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The Basis of Constructivist Learning Theory Uses A Blended Learning Model To Improve Problem Solving Abilities In Mathematics Lessons

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Abstract

Learning is the most important thing in education. A person is born with a different brain volume, through experiences that occurred during past lives, the memories that occur in each person are different. The constructivist thinking process is in line with this thinking. Past experiences have an important role in constructing knowledge. Various methods continue to be discussed as the best problem solving solutions in mathematics lessons, various literature discusses this, but a clear explanation regarding the learning process with the best learning model remains unclear to determine. The aim of this research is to examine constructivist learning theory in the implementation of educational philosophy with a blended learning model as a solution to problem solving abilities in mathematics lessons. The research method chosen was a systematic literature review. The results of this research are that problem solving in mathematics lessons can be done clearly and in more detail if the learning process is carried out using a blended learning system by applying the basic concepts of constructivist learning theory. The conclusion of this research is that the learning process based on constructivist learning theory using a blended learning model is the right combination as a solution to improve problem solving abilities in mathematics lessons.

Keywords: *Constructivist, Blended Learning, Skills, Problem Solving, Mathematics.*

INTRODUCTION

Learning is a process of thinking and real action by educators and students using certain models with the support of comprehensive infrastructure, (1). Learning normally occurs in interaction between educators and students, (2). Each student is basically like a train whose steering is held by the educator. So even though students can carry out independent learning, they need the right direction and this role is carried out by an educator. In the learning process, a foundation or theoretical basis is needed for students to transfer knowledge.

The foundation of constructivist learning theory is the basic basis for how science can be understood by students, (3). Basically, constructivism makes someone have the ability to imagine thinking about knowledge from experience, mental character, and determination which are used to interpret objects and events. So constructivism has a view that knowledge can be created independently through the knowledge and experiences that students have experienced in the past, (4).

Problem solving abilities in mathematics lessons continue to be explored by researchers from all over the world. It can be seen that this topic tends to be discussed frequently, but there has been no research that explains clearly the basis of constructivist learning theory with a blended learning system in problem solving in mathematics lessons, (5).

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Most researchers only discuss the foundations of constructivist learning theory, only discuss blended learning, and only discuss problem solving in mathematics. Problem-based learning with a blended learning approach significantly improves students' problem solving abilities compared to conventional learning. This shows the effectiveness of the integration of technology and active learning methods in developing students' critical and analytical skills (6).

The importance of integrating blended learning with a community science technology approach in improving student learning outcomes in higher education. This approach allows students to not only gain theoretical knowledge through online learning methods, but also apply that knowledge in real contexts through community-oriented projects, (7). This is in accordance with previous research which shows that blended learning can increase students' learning motivation, self-efficacy and academic achievement, (8).

So discussions related to these three topics are overall urgent to carry out. Problem solving in mathematics lessons, so it is important to continue to carry out studies to compare, find out, analyze, and even find new models that are most effective as the most appropriate tools to use in learning, especially in problem solving in mathematics lessons. There is a significant interaction between students' initial mathematical abilities and the learning model on problem solving abilities. This shows that students with different mathematical abilities can benefit from tailored learning models, thereby enabling a more personalized approach to education,(6). The ideal condition that should occur is that problem solving in mathematics should be clear because the topic about this has been going on for quite a long time, but the reality is different because there has been no research that can explain the unique combination of these 3 things.

Based on observation and interview data from 4 educational units, starting from elementary school, middle school, high school and university from various regions in East Java, Indonesia. It was found that as many as 82% of student respondents experienced difficulties in the problem solving process in mathematics lessons. 78% of educators have not found an effective learning model to use in solving problems in mathematics lessons. Around 92% of teachers need a clear explanation of the basic thinking and appropriate learning methods to be used in solving problems in mathematics lessons. Thus, the researcher determined that this related topic was interesting and urgent for research through a systematic literature review.

METHODS

The method used in this research is a systematic literature review. The basic data used to search for international journal articles are Elsevier, Science direct, Proquest journal, PNRI Journal, and Google scholar. The data collection process includes searching for journal articles using a journal search engine. The article search and narrowing started from 1000 international articles then narrowed down to 500, then narrowed down again to 100, after that a review and selection was carried out to 50 articles. These 50 articles were reviewed and then the results of the review were presented in the form of a systematic literature review.

To get a specific and ideal number of journals. Each journal undergoes an in-depth review of the filters used for article selection, starting from the most general to the most specific in the first stage regarding similarity of topic, type of article, year of publication, journal publisher, quartile in Scopus, then number of pages.

