Aesthetic Education: Exploring the Efficiency of Interactive Courseware in Fraction Topic Proficiency

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ABSTRACT

The utilization of multimedia technology has become crucial in the endeavor to enhance and foster education, particularly in Malaysia. Nevertheless, the educational approach that centers around the traditional classroom setting and exclusively depends on textbooks is less effective in fostering students' ability to enhance their ideas and imagination, particularly in the realm of Mathematics. The objective of this study is to assess the efficacy of interactive courseware as an instructional technique in teaching the Fraction topic for Standard 4 Mathematics. The ASSURE Model is utilized with implementation of aesthetic education in the creation and integration of various multimedia components, including text, graphics, audio, video, and animation, to aid and enhance the process of teaching and learning. Aesthetic education refers to the process of developing an individual's sensitivity to and enjoyment of beauty in different forms, such as art, music, literature, nature, and other facets of the human experience. This interactive courseware was created utilizing Microsoft PowerPoint software to enhance comprehension of the students' cognitive processes. A pre-experimental study was done on a sample of 61 Standard 4 students from two schools in the Johor, Malaysia. The study lasted for four weeks and involved a pre-test and post-test. The T-test was utilized to analyze the performance scores of the students who used the interactive courseware. The findings indicate that there were notable disparities in academic performance following the utilization of this interactive courseware. This implementation of aesthetic education in the interactive courseware significantly enhanced student performance and provided a comprehensive set of teaching aids for the Fraction topic in Standard 4 Mathematics.

Keywords
Interactive courseware; Mathematics; Aesthetic Education; Fraction Topics

Introduction

The introduction of the Primary School Curriculum Standard in Malaysia has brought about significant changes in pedagogy and content in teaching and learning. These reforms aim to prepare students for the educational challenges of the new millennium. Accordingly, the Malaysia Ministry of Education (MOE) has called on all educators in Malaysia to employ and integrated instructional technology in education (Cheok et al., 2020). Over the last two decades, researchers in the field of education have responded with growing attention on difficulties linked to teaching and learning Mathematics using English and most studies are focused on learning, teaching, and teacher education (Renganathan, 2023).

This is supported by Kim How, Zulnaidi & Abdul Rahim (2022) who discovered that studies in Mathematics presently focusing on the direction of field-oriented theories and pay special attention to the emergence of related psychological experiments, constructivists and socio-cultural programs. Visualization skills are particularly significant in Mathematics (Presmeg, 2020) and it is a skill in which one may conceive a clear picture of something they learn. This assertion is corroborated by Engelbrecht, Llinares & Borba (2020) who argue that existing features such as animation, video, sound, text, audio, and graphics can engage the student's mind and provide considerable impact on communication in education. The availability of such features will be able to grab students' attention throughout the teaching and learning process as it looks to be able to connect directly with the students (Kaput, Hegedus & Lesh, 2020).

The study from Uyen et al., (2021) indicated that students' mathematical representation skills were higher when they were taught using Realistic Mathematics Education (RME) compared to when students were taught using conventional ways. According to Vagg et al., (2021), the utilization of technology such as multimedia will help to increase students' visual abilities since the combination of materials consisting of images, words, animations, video and audio can activate the whole student's senses. Once this happens, it will strengthen memory and raise interest and desire towards Mathematics learning.

As a teacher who is also a trustee in executing the education curriculum in this country, they need to have a high degree of knowledge, competence, and attitude as well as creativity in carrying out teaching and learning process. Besides, Istiyono et al., (2021) state that a teacher who wishes to carry out efficient teaching and learning should have a strong knowledge of the topics of the lesson and demonstrate a positive attitude and personality as a teacher. According to Sulaiman & Ismail (2020), research from media clipping and forum showed that most instructor were still inadequate in skilful notably via technical factors. At the same time, Perienen (2020) believes that as an educator or instructor, they should be prepared with the knowledge to implement the planned curriculum. An essential goal of teacher education in Mathematics is to develop their awareness of the relationship between real occurrences and Mathematics. According to research by Passarella, (2021), teachers who adopt a modeling perspective are better able to recognize the mathematical goals of the lesson involving real-world problems, think critically about stereotyping textbooks, and see realistic situations as a medium through which mathematical ideas can be considered.

