Technology Transformation in Education: Mathematics Learning Media in the Digitalization Era

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Abstrak

Penggunaan teknologi memegang andil yang amat krusial di dalam proses pembelajaran matematika. Faktor utama keberhasilan mengintegrasikan teknologi ke dalam pembelajaran matematika adalah kemauan dan tekad untuk beradaptasi terhadap transformasi melalui perancangan desain pembelajaran melalui perangkat dan sumber belajar yang tepat, termasuk berbagai jenis media. Studi ini bermaksud untuk menilai efektivitas penerapan media di dalam pembelajaran matematika pada Fakultas Tarbiyah dan Keguruan di UIN Sulthan Thaha Saifuddin Jambi. Metode deskriptif digunakan untuk menganalisis kemampuan dosen dalam mengelola pembelajaran, aktivitas mahasiswa, respon mahasiswa, dan hasil belajar mahasiswa. Bersumber pada analisis deskriptif terhadap temuan penelitian, bisa disimpulkan bahwa integrasi media pembelajaran dalam Pembelajaran Matematika di Fakultas Tarbiyah dan Keguruan di UIN Sulthan Thaha Saifuddin Jambi terbukti efektif. Hal ini terlihat pada efektivitas kemampuan dosen selama mengelola pembelajaran, partisipasi aktif mahasiswa, respon positif mahasiswa akan pembelajaran, dan pencapaian hasil belajar secara keseluruhan. Dengan begini bisa disimpulkan bahwa implementasi media dalam Pembelajaran Matematika di Fakultas Tarbiyah dan Keguruan di UIN Sulthan Thaha Saifuddin Jambi terbukti berhasil dan membuahkan hasil yang efektif.

Keyword: Era Digitalisasi, Media Pembelajaran Matematika, Transformasi Teknologi

Abstract

The use of technology plays a very crucial role in the process of learning mathematics. The main factor for the success of integrating technology into learning mathematics is the will and determination to adapt to transformation through designing learning designs through the right learning tools and resources, including various types of media. This study intends to assess the effectiveness of the application of media in learning mathematics at the Faculty of Tarbiyah and Teacher Training at UIN Sulthan Thaha Saifuddin Jambi. Descriptive methods are used to analyze lecturers' abilities in managing learning, student activities, student responses, and student learning outcomes. Based on the descriptive analysis of the research findings, it can be concluded that the integration of instructional media in Mathematics Learning at the Faculty of Tarbiyah and Teacher Training at UIN Sulthan Thaha Saifuddin Jambi has proven effective. This can be seen in the effectiveness of the lecturer's ability to manage learning, the active participation of students, the positive response of students to learning, and the overall achievement of learning outcomes. In this way it can be concluded that the implementation of media in Mathematics Learning at the Faculty of Tarbiyah and Teacher Training at UIN Sulthan Thaha Saifuddin Jambi has proven successful and produced effective results.

Keywords: Era of Digitalization, Mathematics Learning Media, Technology Transformation

INTRODUCTION

Education is always closely related to the development process, because through education progress is achieved in improving the quality of human resources. Improving the quality of education is a major concern for developing countries, including Indonesia. Although various efforts have been made to overcome this challenge, the results are still not optimal. In this context, educational technology has a very important role in the field of education, with a focus on addressing human learning problems through complex and integrated processes, as well as making a unique contribution in efforts to improve the quality of education [1]

Currently, students are learning in the digital disruption era described by Kerr & Kelly [2] as "environmental disruption due to digital technology". They describe digital transformation as a phenomenon of "systemic shock" arising from a number of innovations that are related to one another. Digital resources have overflowed in the classroom environment and other learning situations, and many educational activities are currently being carried out in virtual form [3] . The impact of modern technological disruption has penetrated almost all aspects of daily life, including in the education sector.

According to Samala et al [4] , drastic changes have occurred in the learning process, switching from face-to-face or classroom methods to integrated learning that relies on technology. Disruption creates a new learning model characterized by innovative and extensive interactions. In facing challenges in the era of disruption, an educator must have the ability to think at a high level, be analytical, and creative as some of the key competencies needed [5] [6] .

The use of technology plays a very significant role in the learning process, especially in the context of teaching mathematics [7] [8] . In mathematics lessons, students are faced with the challenge of turning abstract ideas into more tangible concepts and understanding them while engaging in practical actions. This is where technology-enabled education plays a crucial role, as it helps students to not only concretize complex abstract concepts, but also facilitates understanding of concepts through the use of familiar types of visualizations and theorems, as well as multidimensional approach to study.