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The review is carried out systematically and complete to get an important and comprehensive meaning in each article so that later it can be compared and studied with other articles. This search and filtering process is carried out comprehensively and in detail so as to obtain articles that are truly good for use as sources for systematic literature reviews.

RESULT AND DISCUSSION

Result

There is no end to the ability to solve problems in mathematics lessons through scientific discussions or debates through international journal articles. There are many methods from all over the country to improve skills to solve problems. The results in this systematic literature review confirm that the constructivist foundation with the application of the blended learning model has a big contribution to improving students' problem-solving abilities.

Each educator has a special model for conducting learning at each level of education, according to the characteristics and character of each student, (9). One that is considered a superior model and is popularly used today is the learning model with a blended learning system, (10). In society, blended learning and hybrid learning are often mixed up. In simple terms, the difference lies in the basic concept of thought. Hybrid learning has the concept of combining online and face-to-face learning processes over a certain period of time. Meanwhile, the blended learning model combines joint learning and independent learning modes, (11).

Apart from that, there are still often complicated discussions between E-learning and blended learning, this can be found in international articles and it is still a hot topic being discussed. Even though these two models have their own characters. A very basic difference is that in E-learning there is no reciprocity between educators and students, because students and educators cannot have direct discussions, students only carry out one-way learning, namely learning with media, (12). However, in the blended learning model, this weakness can be covered because in this model there is a direct interaction process in the learning process through face-to-face learning.

The main feature of learning with this model is that learning is carried out by combining online learning and offline learning in a comprehensive manner. After this process, it is followed by evaluating learning with these two systems. In its implementation, the advantage of the blended learning model is that it tends to be more cost and time efficient, (13). In conventional learning systems, students and educators are required to meet face to face in the same place, (14). This of course will take up more funds, because each subject has to use transportation to attend the forum. Problem-based learning with a blended learning approach significantly improves students' problem solving abilities compared to conventional learning. This shows the effectiveness of the integration of technology and active learning methods in developing students' critical and analytical skills, (6)

Apart from that, the aspect of time efficiency is also an advantage of this model, the time used for learning preparation is more efficient because the subject only has to turn on the device in the form of a laptop, tablet, even cell phone to join a learning class, (1). Learning using blended learning can also be utilized as an LMS (learning management system), this software is a complete package which is very flexible in its use. An educator can hold direct meetings anytime and anywhere. Then students can open the study material and do assignments directly from where they live. This process is very helpful, especially in terms of time and fund efficiency, especially if the location of the teacher and students is very far away.

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The majority of students today have quite complete devices. At least you must have a cell phone as a device for doing online learning, (15). This is the basis that every student has a greater opportunity to gain more experience with something. With a device connected to the internet, we can search for anything we want on the internet, (16). Thus, it can be used as a guide that today's participants have more experience from reading, observing and watching objects or events on the internet.

DISCUSSION

Blended learning, a combination of traditional face-to-face teaching and online learning, is increasingly recognized as an effective way to improve problem-solving skills in mathematics education. One of the most important advantages of learning using this method is its ability to meet various student needs and learning styles. By combining face-to-face and digital elements, blended learning allows students to interact more personally with the material. Face-to-face interactions provide opportunities for immediate feedback, collaborative problem solving, and hands-on activities, while online components provide independent learning, access to digital resources, and opportunities for independent practice. Such a combination of methods has been shown to improve problem-solving skills in mathematics, because students can utilize the strengths of each approach to deepen their conceptual understanding and develop more effective problem-solving strategies, (17).

For example, blended learning in a math class might include initial face-to-face instruction in which the teacher introduces a new problem-solving concept, followed by online activities that allow students to apply the concept through interactive simulations. Virtual manipulator etc. and directed reactions, (18). Face-to-face sessions can then be used for group discussions, collaborative problem solving and individual support, improving students' ability to solve complex mathematical problems. Additionally, the flexibility of blended learning allows teachers to personalize learning by providing additional resources and training opportunities for struggling students and challenging advanced learners with more complex problem solving, (19).

This tailored approach can significantly improve problem-solving skills when students receive the support they need to deepen their understanding of mathematical concepts and apply them effectively to a variety of problem-solving scenarios, (20). A blended learning concept that integrates face-to-face and online learning methods with a community science technology approach. Blended learning is considered to provide flexibility and wider access to learning materials, while the community science technology approach aims to increase involvement and collaboration between students and utilize technology to solve real problems in the community, (8).