Additionally, according to Calavia, Blanco, and Casas (2021), teachers who exhibit a high level of creativity have the potential to have a positive impact on the outcomes of teaching and learning that is delivered. On the other hand, teachers who lack originality will cause students to be less interested in their studies and less motivated to learn. Anwar et al., (2021) also show that, students' achievement is influenced by the teaching methodology has is offered by the teacher. In 21st century learning, teachers must integrate the use of computers in teaching without using textbooks as their principal reference source.

The study conducted by Reinhold et al., (2020) has indicated that many students who have issues associated to fractions themes. Similar problems were also observed by Azid et al., (2020) inquiry who also indicates that at primary school level, this problem is a common run-through. Fraction subject is the notion of abstract Mathematics specifically for primary school student's once they learn about round numbers themes. The subtopics of this subject include mixed numbers, improper fractions and their relationship, additions, and subtraction of fractions, solving fraction problems and fractions as part of set objects. In addition, this fraction topic is a prerequisite understanding before students can master the next topics like as decimals, ratios, and percentages. As with other Mathematics topics, the fraction topic expects students to learn deeper factual fractions before addressing further concerns associated to fractions.

Therefore, the utilization of technology in Mathematics instruction is intended to facilitate the development of a constructivist-based learning environment, wherein students are able to construct their own knowledge. The process of generating student knowledge inside a learning system involves investigating several models of knowledge generation that are utilized as analytical tools for online learning (Di Vaio et al., 2021). Visual memory is a cognitive advantage of the human brain that allows for the retrieval of all visual information. Furthermore, according to Icht, Levine-Sternberg & Mama (2020), human memory predominantly retains visual elements in long-term memory rather than oral information. Hence, the utilization of multimedia was highly crucial due to its composition of many resources like graphics, texts, music, video, and animation. This element has the ability to showcase modified visuals and is also capable of generating simulated interactive activities that can mentally visualize the actual shape of an object or component (Seinfeld et al., 2021).

Furthermore, Septiani & Rejekiningsih (2020) study suggested that the utilization of Mathematics interactive multimedia courseware helped most students acquire good outcomes. The study demonstrated that the interactive multimedia courseware for Mathematics themes has increased students' Mathematical thinking in terms of data analysis, assumptions, validation, and conclusions as well as analyzing the validity of arguments. Students' viewpoints and incentives to learn Mathematics were good since multimedia gives interactive video and complete materials where students perceive that the learning process is not limited by place and time. In a study conducted by Wijaya, Tang & Purnama, A. (2020), it was discovered that interactive multimedia courseware packages can be implemented through various means such as compact discs, internet networking systems, and hard disks.

In this study, interactive courseware has been developed to generate a greater comprehension of students' thinking in the Fraction difficulty as an effort to give the greatest teaching resources for teachers in schools, especially in Mathematics. Consequently, the usage of this interactive tool that necessary and trustworthy will assist students learn swiftly and profoundly while teachers can develop their competence in the use of Information and Computer Technology (ICT).

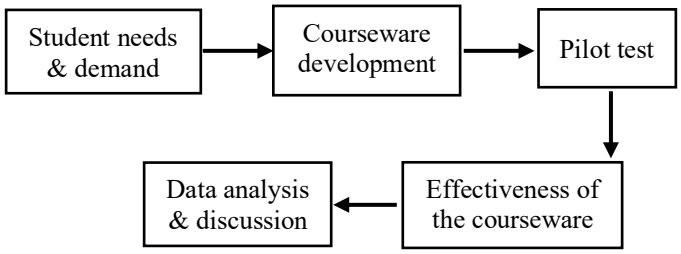
Aesthetic education is often included into school curricula, community projects, and cultural organizations, aiming to enrich individuals' lives and contribute to a more culturally and emotionally conscious society (Gao, 2023). This structure mixes aesthetic education ideals by combining appealing graphics, real-life examples, and interactive features to make learning about fractions more enjoyable and meaningful. Aesthetic education refers to the process of developing an individual's sensitivity to and pleasure of beauty in diverse forms, such as art, music, literature, nature, and other dimensions of the human experience. Hence, the purpose of this study is to analyze the efficiency of this interactive courseware as a teaching aid for the fraction topic of Standard 4 Mathematics Subject.

