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Use of the MIT App Inventor Platform Based on Projects to Improve Students' Productive Struggle

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Abstract

This research aims to analyze the increase in students' productive struggles by using the project-based MIT App Inventor digital platform. The integration of technology with the use of the MIT App Inventor digital platform in learning can increase teacher innovation and creativity in teaching, so that it can motivate students and foster student learning independence so that educational goals can be achieved in strengthening the Pancasila student profile and fostering student enthusiasm and fighting power in learning mathematics. Project-based learning can make the learning atmosphere livelier and more interactive because students are actively involved in learning. The research method used is a mix method research method with a Concurrent Embedded design. This research was conducted at SMP Negeri 2 in Cimahi City with research subjects of 25 class VIII students. The results of this research by implementing the project-based MIT App Inventor digital platform can increase students' productive struggles in learning mathematics.

Keywords: productive struggle, mit app inventor, project-based learning, mathematics education, digital platform.

Introduction

21st-century learning currently demands that students and teachers be skilled in using technology. This is supported by the implementation of the Independent Curriculum, which encourages teachers to integrate technology into learning and actively engage students, thus optimizing learning. The problem of mathematics as a difficult and uninteresting subject for students, coupled with low student motivation, requires solutions from teachers, especially in the current digital era. Online learning requires students to learn independently and creatively. This presents difficulties for students because the media used does not yet meet their needs (Jojor & Sihotang, 2022). Therefore, to address this issue, teachers need to be encouraged and fostered to be creative in designing innovative and creative learning media oriented to student learning needs. Teachers need to upgrade their knowledge of technology and information. Most schools in Cimahi City have been categorized as driving schools and implement the Independent Curriculum.

In the Independent Learning era, all educational communities need to work together to find effective and rapid solutions to educational conditions and problems, in order to improve the quality of education (Dewa et al., n.d.). With the continuous advancement of technology, the use of ICT (Information and Communication Technology) in today's learning process is crucial. Integrating technology with the MIT App Inventor digital platform in learning can enhance teacher innovation and creativity, thereby motivating students and fostering independent learning, thereby achieving the educational goal of strengthening the Pancasila learner profile. The use of learning media can foster student motivation and enthusiasm for learning, particularly in mathematics, making it easier for students to understand the material, thus accelerating the achievement of learning objectives (Prananta, 2021).

Project-based learning can create a more lively and interactive learning environment by actively engaging students in the learning process and fostering student resilience, thus increasing their productive struggle (Muskania & Wilujeng, n.d.) (Baker et al., 2020). The use of the MIT App Inventor project-based digital platform in mathematics learning needs to be optimized to improve the quality of learning, thereby achieving the educational goal of achieving the Pancasila learner profile and increasing student productive struggle. This study contributes to mathematics education research by emphasizing the theoretical relationship between project-based digital learning and productive struggle in the Indonesian junior high school context.

The current learning conditions, especially mathematics learning, still rely on teacher explanations and direction. Learning activities are still unstructured because students are focused on the projects to be produced, not oriented to the learning processes carried out, and there is no digital platform that accommodates teaching materials and records the learning process. This results in less conducive learning, because the learning process and concept discovery by students are still not optimal, the expected competencies have not been achieved and there is no platform that can be used to facilitate the student learning process (Nisa & Amelia, 2021). The impact and problems that occur are the lack of meaningful learning for students, so that the implementation of the independent curriculum to achieve the profile of Pancasila students has not been realized, likewise the objectives of 21st-century learning by integrating technology in learning are still not optimal (Dewa et al., n.d.) (Jojor & Sihotang, 2022). Therefore, it is necessary to design a digital platform using the MIT App

inventor Project to increase student productive struggle so that teachers and students are able to adapt technology in learning.

Method

This study involved 25 eighth-grade students from SMP Negeri 2 Cimahi selected through purposive sampling. The productive struggle questionnaire was validated by experts and tested for reliability using Cronbach's Alpha before implementation. Qualitative data were used to support quantitative findings through triangulation techniques. The intervention was conducted during mathematics learning on quadrilateral topics using a project-based learning approach integrated with the MIT App Inventor platform. This research uses a mixed method research method with a Concurrent Embedded design (a combination of collecting quantitative and qualitative data simultaneously or sequentially where one form of data plays a supporting role for the other form of data) (Cresswell & Plano Clark, 2011). The steps of this research are (1) Formulating the problem, (2) Theoretical review, (3) Collection of qualitative and quantitative data, (4) Analysis of qualitative and quantitative data, (5) Presentation of research data, (6) Conclusion.