The Flipped PARSER Model (FPM) is effective in improving problem solving skills and academic achievement of Thai student-teachers (21). The use of FPM resulted in significant improvements in student-teachers' academic achievement and problem-solving skills compared to the control group. This shows the effectiveness of the learning model developed. The importance of including a comparison group that received traditional teaching methods to provide insight into the effectiveness of innovative models compared to traditional approaches. Additionally, the study highlights the need for future research to consider variables such as socio-economic background, academic qualifications, ICT background/training, and digital literacy to understand the lasting impact of innovative teaching methods.

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A good approach is an approach that focuses more on numerical understanding in teaching mathematics for students in elementary schools which can help improve their mathematics achievement (22). The study showed a significant relationship between cognitive factors, such as fluid intelligence, verbal and visual working memory, and reasoning capacity, and students' mathematics achievement. This can provide valuable information for the development of effective mathematics teaching programs in the future. In addition, it provides strong scientific support for concept and understanding-based mathematics learning, which can influence the development of mathematics teaching methods at national and international levels. Overall, these concepts make an important contribution to understanding how best to teach mathematics to students in schools basic, and can encourage the development of more effective and innovative mathematics teaching methods in the future.

Other opinions point to improving students' critical mathematical thinking skills through various learning models and approaches, with a special focus on blended learning models. The blended learning model assisted by GeoGebra has a significant impact in improving students' mathematical critical thinking skills, with a large effect at the high school and junior high school levels. The importance of critical thinking skills in problem solving and the characteristics associated with critical thinking, as well as the benefits of using GeoGebra in mathematics education and the Realistic Mathematics Education approach, (23).

Mathematical problem solving is a key competency that students must develop to improve their mathematical understanding and to prepare them to face challenges in the real world. Problem solving not only involves applying knowledge and techniques that have been learned, but also requires deep conceptual understanding, critical thinking skills, and creativity in applying that knowledge to new or unexpected situations. The importance of problem solving in mathematics education has been emphasized by various researchers, who show that problem-solving activities can facilitate the development of deeper mathematical thinking and help students build a strong conceptual understanding. Apart from that, the ability to communicate effectively about problem solving processes and solutions is also an important aspect that needs to be developed, because effective mathematical communication can improve students' understanding and learning. This framework also recognizes the important role of technology in supporting mathematical problem solving. The use of digital tools and online resources can enrich the mathematics learning process by providing a broader context for problem solving, allowing students to explore mathematical concepts in more depth, and supporting the development of digital mathematics competencies.

However, challenges in effectively integrating problem solving into the mathematics curriculum remain. Students often face difficulties in applying the knowledge and techniques they have learned to new problem-solving contexts, indicating a gap between procedural knowledge and problem-solving abilities.

Therefore, learning approaches that support the development of conceptual understanding, along with problem-solving, communication, and technology use skills, are needed to more effectively prepare students to face future mathematical challenges. This framework emphasizes the importance of problem solving in mathematics education and recognizes the expansion of this understanding through the use of technology, development of conceptual understanding, and communication skills so that all of these become interesting experiences as key components in improving students' mathematical problem solving abilities, (24).

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Students who are successful in solving problems have higher levels of meta-cognitive behavior compared to students who are unsuccessful. Apart from that, this also shows that students have difficulty understanding the problem correctly, adapting previous problems to the task, choosing the wrong strategy to solve the problem, not having suitable information beforehand and having difficulty remembering formulas, as well as having difficulty ensuring the correctness of their answers. . The subsequent discussion highlights the importance of meta-cognitive behavior in mathematical problem solving. These results support the idea that meta-cognitive behaviors, such as stating plans, clarifying task requirements, reviewing progress, recognizing errors, and detecting new developments, are key to successful problem solving. Besides that, writing about the process of solving mathematical problems can be a promising means of improving meta-cognitive behavior, which in turn can improve student performance in solving mathematical problems.

Other research results confirm that meta-cognitive behavior plays an important role in mathematical problem solving and that the development of meta-cognitive skills can help students overcome difficulties in combinatorics problem solving. This research suggests the importance of integrating meta-cognitive exercises into mathematics education to improve students' problem solving performance, (25)

The importance of blended learning models, especially flipped classrooms, in improving mathematical problem solving abilities. The flipped-classroom model allows students to be more active in the learning process by utilizing class time for activities that focus more on applying concepts, compared to the flex model which provides more learning flexibility but may lack direct interaction and intensive guidance from the teacher. In addition, the finding that self-efficacy plays a significant role in problem-solving abilities confirms previous literature showing a relationship between students' self-confidence in their own abilities and their academic achievement. This suggests that interventions designed to increase students' self-efficacy can be an effective strategy for improving their mathematical problem-solving abilities, (26).

