problem in school, incompetency in mathematics has destructive effects on adulthood's daily life (Lerner, 1926). Individuals with incompetency in mathematics often suffer from anxiety and depression due to their failure in academic achievement. There is a two-way relation between these problems and academic achievement, which means that failing in academic achievement increases emotional and behavioural disorders. Moreover, these problems increase the possibility of failure in acquiring academic achievement (Ghaedi & Hemmati alamdarlou, 2016).

Mathematics is essential because it teaches thinking processes, reasoning and problem-solving. The importance of this matter is higher in elementary school as it is a foundation and basis for education in the future.

It is necessary to provide a basis and situation so that meaningful learning (understanding and insight) occurs. This goal is achieved through making connections and relations between concepts and methods in teaching mathematics so that the opportunity to foster the skill of generalizing is provided (Najafikhah et al., 2012). Particular attention should be dedicated to mathematics instruction, and the basis and framework for teaching math online must be provided during the covid-19 pandemic.

Using computer-assisted teaching is a kind of intervention to improve learning mathematics in students. When a computer is used to deliver educational curriculum material, it is called computer-assisted teaching (Seif, 2009). Computer-assisted teaching is an exciting and motivating method as it provides learning fit to learning strategy and needs of individual students, immediate corrective feedback, and it also delivers content step by step, enabling teachers to follow students' learning graphs and draw their progress chart (Verts et al., 2007).

The combination of text, visual images and sound for presenting and teaching words causes objective and authentic learning and definition of words, improvement in students' short term and long term memory, learning, memorizing and remembering words in individuals with learning insufficiency and reinforcement of visual imagination ability of students and high-quality learning in students (Motamedi et al., 2013).

Considering the benefits and opportunities that computer-assisted and virtual teaching provides us, teachers must use them besides their instruction or as a framework for their teaching. This study tried to provide several approaches to virtual teaching of mathematics and some frameworks for this matter.

Significance of the study

Social The educational situation in Iran and the world has changed due to the covid-19 pandemic. The education department has diverted its focus from in-person teaching to online teaching in this situation. This approach is achieved by using new technologies in education and getting help from the competency of teachers in this matter (Gholami andarati & others, 2021). Lack of connection between class and non-educational time of students has been one of the problems of teaching mathematics in recent years among teachers; Teachers perform all of their educational activities during class and have no access to students outside the classroom to track their teaching-learning process; while successful and active teachers are always in search of novel ways to make use of students' free time to motivate them; For this reason, special attention has been given to using information technology and smartphones, educational websites and communication software (Teimouri, 2017).

Considering the spread of covid-19 and the opportunity for distance and virtual teaching, preparing frameworks and a basis for virtual education becomes critical. In the meantime, the most crucial point is to familiarize teachers with these contexts and strategies to improve their teaching. The importance of math is common knowledge because it teaches the process of thinking, reasoning and problem-solving. Furthermore, teaching math correctly and efficiently

has always been one of the teachers' concerns; this issue becomes more apparent in elementary school, which forms the basis of education for the coming years.
Nevertheless, the question is why despite the evident importance of mathematics to teachers, and after one year is passed since the breakout of covid-19, there is no sign of improvement in teachers' teaching and students' academic achievement in this math? Naturally, part of the issue is that the frameworks and facilities of virtual teaching are not adequate or teachers' lack knowledge on virtual teaching methods, but the most crucial part is that most of the research on this field and information and teachings delivered to teachers for enriching and improving their teaching is merely theoretical. They are not applicable, and neither suitable to the facilities and current frameworks of virtual teaching and thus will not have the required efficiency. Consequently, we tried to introduce one of the virtual math instruction platforms, which will be a notable help in practically improving math instruction.

Literature review

Reliable inquiries related to the topic of this study were few; however, results of inquiries relatively related to this field are given as follows:

Gholami andarati et al. (2021) assessed the view of teachers toward virtual teaching of math subjects in elementary in three levels of knowledge, comprehension and application. Gathered data were analyzed through a T-test, and results showed that virtual teaching has a meaningful effect on three levels of knowledge, comprehension and application of math subjects.

Zeinivandnejad's study (2019) called "Accrediting tools using theories of activities and item and response for assessing students' comprehension of virtual warm-ups in learning mathematics" assessed students' motivation to work with virtual warm-ups as tools in learning mathematics. A validated tool was prepared to measure students' motivation to use virtual warm-ups.

