Research and Innovation in Social Science Education Journal
Vol. 1 No. 2 December 2023 (83-89)
https://ejournal.ump.ac.id/index.php/rissej
ISSN: 3026-457X

Collaboration of a STEM-Based Blended Learning Model to Enhance Mathematical Comprehension

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ARTICLE INFO

Keywords:

Blended Learning; Digital-Based Innovation; Education; Pandemic; STEM approach

DOI: 10.30595/rissej.v1i2.127

ABSTRACT

Paradigms in the era of digitalization, particularly in the field of education in the use of Blended Learning in collaboration with the STEM approach (Science, Technology, Engineering, and Mathematics) as a guide for teachers in technological development capable of raising the standard of education in Indonesia. In class 5 SD N 3 Bangsa, a quantitative sampling model with probability is used as the research methodology. using observational and questionnaire data gathering methods, up to 32 students served as respondents. According to the statistical analysis, there is a substantial correlation between STEM-based Blended Learning and primary school student grasp of mathematics, with a significance value of 0.668. Blended Learning with a STEM focus significantly enhances students' mathematical comprehension of cube nets. Students struggle with smartphone operation uncertainty. It is okay to apply this learning technique for teaching social sciences, math, and science.

1. Introduction

Building an existence as a nation of character is the problem facing the Indonesian nation in the 21st century. Due to children's propensity for being interested in tech-related topics, it plays a significant part in developing a country of character in this age of digitalization. Due to the influence of science and technology development, curriculum, technology, and media changes are the first step in the shift in learning paradigm. Using technology and communication science to understand learning is one of the requirements of 21st-century education. The ability of teachers in Indonesia to use technology into the process of learning activities remains a major challenge. To discover creative solutions and new regulations pertaining to the use of digital technology in the learning process, it is necessary to identify this global divide. (Haryanto, 2018).

The integration of students, the learning environment, and the body of knowledge results in a successful learning system. Because they must acquire the essential knowledge and abilities, students are the true creators of learning.(Crittenden et al., 2019; Suharti et al., 2020). Education institutions are in charge of producing skilled and competitive workers since the new world of advanced digital technology demands it. In turn, widespread digitization necessitates new management strategies for institutions of higher learning that are outlined in the advancement of science and technology. These strategies include reorganizing educational processes, redefining instructors' roles, and altering management strategies (Kobysheva et al., 2021). Because learning and knowledge creation are co-creative processes that incorporate emotional intelligence, social learning, and independent learning and are most successfully created by teachers, even with today's modern technology, the teacher's job should not be supplanted by a digital platform (Yangari & Inga, 2021). Students can actually be the subject of interactive learning activities; they are not merely passive participants in "silent" learning activities. From this point on, traditional learning must progressively be changed or upgraded to a paradigm that encourages student involvement (Aka, 2017)

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Received July 08, 2023; Received in revised form Sept 15, 2023; Accepted Dec 15, 2023; Available online Dec 20, 2023
3026-457X/

One of the sectors with a vital function in enhancing the caliber of human resources is education. It is ideal for teachers to use technological advancements in education to help student reach their full potential rather than the other way around. Students from the millennial generation and older generations have extremely varied skills when it comes to using information technology in this digital age. So that it can be used as a valuable addition to help student learning activities in the classroom once technology is provided and mastered. (Sari, 2021) In addition to using traditional teaching methods, educators must also integrate technology. Therefore, it is necessary to raise teacher standards in order to raise educational standards (Hazmi et al., 2021). In addition to learning how to use a variety of technologies, teachers also pick up new teaching techniques, thus they must revisit their pedagogical assumptions in order to properly incorporate technology into student learning. Teachers can actively participate in creating an innovation in learning to assist them achieve the transformative change they desire (Agélii Genlott et al., 2021) Primary school instructors can more easily organize lessons and deliver them because to digital integration. The use of technological tools can help teachers perform better while implementing digital-based learning (Jannah et al., 2020)