The application of technology in learning mathematics also increases the ability of lecturers to emphasize problem solving and conceptual understanding in creative ways and engage students cognitively. By utilizing technology, understanding mathematics and solving problems can be more easily achieved. One way is through the use of technology in the delivery of teaching materials.

Even though the positive opportunities from combining technology in the mathematics learning process are very interesting, the facts that occur do not fully reflect this. The use of technology in learning mathematics has not yet reached its peak. Several studies have found that the implementation of technology in learning mathematics in the classroom is still limited. This problem is a significant thing that requires attention. The principle of implementing technology integration in mathematics learning is basically to avoid the use of technology which can result in students' lack of understanding of mathematical concepts and mathematical intuition skills [9] [10]

In utilizing technology in learning mathematics, educators need to ensure that the use of this technology does not replace conceptual understanding, but instead supports students' conceptual understanding [11] . Technology should be used as a tool to help illustrate mathematical concepts more visually and interactively, so as to strengthen students' understanding. In addition, technology can also be used to facilitate mathematical exploration, solve problems, and improve students' critical thinking skills and creativity [12] .

In the application of technology, there are several foundations that underlie technological principles including the application of technology in learning must always consider the characteristics of students, educators, and education staff [13] . This needs to be designed with the aim of increasing student interest and motivation in utilizing technology to develop their intellectual, spiritual, social and physical abilities. However, the application of technology must also ensure that students are aware of the importance of direct interaction with humans and the environment, so that they do not become too focused on technology and ignore interpersonal relationships [14] . Even though using technology, it is also important to teach students to respect and appreciate the application of technology, even the simple ones. The purpose of applying technology in learning is to improve students' ability to think creatively and innovatively.

Learning media plays an important role as a crucial element that supports the teaching and learning process. In this case, it is important to adapt learning media with the ongoing development of information and communication technology [15] . Digital learning media is the right choice to keep up with the rapid development of today's technology. The use of digital media and educational technologies enables better support for learners with diverse learning abilities and creates more educational opportunities.

A number of studies related to the incorporation of digital technology in mathematics learning have shown positive results. Findings from research studying the development of instructional media using Macromedia Flash revealed that the developed media received positive responses from students with a very high level of attractiveness [16] . Another study that focused on the application of game-based media through the Quizizz application stated that this approach was able to improve students' mathematics learning outcomes [17] [18] .

In addition, various other studies that emphasize the development of digital technology in mathematics learning also conclude that the digital media used meets the criteria of validity, practicality and effectiveness [19] .

Applying technology and media in the learning process brings complex challenges. Developing lesson plans that reflect real life is often a complex task. Therefore, digital media that is able to represent the real world and its problems is very essential in the classroom, so that students can be trained in solving problems in real contexts. The successful use of learning media requires detailed planning. A thorough analysis that considers various aspects, such as learning objectives, student characteristics, learning facilities, time allocation, and teacher abilities, is an important factor to ensure the effective use of media.

Based on the previous explanation, the evaluation of the success of technology integration can be measured based on the extent to which students can utilize various technological tools to assist them in solving problems and increasing their understanding of learning material. In addition, the success of technology integration is also related to the availability of the types of technology available and the level of affordability for students. The most fundamental factor in achieving successful technology integration is the determination of teachers to continue learning and innovating so that the learning process remains relevant to technological developments.

RESEARCH METHODS

This research uses a qualitative descriptive approach, with the application of descriptive statistical analysis to evaluate the effectiveness of media in learning the basics of mathematics for students at the Tarbiyah and Teacher Training Faculty of UIN Sulthan Thaha Saifuddin Jambi.

This research measures learning effectiveness based on four main indicators: (1) lecturer skills in managing the learning process, (2) level of student participation and activeness during learning, with reference to the ideal time for each activity. (3) student activity (4) learning completeness, measured through individual completeness (a student is considered to have completed learning if he has the ability to absorb a minimum of 70% of the maximum score of 100) and classical completeness (a minimum of 80% of students achieve individual completeness).

If all these aspects meet the criteria for learning completeness, then learning using integrated digital learning media in mathematics learning is considered effective. The data analyzed in this research includes the lecturer's ability to manage learning, student activities during learning, student responses to learning, and student learning outcomes.