"Rasch-Andrich Rating Scale model" based on the item response theory was used to investigate psychometric aspects of tools such as acceptability of the index, learner's ability, suitability and one-dimensionality. This tool can be used to find factors indicating students' understanding of virtual warm-ups in math class. Additionally, we can assess the relationship between structures of this questionnaire using this tool, which will produce models related to students' motivation in using virtual warm-ups that broaden the threshold of knowledge in this area and improve the quality of teaching and learning process of mathematics.

The findings of Teimouri's research (2018) imply a notable increase in the amount of learning and academic progress of students under the study in a way that the average score of the students before implementing this design and employing novel methods in teaching (using social media and creating groups on Telegram for class participants) was 06/12 which had increased to 25/15. Statistical charts also confirm that employing this method in teaching math subjects increases students' learning ability with an assurance of 4/94 percent.

In Osareh et al.'s inquiry titled "Study of the effect of computer-assisted math teaching on the attitude of 9th-grade female students toward mathematics," Cronbach's alpha coefficient of 0/85 was gained. Initially, both control and experimental groups gave a pretest of attitude toward mathematics. The educational variable (computer-assisted instruction of mathematics) was conducted for 16 weeks on the experimental group afterwards, and then a post-test was conducted on both groups. Analyzing covariance results showed that computer-assisted instruction of mathematics had improved the attitude of 9th-grade students toward this subject. Thus the findings of the study imply that a significant relationship is present between computer-assisted instruction of mathematics and students' attitude towards this subject.

Analyzing the data taken from Ghaedi et al. research (2016) titled "effectiveness of computer-assisted teaching of working memory on the mathematical performance of students with mathematical incompetency" through analyzing the covariance indicated that the mean

score of mathematical performance and its subscales (the aspect of operation and application of mathematics) in the experimental group increased significantly, however, this instruction did not have a significant impact on the aspect of mathematical concepts. The findings indicated the effect of teaching working memory of computer-assisted teaching on students' mathematical performance with mathematics incompetency.

In the study of Motamedi et al. (2011) titled "Comparison of the effectiveness of three methods of direct, computer-assisted and combination education on reducing the problems of students with math disorders," 20 students diagnosed with math disorder through clinical interview, Wechsler intelligence test and standardized test were selected voluntarily. Then these students were randomly placed in 4 groups of 5. Three experimental groups each received 12 sessions of their special instruction in three 45 minutes' sessions every week. The control group continued the regular education they received in the center to cure particular learning disorders. All four groups were given a pretest and post-test, and the data were analyzed with variance analysis. The results of this research showed that the three methods of direct, computer-assisted and combination education were (p=0/05) effective in reducing mathematical disorders of the students. Accordingly, it is concluded that using direct, computer-assisted and combination teaching methods can be more effective in reducing

Purpose of the study

Main purpose:

- The facilities of virtual teaching of mathematics in elementary school

Subsidiary purpose

- Presenting an online framework as a solution to improve virtual teaching of mathematics in elementary school

Methodology

The purpose of the present study is to study the facilities of virtual teaching of math in elementary: a case study of the mathsframe.co.uk website. Thus, the research method is descriptive-qualitative and case study (in-depth). Moreover, all the data were gathered through direct observation of the earlier website. In-depth research is studying a case or a unit and exploring it deeply. In fact, in this type of research, different aspects of a phenomenon are examined, and while describing its features and characteristics, the cause or causes of some of its actions and reactions are analyzed. In in-depth research, the researcher, makes his hypotheses and gathers information about it. To do this, the researcher uses all interviewing methods, observing, questionnaires and studying libraries. Then the researcher analyzes and forms a conclusion. An important point to consider in case studies is that the results of such studies can be generalized to a statistical population with some commonalities.

Findings

In general, mathsframe.co.uk is ideal for the gamification of mathematics instruction. The capabilities and facilities that this website offers to the users are based on teaching elementary math lessons through different online games.

In addition to providing a suitable environment for students to practice and repeat math, teachers can use this site to teach the topic with the necessary explanations by recording their screen and sending it to the class group. In Figure 1, the capabilities and facilities of this site are shown.