There are numerous connections between digital competencies and the conceptual prerequisites for the implementation of mixed learning. Consequently, timely assessment of student degrees of digital competence based on the level structure (Bykova et al., 2020) In the current digitalization era, integrated STEM (Science, Technology, Engineering, and Mathematics) study is acceptable and still correlates with the Indonesian curriculum. STEM programs, whether academic or extracurricular, concentrate on the subjects of science, technology, engineering, and mathematics and can offer both structured and unstructured learning environments to assist students comprehend various types of learning. When students interact with the community and the STEM program, STEM strives to inspire them to pursue jobs in the field in order to help them overcome learning challenges connected to comprehending and using the 4 STEM competency areas. (Nguyen, 2019)

STEM is defined as an interdisciplinary approach to learning where academic concepts are connected to the real world, allowing students to apply science, technology, engineering, and mathematics in contexts, fostering a connection between learning in schools, the community, the workplace, and multinational corporations (Kurniawan, 2021). A variety of disciplines are included in the STEM learning strategy, and each STEM topic includes practical exercises to enhance student learning (Simarmata, 2020). STEM aims to increase public awareness of its significance. STEM refers to a person's capacity to apply knowledge of the connections between four fields—science, technology, engineering, and mathematics (Kahriyah, 2019) . Modules, lesson plans, learning media, worksheets, learning videos, and assessment tools make up the STEM approach's constituent parts. It is important to promote today's innovative learning because STEM education in the age of digitalization is a different type of education that can prepare future generations to tackle the 21st century (Firdaus & Hamdu, 2020).

Blended learning is one of the formal educational programs that may be described as a combination of in-person instruction and online learning, according to Graham (2013). (Polat, 2020). The Blended Learning learning model places restrictions on the teaching and learning processes that take place in the classroom. In Indonesia, blended learning is genuinely adequate and appropriate to be adopted gradually. The application of this teaching strategy should be possible with the advancement of technology and communication. While STEM itself is studying real life problems to find the right solution for each problem and can be creative and critical. According to Sartika, in the era of global competition, Indonesia also needs to provide skilled human resources in implementing quality implementation of STEM components. The concept of STEM education is very possible to be used in the 2013 Curriculum, with concept equations that are integrated in various concepts in the field of knowledge (Sartika, 2019).

Due to the combination of digitalization of learning from the Blended Learning learning model and solving real-life problems in a STEM approach, the learning strategy between the STEM approach and Blended Learning is an innovation that may be well collaborated.

There is a need for technology as a medium to supply learning materials, notably in learning mathematics, specifically cube nets in grade 5. The Covid-19 issue has made it necessary to implement learning that is carried out from home (online). A class scope based on technology is created by this circumstance. The STEM method places a strong emphasis on learning from real-world situations in order to critically and creatively choose the best answer for each one. A mixed learning model is used as a supporter to optimize learning activities in order to maximize STEM performance, specifically in the sector of technology. One approach to addressing the aforementioned issues is the blended learning concept. Combining online and offline learning is known as blended learning. The Blended Learning learning model places restrictions on the amount of teaching and learning that can take place in the classroom. In order to increase the quality of education, it is acceptable and harmonious to combine the blended learning learning

model with the STEM approach. This is done by taking into account the existing situation and conditions (Nopitasari et al., 2021).

According to the research by Erna Nopitasari, Fitri Puji Rahmawati, and Wahyu Ratnawati, this study demonstrates how a variety of internal and external student characteristics affect learning results when employing blended learning models with blog media. (Nopitasari et al., 2021). The findings of the study by Herlin Yanti, Lisa G. Kailola, and Dameria Sinaga are the outcome of the discussion of the current issues with the application of teacher digitalization competences in blended learning since teachers have not implemented the blended learning model optimally (Yanti, 2022) Based on the findings of a literature analysis, blended learning with a STEM approach that solely uses the three-space model can still significantly and successfully develop students' critical thinking abilities (Wahyunita & Subroto, 2021). Based on the findings of prior studies, the STEM-based Blended Learning learning model can be utilized for the foreseeable future by modifying the relevant curricula and taking into account the digitalization era. The STEM approach has other advantages as well, one of which is an intriguing learning strategy to teach children how to reason logically before having them solve actual world problems and master technology.

2. Method

Quantitative approaches are used in this investigation. The process of using quantitative research methodologies involves gathering and analyzing data. The population was used by the study's participants or informants. As a data source, the population is the entire subject. The sampling methodology makes use of probability sampling, a sampling method that gives every member of the population an equal chance of being chosen as a sample member. The 33 children that participated in this study were all fifth graders at SDN 3 Bangsa, including 15 boys and 18 girls. Observation and questionnaires or questionnaires were the instruments utilized in this investigation. The distribution of questionnaires is intended to ascertain students' opinions about STEM-based Blended Learning, which can enhance mathematics comprehension.