Data Analysis Lecturer skills in managing the learning process

Observations of lecturers' abilities in managing the learning process are expressed in the form of assessments with the categories "Very Good", "Good", "Fair", "Poor", and "Not Good". Each of these values is then broken down by referring to the observation aspect table according to the situation. The lecturer's expertise in managing learning is considered effective if each RP S score in each aspect assessed is in the minimum "good" category. The aspects he observed included: arousing student motivation, conveying learning objectives communicatively, reminding students of prerequisite material, providing challenges through learning media, giving students opportunities to ask questions about things they don't understand, organizing student groups, guiding students in solving problems, guiding students in collecting relevant information related to problems, leading debates in class, encouraging students to ask and answer questions, respecting various student opinions, directing students to conclude the material they have studied, and providing exercises or quizzes through learning media.

The data were obtained from the results of lecturer observation sheets and student activities where the formula used to find the percentage of lecturer activity was by means of the total score obtained in the observation divided by the number of aspects observed (maximum) multiplied by one hundred percent.

$$Percentage\ of\ activeness = \frac{total\ score\ of\ observations}{maximum\ total\ score} X\ 100\%$$

Analysis of Student Activity Data

The effectiveness of student participation is determined by the extent to which the activities carried out are in accordance with standard activities that are considered ideal, which are explained with reference to the time set as the standard. The time standard that is considered ideal can be found in the table of time criteria

that are considered optimal for various student activities. Student activities are considered successful if the average time required for each aspect observed in the entire Semester Learning Plan is in accordance with the ideal time limit that has been set.

Data obtained from the results of student activity observation sheets were analyzed using a formula.

$$AP = \frac{\sum P}{\sum p} X \, 100\%$$

Information:
AP = value sought
∑P = student activity
∑p = number of student activities

Analysis of Student Response Data

The results of the student response survey were analyzed in percentage form. Student responses are considered positive if the percentage of positive responses for each aspect examined reaches a minimum of 82%.

Data analysis of student study results

Data analysis of student learning achievement results is carried out to describe the level of achievement of student learning objectives. The data analyzed in this case is the posttest data. A student is considered to have achieved individual completeness if the value obtained by the student reaches 70% or more of the total possible score. Meanwhile, overall learning mastery is considered achieved classically if more than or equal to 80% of the total number of students in the class have achieved learning mastery on the topic in question, namely flat shape material in this case. Mathematics learning media is considered successful if all the four criteria above are met.

RESULTS AND DISCUSSION
Research result

Descriptive statistical analysis method is used to evaluate the effectiveness of mathematics learning media in teaching flat shape material. The processed data includes information about the lecturer's ability to manage learning, student activities during learning, student responses to learning, and student learning outcomes.

Evaluation of Lecturer Competence in Learning Management

Observational data related to lecturer competence in the aspect of learning management is expressed through score classifications which include the categories "very good," "good," "adequate," "poor," and "not good." These scores are then described with reference to predetermined criteria regarding the lecturer's ability to manage the learning process.

Table 1. Data regarding the Teacher's Classroom Management Proficiency

Lecturer activity	Score	Classification
Inspire enthusiasm in learning efforts	4	Good
Provide clarification regarding learning objectives.	5	Very good
Refreshing the concept of material that is a prerequisite.	5	Very good
Presenting challenges or problem situations through learning materials.	4	Good
Allowing students to ask questions related to learning content that has not been understood through the media used.	5	Very good
Divide students into groups.	5	Very good
Guiding students in finding solutions to a problem.	4	Good
Maximize interaction between students in group discussions.	4	Good
Directing students in gathering relevant information to solve a problem.	4	Good
Directing and managing discussions in class.	5	Very good
Give appreciation to the views and opinions expressed by students.	5	Very good
Encourage students to formulate conclusions from the learning material that has been completed.	5	Very good

Analysis of Student Activity Data

The effectiveness of student activities depends on the extent to which these activities are in accordance with the ideal pattern reflected in the allotted time.

Table 2. Percentage of Student Activities in Learning

Observation Aspect	Average
Listen to explanations from lecturers or colleagues.	64 %
Gain an understanding of the problems presented in the learning materials.	72 %
Finding a solution to a problem.	80 %
Participate in discussions with colleagues actively.	89,64 %
Carry out activities related to the learning process.	85,28 %
Formulate conclusions based on procedures or concepts that have been studied.	21 %
Carry out activities that are not related to the learning process.	10,2 %

From Table 2 above, it can be seen that the percentage of student participation in each aspect observed during the learning process has met the ideal time standard that has been set. Therefore, it can be concluded that student activities have been effective.