Methodology

This study is a pre-experimental study that utilizes two treatment groups with pre-test and post-test measures. The participants in a selected group were administered a pre-test, received the treatment, and then took a post-test. This methodology aims to assess the effectiveness of the interactive courseware as an instructional tool for teaching the Fraction topic in Standard 4 Mathematics. Furthermore, pre-test and post-test assessments were conducted on students to examine the impact of using this interactive courseware on their knowledge in specific themes. Figure 1 illustrates the research flowchart for this study. According to Sundayana et al., (2017) ASSURE learning design is an abbreviation of the necessary stages which are incorporated in the learning model. The ASSURE model consists of six phases. First, learner analysis, secondly is a declaration of the learning objectives to be reached. Third is the selection of methods, media and educational materials. Fourth is using media and resources and the fifth includes the inclusion of students in learning. The last one is appraisal and review.

Integrating aesthetic education into the ASSURE model enriches student knowledge by stimulating creativity and critical thinking, improving the learning experience, and promoting a holistic development of technical and creative skills (Irawan et al., 2021). This technique ensures that students not only acquire knowledge but also develop a sense for beauty and design, which is vital in many occupational disciplines. In this project, the ASSURE model is employed as a design approach in designing interactive courseware for the topic of fractions as in figure 1.

Figure 1
Interactive Courseware Development Flowchart



Population and Sample

The researcher adopted the purposive sampling approach to pick a sample that would give the essential data and information to meet the study questions (Sibona, Walczak & White Baker, 2020). This technique incorporates numerous rounds of sample selection through categorization, designed to satisfy the requirements of researchers. Extensive surveys could create obstacles for researchers. The sample selection in this study begins with researchers splitting it into schools in one of the districts in Johor, Malaysia that contained a computer laboratory capable of functioning, ultimately choosing 6 schools that fit these criteria.

Subsequently, the researchers determined the educational institutions that now offer Communication and Information Technology courses to fourth-grade students and discovered that two schools met these criteria. Additional discussions

should be conducted with the respective school administrations to determine the specific class associated with this assessment of interactive courseware. Researchers have chosen to collect a sample of students from these two institutions in order to study the teaching and learning process of Information and Communication Technology (ICT) topics that they have studied.

This topic focuses on obtaining and using creative information and skills to benefit students in their everyday life. It involves exchanging ideas and information among students both within and beyond the school, as well as accepting ownership and being accountable for the ICT infrastructure (Hashim, Ismail, & Masek, 2017). The information that this student's learn from the ICT subject was hopefully would contribute in employing this interactive courseware. These random sample procedures were utilized to choose a total of 61 Standard 4 student from Johor, Malaysia.

Interactive Courseware Development

The premise for this interactive courseware development is to employ Microsoft PowerPoint software. The construction of this courseware is concentrated on the basic components of pedagogy for teaching in addition to prioritizing multimedia qualities such as text, audio, video, graphics, and animation. By incorporating aesthetic concepts into the analysis, objectives, procedures, media selection, participation, and assessment phases, educators can build more engaging and effective teaching strategies that cultivate both functional and aesthetic competencies in students. These two parts aim to ensure and structure students' knowledge of the material supplied as well as to foster involvement in the activities being carried out. This interactive courseware was created with four key aspects of pedagogy: induction sets, theoretical presentations, consolidation (quizzes, questions, group activities) and closing.

Treatment Methods

Both groups used the interactive courseware for four weeks. Both teachers at these two schools continued to teach and learn in accordance with the Standard 4 primary school mathematics syllabus. In the first week, these students took an exam on Fraction topics to assess their past knowledge. The interactive courseware was then sent to instructors as a teaching aid for fraction themes during the first week of the teaching and learning process. They use interactive courseware with multimedia features to teach fraction concepts, and student engagement is required to complete all of the learning activities in the courseware. The teaching session lasts four weeks, and at the end of the fourth week, students are given a knowledge test.