Thirty two (32) of the thirty three (33) students at SDN 3 Bangsa who have participated in a series of cube-netting math courses using Blended Learning and STEM collaboration participate in the lessons. Due to illness, 1 student missed the lesson. This Blended Learning activity makes use of a live worksheet with a variety of student responses to carry out the online learning process for them for the first time, followed by offline learning on cube nets learning material with the idea that students follow the instructions on how to make cube nets and find other cube nets. Used cardboard and scrap paper are used as the cube net-making materials in the STEM approach to learning cube nets.

At SDN 3 Bangsa, learning starts offline or face-to-face in grade 5. Both the teacher and the student pray before beginning their studies. The teacher then inquires about the students' news and attendance before beginning the lesson. By asking the class "How to construct a gift in the shape of a cube and how to make a cardboard," the teacher is teaching perception. The instructor explains the goals of the lesson and the advantages of studying cube nets. "In order that you construct this cubic space in accordance with the theory or the laws." Additionally, we use the YouTube platform developed by the Spekta Mathematics channel to convey the content with animated learning movies so that kids are not bored. (https://www.youtube.com/watch?v=sDDDYg5Iwkw).

Fig 1. Educational Video

The instructional movies are closely watched by both teachers and students. After that, the teacher had the student practice making cube nets out of cardboard and paper, which they would then put together to form a cube. Students are given plain paper, instructed to cut out the cube's grid pattern, and then asked to put the pieces together to form the cube. Students are then instructed to construct variously patterned cube

nets. The teacher also assigns LKPD to students online using a live worksheet once they have mastered the cube nets (https://www.liveworksheets.com/rz3121908us).

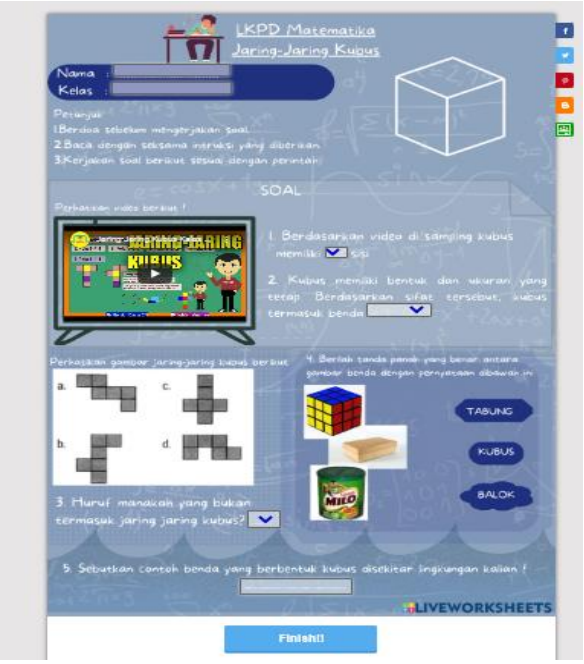

Fig 2. Live worksheet

Additionally, the teacher can immediately see the results of student work on a live worksheet and recapitulate them. Results of student work on the LKPD Liveworksheet show that 25 students received scores of 10, 5 received scores of 8, and 2 received scores of 7. As a benchmark criterion, this study uses a Likert scale technique with a validation range of 1 to 4. According to Paranatawijaya, utterances with a score of 5, 4, 3, 2, 1 on the Likert scale are considered to be positive. (Pranatawijaya et al., 2019).

Table 1. Skala Likert

Respond	Score
Strongly Agree	4
Agree	3
Disagree	2
Storngly Disagree	1

By comparing the scores of each question item with the sum of all the scores for each item, validity testing is done using a product moment. strong agreement strong disagreement strong agreement (Ningtiyas et al., 2019).

Table 2. Pearson Validity Test

r_{value}	Conclusion
$r_{value} > r_{table}$	Valid
$r_{value} < r_{table}$	Invalid

3. Result and Discussion

The goal of the correlation test is to assess the strength of the association between variables as reflected by the correlation coefficient (r). There are both positive and negative relationships between blended learning, the STEM approach (variable X), and Mathematical Comprehend (variable Y). It is associated if the significant value is 0.05, and it is not correlated if the significant value is > 0.05.