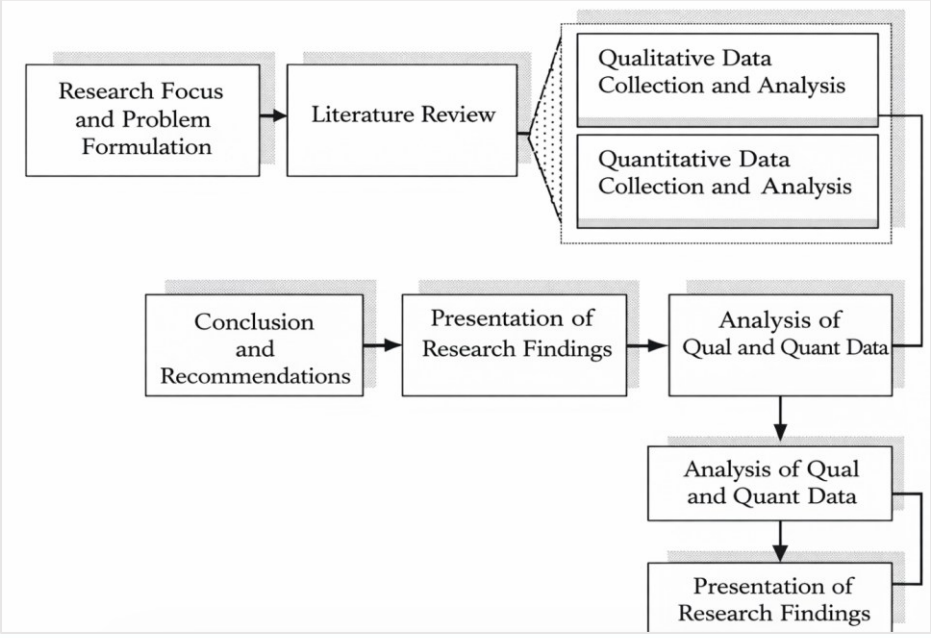

Figure 1. Steps of Concurrent Embedded Research

The use of mixed methods data collection in this research is believed to facilitate researchers in explaining the research objectives and in obtaining complete, reliable, and

objective data and information. By using a combination of methods, the information obtained can be corroborated with data obtained through both qualitative and quantitative approaches.

Results and Discussion

Results

The qualitative data processing in this study examined the validity and feasibility of the MIT App Inventor project-based digital learning platform by three validators, including a media expert, an IT expert, and a learning expert. The MIT App Inventor digital platform was designed to integrate project-based learning. The learning stages adhere to the syntax of the project-based learning model, enabling students to be more interactive.

Here is the design of the MIT App Inventor platform that was designed.

Figure 2. Project-based MIT App Inventor platform

The following are the validation results from 3 validators, including media experts, IT experts, and learning experts.

Table 1. Recapitulation of Validation Results

No.	Component	Validator I	Validator 2	Validator 3	Average	Criteria
1.	Rationale	3,5	3,7	3,5	3,57	Very Valid
2.	Media Development Foundation	3,6	3,5	3,75	3,62	Very Valid
3.	Basic Principles of the Model	3,5	3,65	3,5	3,55	Very Valid
4.	Syntax	3,65	3,45	3,55	3,55	Very Valid
5.	Support System	3,25	3,45	3,25	3,32	Very Valid
6.	Social System	3,55	3,5	3,5	3,52	Very Valid

7.	Instructional Impact and Accompanying Impact	3,5	3,5	3,52	3,51	Very Valid
		Total			24,62	
		Average			3,52	Very Valid

The average validation result from 3 validators regarding the MIT App Inventor project-based digital platform is 3.52 with very valid criteria. This shows that the learning platform is valid and suitable for use in terms of several aspects, the assessment is based on the components: 1) Rationalization, 2) Media Development Foundation, 3) basic principles of the model, 4) Syntax, 5) Support System, 6) Social System, 7) Instructional Impact and accompanying impacts. The validation result by three experts through Focus Group Discussion (FGD) obtained an average of 3.52 which shows that the digital learning platform is very valid and effective to be implemented with several notes, namely slight revisions that need to be added and adjusted based on the input of these experts. Inputs submitted by media experts include the component of the media development foundation must show a closer relationship between the legal, empirical, and theoretical foundations. Meanwhile, IT experts suggest that more adequate facilities/means be provided so that the learning model is more optimally applied to students. Meanwhile, from learning experts, the input submitted is that the model principles must be more relevant to one another. Researchers used the input from these experts as evaluation material so that the project-based MIT App Inventor digital learning platform could be implemented well for students in mathematics learning.