In this virtual environment, digital resources are integrate with other learning resources in a structured manner, indicating that students experience the VLE as a better support for their learning. In addition, statistical analysis shows that the blended learning approach has a positive effect on test scores and course evaluations reported by students. To test the effects of blended learning compared to traditional learning approaches, a t-test for independent samples was used. The independent variable is delivery method (BL vs FF), while the dependent variables are course grades and evaluations.

The discussion in this study highlights how the use of contemporary digital strategies in bioscience teaching, which complement the use of traditional lessons, has led to the enrichment of biosciences in nursing programs. The use of tablets and smartphones in higher education has been shown to improve learning through better observation, higher motivation, better feedback from instructors, increased sharing of knowledge and opinions, better coherence, better structure, better preparation well, and increased reflection. Teaching strategies in which online digital resources are combined with traditional approaches offer the potential to improve learning outcomes and student satisfaction in nursing education, (27).

Basically, applying blended learning to mathematics education is not difficult. One common problem is the potential for misuse or over-reliance on technology, allowing students to focus more on digital tools than the actual mathematical content, (28).

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Additionally, there may be concerns in ensuring adequate mastery of basic mathematics, as the online component may not always provide the depth of understanding necessary to solve complex problems. Effective integration of face-to-face and online elements requires careful planning, teacher training, and ongoing evaluation for an integrated approach to truly improve student learning outcomes. Despite these potential challenges, the benefits of blended learning in improving mathematical problem solving skills have been well documented, (29). By harnessing the power of traditional learning and using digital learning environments, teachers can create more engaging, personalized, and effective learning experiences for students, ultimately empowering them. Become a confident and competent mathematical problem solver.

The implementation of the blended learning model uses principles that must be adhered to, including: Integration of technological advances with face-to-face learning. This principle can be seen using technology to support and make classroom learning more varied. Apart from that, online learning platforms can also be used to provide additional material, question descriptions and discussions between students and with educators. The second principle is the active involvement of students. Using blended learning can stimulate more active student participation through online discussions, quizzes and project collaboration. Apart from that, making assignments can make students have the ability to think critically and apply mathematical concepts to real situations.

The third principle is flexibility of time and place. Thus providing students with the opportunity to carry out learning at a time and place that suits their needs. Using materials that can be used at any time, such as video tutorials, e-books and online modules. The fourth principle is personalization of learning. The blended learning model makes it possible to provide material that can be arranged according to the level and learning style of each student. The next application is the use of data analysis to understand the needs and development of students and then adjust the material and teaching approach. The fifth principle is continuous assessment and feedback. Implementation of this principle is carried out by utilizing various online and offline assessment methods to assess student knowledge and knowledge. Apart from that, it provides constructive and timely feedback which helps students facilitate their understanding. The sixth principle is about collaboration and interaction. The application can be in the form of creating opportunities as a collaborative step between students through online discussions, group processes and interactive activities. In addition, it facilitates interaction between educators and students, as well as between students to build a supportive learning community.

The seventh principle is the development of digital skills. Application of this principle can help students in developing appropriate digital skills, for example use of mathematical software, online collaboration tools, as well as other digital resources. Apart from that, it also builds comprehensive digital literacy, including the application of ethics in the use of technology and online security. The eighth principle of balanced curriculum design. In blended learning, the use of online and offline activities is arranged so that both run regularly and systematically. Apart from that, it also ensures that every aspect of the curriculum has clear objectives and is integrated with each other.

The ninth principle, namely independent learning, encourages students to form an independent attitude during learning preparation, namely providing material for self-study and making it a comparison with what the teacher will convey.

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Apart from that, it also provides guidance and tools that help students manage their time and monitor their own learning progress. The tenth principle is the use of varied learning media resources. Resources that can be used include videos, articles, interactive simulations, mathematical games to support mathematics learning.

Basically, implementing the blended learning model for problem solving abilities in mathematics lessons is not difficult but requires precision and patience. Curriculum planning and design is a crucial stage in implementing blended learning that determines how face-to-face and online components are integrated to create an effective and comprehensive learning experience. The following is a description of the important steps and considerations in the curriculum planning process, identifying learning objectives. analysing student needs, developing curriculum structures, integrating face-to-face and online learning, selecting and developing learning materials, technology and supporting tools, assessment and evaluation, teacher training and development, as well as evaluating and adjusting the curriculum. The entire process is carried out comprehensively and systematically to obtain maximum results, (30).

In implementing overall learning, an educator is obliged to carry out a complete process. Starting from selecting problems in learning, then searching for and understanding various learning sources. Next, do the planning, choose a sub-topic for discussion, then prepare a learning plan and the material to be taught. Next is Implementation, students carry out learning from start to finish. Next is analysis, students carry out analysis of students. Activities that also illustrate this are intense discussions between educators and students as well as implementing learning planning. The next process is reflection, remembering the objectives of the learning and reflecting on the learning problems that have been identified. The final process is revision, in this process comparing with literature studies, (31).