Instruments and Data Analysis

In this study, the researcher designed a relevant test question to assess students' knowledge of the Standard 4 Fraction problem. The topical test questions presented to the students were separated into three sections: Section A (five questions), Section B (ten questions), and Section C (five questions). As a result, the researcher employs 20 exam questions written in Malay. Each component displays the level of difficulty to establish legitimacy, as well as referencing to the pertinent sub topics as mentioned in the syllabus.

Furthermore, two primary school mathematics specialists evaluated the overall substance of the produced questions in terms of language and applicability. The instrument dependability index was derived using Cronbach's Alpha (α). The results reveal a decent index reliability of 0.899. The study's validity was evaluated through a series of pilot tests to ensure that the respondents understood the questions and that there was no confusion over the word or measurement (Fink & Litwin, 1995).

Descriptive tests were performed in this study to compare pre-test and post-test data using mean and standard deviations. Paired t-tests were employed to assess statistical differences. First, researchers must examine data distribution for parametric testing. According to Zacks (2014), this test is used to determine whether data fits the distribution of a certain population, which can be normal or Weibull. In other words, the study data represents what the researcher expects to find in the actual population.

Results

Respondents who experienced the teaching and learning process of Mathematics subjects through this interactive courseware were 61 students. The number of female students was more than male students as stated in Table 1.

Table 1
Number of Respondents by Gender

Gender	Frequency	Percentage (%)
Male	28	45
Female	33	55
Total	61	100.0

The skewness value (0.22) is within the normal distribution range of from -2 to +2 (George & Mallery, 2019). Data is further examined using the Shapiro-Wilk test to perform data inference against the normal distribution. This test is excellent for testing data normality (Razali & Wah, 2011). Next, table 2 provides the normality test analysis of pre-test and post-test in this study.

Table 2
Normality Test Analysis for Pre-Test and Post-Test

	Shapiro-Wilk		
	Statistic	**df**	**P-value**
Pre-Test	0.981	61	0.730
Post-Test	0.972	61	0.460

The significant value for normal test data using Shapiro-Wilk for the pre-test is 0.730. Since the value is greater than the chosen alpha level of 0.05, the null hypothesis is accepted and concludes that post-scattered test data is normal. The value of the post-test data is 0.460, also larger than the specified alpha value, 0.05. Since both pre-test and post-test values are above alpha, the researcher can reach a judgment that this data is deemed to be regularly distributed. The efficiency of this interactive courseware in supporting the student's Mathematics learning is assessed by pre-test and post-test scores comparison between the two groups. The hypotheses to test are:

Ho: There is no statistically significant gain before and after studying utilizing interactive courseware on Fraction topic in Mathematics courses for Standard 4 students at a confidence level of 0.05

The findings of group 1 showed that the pre-test score (M = 33.64, SD = 8.71) was lower than the post-test score (M = 51.89, SD = 7.08) after four weeks of treatment. Further analysis using a paired t-test demonstrates that the findings are significant, so null hypotheses are rejected [t (27) = -10.06, p <0.05]. This shows that there was a statistically significant difference in the knowledge test score for group 1 before and after the four weeks of therapy utilizing interactive courseware for Fraction issue in Mathematics disciplines. Table 3 presents the findings of the analysis.

Table 3
Paired T-Test for Group 1

		Different pairs					**t**	**df**	**Sig. (2-tailed)**
					Confidence level at 95%				
		Mean	SP	SEM	Lower	Upper			
Group 1	Before-After	-18.2500	9.60179	1.81457	-21.97319	-14.52681	-10.057	27	.000

The data for group 2 showed that the pre-test score (M = 25.58, SD = 9.22) was lower than the post-test score (M = 40.73, SD = 11.27) following four weeks of treatment. Further analysis using a paired t-test demonstrates that the findings are significant, so null hypotheses are rejected [t (32) = -8.24, p <0.05]. This shows that there were statistically significant differences in knowledge test scores for group 2 before and after during four weeks of therapy using interactive software for fractional themes in the 4th year mathematics curriculum. Table 4 illustrates the findings of the analysis.