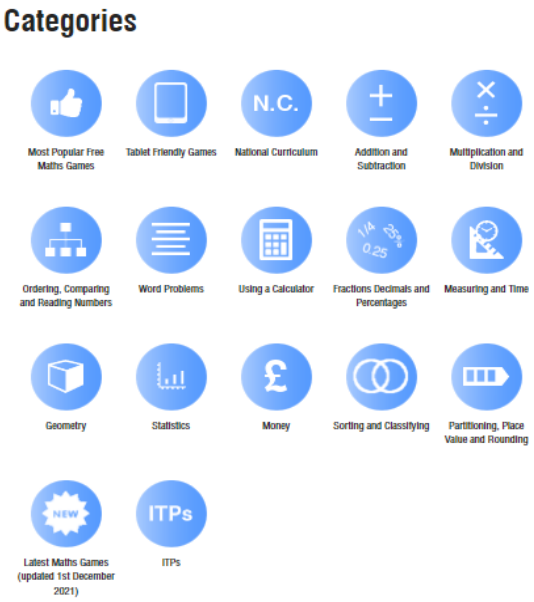

Figure 1. Facilities and capabilities of mathsframe.co.uk as a framework for virtual teaching of math in elementary

Each category is introduced below:

Most popular free mathematics games: In this section, there are online games that one can enjoy math playing them! These games are suitable for elementary and younger ages as well. The student uses many mathematical actions unintentionally while playing the games. Students practice and exercise mathematics while playing these games, and also they get to know different functions of mathematics and have a new attitude toward this subject.

Tablet-friendly games: this category has online and free tablet-friendly games. These games also help students practice and repeat mathematics in an exciting and new environment.

Word problems: In this section, definitions and concepts of mathematics are explained by games based on problem-solving. Concepts such as divisibility, proportion, and mathematical operations are introduced through problems so that students can solve problems and play games by mastering the definitions of these concepts. These games are primarily based on math equations; thus are suitable to lay the foundations for this subject in elementary. Some of these games are free and only require an internet connection, while to get access to some of the other games, the user has to sign up on the website and give his information along with a yearly subscription fee to use the facilities.

Using a calculator: This section is ideal for sharing one's class on an interactive whiteboard. Moreover, children can use it separately to trace and fix their calculation mistakes.

Money: In this section, students are introduced to adding and subtracting amounts of money and comparing their value in online games such as cash registers and salespeople. While providing an attractive environment, these games help add and subtract money in students' daily lives and their mental calculations. Most of the games in this section require a fee.

Sorting and classifying: In this section of the games, students try to classify geometric shapes and numbers based on their characteristics, such as divisibility into a number or regularity, right

angles, and other topics related to mathematics. Some games are free but to play, having a basic knowledge of English is necessary.

National curriculum: This section consists of five options: year 2 programme of study, year 3, 4, 5 and 6. In each part, different online games are categorized into separate groups. For example, number and place value, addition and subtraction, multiplication and division, fractions, measures, properties of shapes, position, direction and motion and statistics are in the year 2 programme. Furthermore, each option has different online games in the area of the group title. For instance, the games that are presented in number and place value of year 2 follow these goals: the student should be able to start counting from zero, recognize the place value of each digit in a number, compare numbers from 0 to 100 and use appropriate numbers, write numbers in letters and digits. Games become more complex from year to year, and students can use them based on their age and lesson subject.

Addition and subtraction: There are a variety of games in that students learn addition and subtraction in an exciting and new environment and improve their mental calculations. These games are designed so that the students can learn the addition and subtraction of different numbers by earning or losing scores while playing games. Most of the games of this section require a fee.

Fractions, decimals and percentages: There are games and facilities in this section that are ideal for students to practice and repeat and teachers to teach these topics. Students must calculate the percentages and fractions of the numbers correctly during the games to advance to the next stage. These facilities require a basic knowledge of English and paying a fee.

Measuring and time: Games specific to time and clock practice are mainly based on recognizing or defining time from the clock. Measuring time, volume, weight, temperature, angle, area and line length with the right tools is one of the free features that teachers can use in their teaching.

Partitioning, place value and rounding: In this section, there are games to compare the position of numbers on the axis and their amount and rounding two-digit and three-digit numbers, which provides an excellent opportunity to practice in this area. Most games in this section require a fee.