The most efficient and best learning is that which can understand how students can learn, (32). This of course requires special attention and unique abilities from educators to explore student behavior and position themselves as students so that educators understand how students learn. Apart from that, in a good lesson, a teacher can ideally summarize the student's condition after the learning process is complete, to monitor the extent to which the student thinks about a lesson. In this way, educators will be able to know what actions to take for the next lesson. In mathematics lessons, skills are needed to solve problems quickly and accurately. Each student has different abilities from others. Students who can sharpen their thinking patterns can easily improve their problem-solving abilities.

Several important processes in learning to improve problem solving abilities, especially in mathematics lessons. The first concerns the concept of representation, representation in material form such as images and embodiment. The second concept concerns the basic thinking of students. This concept focuses on the idea of taking ideas by students through reconstructing representations and finding ways to expose these ideas to others, who may also share movements when the teacher facilitates through discussion. (33). the next most important thing is the third concept when an educator measures the quality of students by means of assessment after carrying out the learning process.

The learning process using the form of representation, displaying students' thinking in teaching requires teachers to consider what students know and understand and then respond with instructional decisions that prioritize opportunities for students to represent and express themselves. Share ideas in a way that builds on their existing knowledge.

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The most important thing to take steps to help improve children's problem solving abilities is that an educator must seek information about the needs of the students themselves. All learning plans that are usually made by educators cannot show that educators have searched for information related to students' needs. Information regarding student needs can be obtained from interviews or questionnaires with students directly, not from literature studies conducted by educators. Learning difficulties must be explored from students so that when the data is complete, educators will know how to make learning plans that suit the needs of students. So that in its application it will be easier to achieve global education goals, (34).

One of the main factors for difficulty in developing problem-solving abilities is excessive anxiety and fear. With increasing anxiety, it will disrupt the thinking process so that concentration will be disturbed which will ultimately hinder the improvement of thinking abilities to speed up problem solving in mathematics lessons.

Anxiety is synonymous with fear, excessive fear will give rise to worry, this feeling will drag on and stunt human thought patterns. This is an important process to improve accurate problem solving. A study revealed that there is a positive relationship between anxiety in learning and reasoning in mathematics, (35). According to this research, anxiety can be reduced by increasing motivation for students.

Adding motivation can be in the form of providing rewards when students can carry out their tasks quickly and correctly. Another opinion is in line with this idea, namely that the results are consistent with the expected value assumptions and drawing theories produced by students. One of the practical implications is that attention must be paid to Strategy-Based Motivation in mathematics learning, (36).

In this way, students have stronger determination and maximum concentration to solve a problem in mathematics lessons. One way to increase students' understanding to improve problem solving abilities is that teachers must emphasize the importance of agreement between calculations and empirical examples provided as support for students' progress towards mathematical proof, (37). Learners collectively use their mathematics and problem-solving content knowledge to focus on pedagogical problem-solving knowledge, that they navigate between different levels of knowledge and that the roles of teacher and facilitator are different but also equal, (38).

Basic performance first and foremost visualizes competence, describing the student's metacognitive abilities. In addition, emotions of enjoyment in doing everything in the world of mathematics and anxiety in mathematics influence these beliefs, and that boys have higher competence beliefs than girls, while their mathematics achievements are no different. This suggests that situation-based interventions, aimed at showing girls how often their answers are correct and stimulating them to have positive beliefs can influence their level of self-confidence, (39).

Apart from that, the application of blended learning to help improve problem solving abilities in mathematics lessons needs to be integrated with movement practice simulations as the basis of human nature. Physically active Mathematics learning interventions appear to offer synergistic benefits in relation to cognitive and motor development, which is critical for optimal development in the early years, (40).

Apart from that, the most important thing is how educators understand how students learn, thus educators must really understand the character of students. In this way, the ability to solve problems will increase (41).

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Apart from that, what needs to be noted is that the frequency of practice for learning needs to be given additional time periodically every week to obtain significant improvement.

CONCLUSION

The conclusion of this research is that the learning process based on constructivist learning theory using a blended learning model is the right combination as a solution to improve problem solving abilities in mathematics lessons. By applying a combination of several aspects, problem solving skills in mathematics are easier to do.

The author suggests conducting research on similar topics using more complete variables and more varied research methods. In addition, it includes considering variables such as socio-economic background and academic qualifications in evaluating the effectiveness of learning models. This can become a basis for further research development in the field of education.

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