Table 4
Paired T-Test for Group 2

		Different pairs					t	df	Sig. (2-tailed)
					Confidence level at 95%				
		Mean	SP	SEM	Lower	Upper			
Group 2	Before-After	-15.1515	10.5597	1.83821	-18.89583	-11.40720	-8.243	32	.000

Using descriptive analysis, the comparison of pre-test and post-test score was based on the percentage difference between pre-test and post-test. This shows that the use of this courseware has brought effect to fourth-grade students for the Mathematical disciplines of Fractional titles. This definitely indicates the good effect of the courseware therapy in this study.

Discussion

The findings imply that the usage of this interactive courseware can increase student knowledge during a four-week study on fractional topics for Standard 4 Mathematic courses. In the first scenario, the first and second groups reflect a percentage improvement in knowledge from 10% to 15% based on ratings obtained. This suggests that the deployment of this program has influenced Standard 4 students for Mathematical title breakdown. This is because the usage of interactive courseware can provide a suitable learning environment and flexibility in terms of location, time and rewards to users (Hamzah et al., 2020). With a good development strategy and the incorporation of appropriate ideas, it is expected that the developed software will assist students learn properly and also increase student accomplishment in Mathematics topic (Gaddi et al., 2024).

There are limitations in traditional classroom teaching through new learning methods where teachers and students can explore the application of multimedia technology in Mathematics teaching, analyze the disadvantages and discuss the steps to use multimedia technology to help teaching Mathematics (Akinoso, 2018). This digital learning platform allows students the flexibility to choose the suitable time, location and place to study the topic of learning. The success of using this interactive tool is improved by the availability of facilities in terms of home or school access. Additionally, the diversity of information delivery modalities including the usage of a courseware has supplied differentiated attention to students to review fractional subjects (Lisnani & Putri, 2020). This is proved by the outcomes of the study by Taban (2021), the employment of a courseware has been able to improve student accomplishment where students score not less than 80% after learning to use it. As such, Mathematical software can assist inspire students to learn Mathematics by delivering experience and exposure as well as allowing them to choose alternative learning ways based on their priorities.

Among additional grounds to support the raised of student knowledge in this study is the component of this interactive courseware in delivering fresh insights on the topic of fractions after the teacher's explanation. According to Azmuddin, Nor & Hamat (2020), the explanation of the instructor on something would become easier to comprehend when aided by a variety of materials and devices that capable of translating the clear meaning with the description of the teacher. The utilization of beautiful and concrete visual components not only assists students' grasp of the topic but also has a big impact on the student's moods.

The augmentation of knowledge via interactive multimedia courseware resources has long been employed in learning whether at the level of primary education to higher education. Thus, this study is fully analogous to the findings of

Munna & Kalam (2021), where students can expand their knowledge about the topic over particular activities by the utilization of the courseware. This finding also is in line with the study of Castro & Tumibay. (2021), which indicated that students had enhanced their knowledge on the topic that they learn using interactive courseware.

Conclusion

Based on these discussions, it is obvious that academics have developed interactive courseware that coincides with the Standard 4 Mathematics Curriculum and Assessment Document in Fraction topic. Furthermore, the researcher has undertaken a study on the impacts of the use of the interactive courseware on the students whose results indicate that there has been an increase in their achievement aspect on the selected topic. Integrating aesthetic education into the ASSURE paradigm enriches student knowledge by fostering creativity and critical thinking, increasing the learning experience. The interactive courseware is based on important elements of pedagogy and multimedia components, making this content acceptable and correlates with the subject and context of Mathematical learning. Student performance enhancement illustrates the usefulness and contribution of this interactive courseware in learning as a teaching tool, notably in this study through the students' outcomes. This growth is believed to be stimuli by taking into account diverse IQ factors that occur in different students. In this way, the interactive courseware generated is based on some of the essential elements of multimedia such as text, graphics, animation, video, and audio, as well as justifying the effectiveness of the interactive courseware that has been established. In additional study, researchers hope to produce interactive courseware that can include other themes in the mathematics curriculum which is vital to the students. There are three levels that need to be contained in the material of this interactive courseware: high, medium and low levels. These three levels should be in the curriculum so that the teacher can choose the appropriate level according to the student's performance.

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