The improvement in productive struggle can be measured through several indicators that can be achieved and analyzed based on quantitative data using a dependent two-sample statistical test by comparing the pretest and posttest scores of the same subjects to determine the increase in students' productive struggle. A non-test instrument/questionnaire based on indicators of students' productive struggle was administered during both the pretest and posttest.

To determine the improvement, the pretest, posttest, and N-gain data were analyzed using the following hypotheses:

H_0: $\mu_1 \leq \mu_2$ (The students' productive struggle after the implementation of the project-based MIT App Inventor digital learning platform is not better than before the implementation of the project-based MIT App Inventor digital learning platform.)

H_1: $\mu_1 \geq \mu_2$ (The students' productive struggle after the implementation of the project-based MIT App Inventor digital learning platform is better than before the implementation of the project-based MIT App Inventor digital learning platform.)

The following are the results of the statistical tests produced:

Table 2. Statistical Test Results

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PRETEST - POSTEST	-13.077	11.996	3.327	-20.326	-5.828	-3.930	12	.002

Based on Table 2, the statistical test results regarding the increase in students' productive struggle show a Sig (1-tailed) value of 0.002/2, which is 0.001 < 0.05. Therefore, the hypothesis (α) is rejected and the hypothesis (β) is accepted. Therefore, students' productive struggle after implementing the MIT App Inventor project-based digital learning platform is better than before implementing the MIT App Inventor project-based digital learning platform. It can be concluded that students' productive struggle increased after implementing the MIT App Inventor project-based digital learning platform.

Discussion

Based on the results of field data analysis regarding the MIT App Inventor digital platform, which was designed to integrate project-based learning, the implementation of the MIT App Inventor digital platform is suitable for use in learning quadrilaterals, as seen from the results of the platform validation analysis according to input from validators. This is supported by (Edriati et al., n.d.-a) who stated that MIT App Inventor is an Android-based application that can be engaging for students and teachers in learning and facilitates student understanding of the material being taught. The project-based learning stages implemented using the MIT App Inventor digital platform for eighth-grade students at SMPN 2 Cimahi significantly assisted teachers in exploring student knowledge and fostering students' self-discovery of concepts. Students were able to discover the properties of quadrilaterals based on their activities. The learning stages adapted the syntax of the project-based learning model. The MIT App Inventor platform is accessible to students on their Android devices/mobile phones, making it easier for them to use the application. Learning was also more interactive,

as students could work directly on their Android devices (Edriati et al., n.d.-b). The learning material analyzed in this study was quadrilaterals. Through the project, students were able to identify the properties of quadrilaterals and discover the relationships between them.

The implementation of project-based learning through the MIT App Inventor platform fostered students' resilience and encouraged them to explore their potential. Concept discovery through teamwork can enhance students' productive struggle. The increase in students' productive struggle can be seen from several indicators that develop in students, such as facing challenges with optimism and perseverance to achieve better understanding (Arifin, 2022). Through project-based learning, students can discover concepts independently through the activities and stages of project-based learning that are applied, learning focuses on the process in which students face challenges or difficulties in understanding new concepts, but they remain persistent in solving these problems. (Mefiana et al., 2023) states that productive struggle is one of the soft skills that is very important for students to have, because students who have high productive struggle will have better mathematical understanding abilities. This is also supported by (Melani et al., 2023) (Fitriyaningsih et al., 2023) productive struggle can encourage students to be involved and active in the learning process, pay attention to student progress in solving relatively complex tasks, involve critical thinking, and really pay attention to the steps decided to achieve learning goals. (Permatasari & Pd, n.d.) Productive struggle provides students with the opportunity to build knowledge and to examine and restructure that knowledge. These findings indicate that teachers can utilize digital project-based platforms to encourage active participation, collaborative problem-solving, and student persistence in mathematics learning.

Conclusion

The project-based MIT App Inventor digital platform is suitable for use in mathematics learning. Students' productive struggle after implementing the project-based MIT App Inventor digital learning platform is better than before implementing the project-based MIT App Inventor digital learning platform. Therefore, it can be concluded that productive struggle increased after implementing learning using the project-based MIT App Inventor digital platform. However, this study was limited to a small sample from one school

without a control group; therefore, further studies with larger and more diverse samples are recommended.

Ethical Considerations

Permission to conduct the research was obtained from SMP Negeri 2 Cimahi. All participants were informed about the purpose of the study, and student data confidentiality was maintained throughout the research process.

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