Analysis of Student Response Data

Data from student response questionnaires were analyzed through percentage calculations. Student responses are considered positive if the percentage of positive responses for each aspect asked reaches at least 82%.

Table 3. Student Responses to Learning Activities

Statement	Student response		Percentage of Student Responses	
	Yes	No	Yes	No
Feel happy with math lessons.	23	2	92	8
Shows enthusiasm in learning mathematics.	25	0	100	0
Participate actively in following math lessons.	22	3	88	12
Have an interest in mathematics.	25	0	100	0
Pay close attention to the lecturer's explanation.	22	3	88	12
Happy to participate in discussions with friends.	21	4	84	16
Ask questions to the lecturer when you don't understand the material.	21	4	84	16
Actively involved in group discussions.	21	4	84	16

Analysis of Learning Outcomes Data

Table 4. Student learning outcomes

Completeness Criteria	great Student	Percentage
Complete	22	88
Not Completed	3	12

Table 4 shows that the average score of learning outcomes reaches 88. If you pay attention, the class has succeeded in achieving the set classical learning mastery level, which is 80%. This fact can be seen from the number of students who achieve mastery learning individually, where 22 out of 25 students, or around 88%, succeed in achieving this standard. This description indicates that the use of integrated media with mathematics learning has been effective in achieving classical learning mastery.

DISCUSSION

Based on the research findings above, effectiveness indicators show results that exceed the minimum criteria that have been set. Evidence of this can be found in the data regarding the ability of lecturers to manage learning which has achieved good and very good categories. In addition, student participation also shows that the percentage of student involvement in each aspect observed during the learning process is within the expected range of time tolerances. Student responses have also reached a positive level, which is reflected in the achievement of positive responses from students for each aspect with a rate that exceeds 82%. In addition, if you look at the achievement of classical learning completeness which is set at 80%, the class has succeeded in achieving it. This can be seen from the number of students who managed to achieve the level of mastery learning individually, namely 22 out of a total of 25 students, or around 88%. In conclusion, learning media that are integrated in learning mathematics have proven effective based on evaluating the ability of lecturers to manage learning, student participation, student responses, and achievement of student learning outcomes.

The findings from this study are in line with some previous research which has indicated that digital learning media has very high effectiveness in various aspects, including student and lecturer engagement, student responses, and student learning test results [20] [20] [21] . Other studies have also noted that in each aspect of managing the learning process, student activities during learning, student learning outcomes, and student responses after participating in learning, all meet good standards, indicating that the application of instructional media in learning mathematics is significantly effective [22] . In line with this, other studies have also found increased motivation in the form of positive responses from students in using digital media in learning mathematics [24] [24] .

The role of technology in the context of mathematics education involves a significant role as an alternative teaching tool that is efficient and effective in supporting students' understanding of abstract mathematical concepts. In the realm of learning mathematics, two fundamental aspects consisting of mathematical knowledge and mathematical practice are the main focus. In relation to aspects of mathematical knowledge, technology plays an important role as a learning instrument that supports students' efforts to solve various mathematical problems in an effective and efficient way. Meanwhile, in the aspect of mathematical practice, technology acts as a learning tool that integrates its role in assisting students in the process of exploring and understanding complex mathematical concepts. The existence of technology in learning mathematics is essential for optimizing the educational process and having a positive impact on the mastery and application of mathematical concepts by students.

CONCLUSION

The results of this research indicate that the use of integrated learning media in mathematics learning is effective. Lecturers have succeeded in demonstrating good skills in managing the learning process, such as stimulating enthusiasm for learning, providing clarification of learning objectives, and encouraging interaction between students. Student participation in learning reaches the set ideal time standard, indicating that student activities are running according to the expected pattern. Students' positive responses to learning mathematics also reached a sufficient level, with the percentage of positive responses exceeding 82% for each aspect asked. Student learning outcomes are also encouraging, with a classical learning mastery level of 80% successfully achieved, with around 88% of students succeeding in achieving it. In the context of learning mathematics, the use of technology as a learning tool has proven to be efficient and effective in increasing students' understanding of abstract mathematical concepts. In conclusion, integrated learning media in mathematics learning has a positive impact on lecturer abilities, student participation, student responses, and student learning outcomes, as well as supporting the overall quality of mathematics education.

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