Table 3. Correlation

		Blended Learning	Mathematical Comprehend
Blended Learning and STEM Approach (X)	Pearson Correlation	1	.668**
	Sig. (2-tailed)		,000
	N	32	32
Mathematical Comprehend (Y)	Pearson Correlation	.668**	1
	Sig. (2-tailed)	,000	
	N	32	32

Based on the findings of the research instrument, the following validity, reliability, and Pearson correlation tests were performed using SPSS software. There were 12 valid and 2 invalid assessment instruments utilized in the validity test, which included 14 assessment instruments in the form of a questionnaire. The value of the r table with n = 32 and 5% significance in the distribution of the r table's value in statistics is 0.349, and the Cronbach's Alpha reliability value is 0.721, which indicates that the results are reliable. The type of correlation between the variables X and Y in the hypothesis test is correlative because, according to the decision's findings, the significance value is less than 0.05, or 0.00, and the strength of the correlation is indicated by the Pearson correlation values of 0.668. In order to draw the conclusion that there is a correlation between the STEM-based Blended Learning learning model to improve mathematical understanding in cube mesh material, the correlation test results between the STEM-based Blended Learning learning model to improve mathematical understanding with a probability of 0.00 < 0.50 (5 percent significance) then Ho is rejected.

In the era of digitization, the use of the STEM-based Blended Learning studying model is quite successful and improves student motivation in learning. According to the findings of Erna Nopitasari, Fitri Puji Rahmawati, and Wahyu Ratnawati, it can be concluded from this study that a variety of internal and external student characteristics affect students' learning outcomes when adopting a Blended Learning model with blog medium. Based on internal elements, such as the infrastructure and facilities for smartphones that students have, while external considerations for these student are school amenities like LCD projectors and wifi.

The findings of Herlin Yanti, Lisa G. Kailola, and Dameria Sinaga's study, namely from the challenges with the application of teacher digitalization competencies Blended Learning , the reason why teachers are not adopting the Blended Learning model optimally. The obligation of the teacher as an educator to enhance education is enormous. Teachers at SDN 3 Bangsa are eager to learn about technology advancements in order to maximize Blended Learning there.

Ika Wahyunita and Waspodo claims, based on the findings of a literature analysis, that Blended Learning with a STEM approach, even when implemented merely using a three-space model, may still significantly and successfully boost students' critical thinking abilities. Before beginning lessons, students are required to bring a smartphone. The teacher then sets up wifi and an LCD projector. All SDN 3 Bangsa grade 5 kids have cell phones, either their own or their parents'. The three experiments—using a smartphone, a wifi network, and an LCD projector—that were conducted in class 5 at SDN 3 Bangsa were generally effective, albeit occasionally students were still unsure how to utilize smartphones and the internet. When using cellphones for online learning, teachers still need to mentor their students.

4. Conclusion

Based on the study's findings, it is possible to draw the conclusion that teaching students to think rationally and logically through the use of cube nets and the STEM learning model can prepare them to solve problems in the real world and understand technology. Students who use this method find it effective in their learning experience. Additionally, I want to mention that we can use smartphones and the internet as learning tools. The validity test statistical findings show that each variable's value is more than 0.349, making it possible to use the study's data because its validity has been established. . The Cronbach Alpha value of 0.721 is greater than 0.60 according to the reliability test findings, indicating that the system is dependable. The correlation variable, which has a significant value of 0.00 and a value of the degree of relationship of 0.668, which indicates that the correlation is strong, is the most important factor in the application of the Blended Learning model based on the STEM approach to improve understanding of cube nets. so that Blended Learning and the STEM approach can work together well and be tested out in various

learning processes. The accepted variables are that students pay more attention to both online and in-person learning in class, can solve a problem, carry out interactions well, and can master the material. STEM-based Blended Learning learning models facilitate learning, students are interested in showing learning videos, doing worksheets online, and can find out how to implement learning materials. Students who seek literacy independently of books or the internet and students who are uninterested in arithmetic coursework based on cube networks are the variables that were excluded.

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