Latest mathematics games: There are many new games suitable for various math topics in this section. Register and enter personal information and pay a yearly subscription fee to access them.

Multiplication and division: in this section, students face multiplication and division questions in the exciting environment of the game, and if their answer is correct, they can pass to the other stage of the game. Most of the games in this section require a fee.

Ordering, comparing and reading numbers: the games designed for this section help students to compare numbers such as decimals and fractions, place the numbers on the numbers axis, and recognize digits of the numbers from their written form of them. To get access to more games, paying a fee is required.

Geometry: There are games in this section that require the student to find the coordinates of a point according to the information obtained, measure an angle with a conveyor, or obtain an

angle based on the information to get to the next stage of the game, Categorize geometric shapes according to the required properties, calculate the perimeter and area of the shapes, and draw the symmetry of the shapes correctly. Most of the games in this section are free.

Statistics: The exercises and games in this section include getting to know and reading charts such as bar, circular and linear, answering questions about the chart, obtaining the mean or numbers of a sample from the mean, and probability exercises. Most of the games in this section are free but require a basic knowledge of English or using an online dictionary.

ITPs: These features have been refurbished to work in all modern browsers and devices without installing flash. All games and facilities in this section are free and are a suitable environment for teaching. Tutorials for reading and working with different types of charts, divisible numbers to one and prime numbers, decimal numbers, angle measurement, number axis, practice and training of various mathematical operations, multiplication table, number comparison, counting numbers, showing the number of shapes and categories, spatial table value, measurement of volume, ratio, fractions, probability, how numbers are transmitted in addition and subtraction, symmetry, measurement of weight and temperature, coordinates, hours, ruler, environment and area are all features of this section.

Discussion and conclusion

This study aimed to study the facilities of virtual mathematics instruction in elementary school: a case study of mathsframe.co.uk. The results of the data description showed that such platforms could provide an excellent opportunity to make virtual teaching objective and attractive; in a way that students can learn math topics and problems while playing fun online games instead of practicing it traditionally on paper. This method will change students' attitude towards maths as a dull and rigid subject and solve a concern of teachers, which is to explain math to students in a meaningful way. In addition, by connecting mathematics with games, which is attractive to students, it is possible to deepen the learning and persistence of the material.

The findings of the present study are in line with the findings of these researches: Gholami andarati et al. (2021), Zeinivandnejad (2019), Teimouri (2018), Osareh et al. (2018), Ghaedi et al. (2016) and Motamedi et al. (2012); Thus we can elaborate on the findings above that this website is ideal for gamification of mathematics. This website's features and facilities are based on teaching elementary mathematics lessons with different online games. In addition to providing a suitable environment for students to practice and repeat math, Mathsframe.co.uk can also be used by teachers to teach the topic and the necessary explanations by recording their screen and sending it to their virtual classes.

The facilities and games of the website were divided into categories of Most popular free mathematics games, Tablet friendly games, Word problems, Using a calculator, Money, Sorting and classifying, National curriculum, Addition and subtraction, Fractions decimals and percentages, Measuring and time, Partitioning, place value and rounding, Latest mathematics games, Multiplication and division, Ordering, comparing and reading numbers, Geometry, Statistics and ITPs. There are games and options in these categories which are suitable to teach and exercise subjects like money, reading charts and working with different types of charts, numbers divisible to a certain number and prime numbers, decimals, measuring angles, numbers axis, exercising and learning different math operations, multiplication table, comparing numbers, showing the number of shapes and categories, counting numbers, place value chart, measuring volume, ratio, possibility, fraction, the method of transferring numbers in technical addition and subtraction, symmetry, measuring mass and temperature, coordinates, clock, working with a ruler, volume and perimeter.

Many math instruction games and facilities complementary to teachers' teaching are free and do

not require registration, entering one's information or paying a fee. However, a basic knowledge of English or using an online dictionary or Google translate is needed for teaching or practicing games of the categories. Although some domestic software and website provide these facilities in a more narrow domain, it is suggested to design and offer domestic sample websites or national and free software or with small fee modelling the games and facilities of this website and make them accessible to teachers and students to facilitate the virtual education of courses and to witness the improvement of teachers' teaching and the academic progress of our students.

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