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VAKSIN-Based Blended Learning in Moodle on Students' Geometry Problem-Solving Skills

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Abstract

As institutions adapt to the "new normal" era, educators are challenged to design learning experiences that remain engaging, effective, and accessible. To respond to this need, the VAKSIN (Video Animation for Online Learning Systems) approach was developed as part of a blended learning model. This study aimed to determine whether blended learning using VAKSIN in Moodle is more effective than the online learning model in improving student problem-solving. The study employed a posttest-only control design on students' bisectors in a geometry course. A saturated sampling technique was used to select all population members as samples. There are 80 subjects and data collection methods, including documentation and testing. Final semester test scores are used to test the sample class's normality, homogeneity, and balance before being subjected to treatment. Hypothesis testing was conducted using a t-test. The results of the data analysis revealed that the t-value for the experimental and control groups was t_{count} = 3.191084707 and t_{table} = 1.99084707. Since $t_{count} > t_{table}$, the null hypothesis (H0) was rejected. Thus, it can be concluded that blended learning using VAKSINN is effective in *improving* students' problem-solving abilities in learning mathematics on the geometry of lines and angles.

Keywords: *Blended Learning, Geometry, Moodle, Problem Solving, VAKSIN.*

Blended Learning Berbasis VAKSIN di Moodle terhadap Kemampuan Pemecahan Masalah Geometri Siswa

Abstrak

Institusi beserta para pendidik ditantang untuk merancang pengalaman belajar yang tetap menarik, efektif, dan mudah diakses di era new normal. Untuk menjawab kebutuhan ini, pendekatan VAKSIN (Video Animasi untuk Sistem Pembelajaran Daring) dikembangkan sebagai bagian dari model pembelajaran campuran (blended learning).. Tujuan penelitian ini untuk membuktikan apakah model pembelajaran blended learning berbantuan VAKSIN (Video Animasi untuk Sistem Pembelajaran Online) lebih efektif dibandingkan dengan model pembelajaran online terhadap pemecahan masalah mahasiswa. Desain *posttest only control* dilaksanakan pada mata kuliah Geometri sub bisektor. Penelitian ini menggunakan teknik sampling jenuh dimana semua anggota populasi dijadikan sebagai sampel. Ada 80 subjek penelitian, dimana teknik

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pengumpulan data dalam penelitian ini menggunakan teknik dokumentasi dan tes. Skor Ujian Akhir Semester (UAS) digunakan untuk menguji normalitas, homogenitas, dan keseimbangan dari subjek penelitian sebelum diberikan perlakuan. Uji hipotesis menggunakan t-test. Hasil dari analisis data diperoleh uji hipotesis pada kelas eksperimen dan kontrol diperoleh t_{hitung} = 3,18219098 dengan t_{tabel} = 1,99084707. Karena $t_{hitung} > t_{tabel}$ maka H_0 ditolak. Sehingga dapat disimpulkan bahwa pembelajaran campuran dengan menggunakan VAKSIN efektif dalam meningkatkan kemampuan pemecahan masalah siswa dalam pembelajaran matematika pada materi geometri garis dan sudut.
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Kata kunci: *Blended Learning*, Geometri, Moodle, Pemecahan Masalah, VAKSIN

INTRODUCTION

The COVID-19 pandemic has drastically transformed the landscape of education, shifting traditional face-to-face learning into online and blended learning formats (Achmad et al., 2021). As institutions adapt to the "new normal" era, educators are challenged to design learning experiences that remain engaging, effective, and accessible. This shift has exposed several gaps, particularly in student engagement, motivation, and problem solving when using conventional online learning tools. One of the strategies to address these challenges is the integration of video animation as a dynamic instructional medium. Video animations are proven to enhance attention, simplify abstract concepts, and improve retention. When used within Learning Management Systems (LMS) like Moodle, they can support asynchronous learning while accommodating different learning paces (Bendou et al., 2017).

To respond to this need, the VAKSIN (Video Animation for Online Learning Systems) approach was developed as part of a blended learning model, combining face-to-face interaction with animated instructional content delivered online. This study explores the impact of VAKSIN in enhancing learning effectiveness in Moodle-based courses in the new normal context. The rationale for this study lies in the urgent need to develop innovative, student-centered learning solutions that not only adapt to digital platforms but also actively increase student participation, comprehension, and satisfaction in blended learning environments. The objective of this study is to ascertain the efficacy of VAKSIN-based blended learning in Moodle in enhancing student problem-solving skills in the context of the new normal era, thereby contributing to the success of the *Merdeka Belajar Kampus Merdeka* (MBKM) program. A body of research on blended learning has emerged in support of the

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MBKM program (Risdianto & Mayub, 2022; Susiyawati et al., 2024). This research endeavors to formulate a collaborative and participatory learning design, engaging lecturers, students, and university partners through the VAKSIN-based blended learning model in the LMS (Learning Management System) Moodle. In light of the shifting educational landscape, educational institutions must adopt the blended learning model, a strategy that has been proven to be effective, efficient, and conducive to success in this new era (Sakina et al., 2020; Sohaya, 2020; Sukirman et al., 2022; Thahir et al., 2023).

The problem-solving skill is defined as the ability to select the sequence of steps and the method (Subekti et al., 2022) and to integrate knowledge, techniques, and rules to generate novel solutions (Orton, as cited in Barham, 2020). Consequently, developing problem-solving skills is critical to the educational process, enabling students to evaluate and overcome daily challenges (Ahdhianto et al., 2020). Its indicators encompass the interpretation, planning, solving, implementation, and evaluation of problems (Yasin et al., 2020). As stated by Widodo et al. (2021), applying problem-solving skills facilitates identifying methods to address challenges by integrating knowledge and techniques to formulate solutions to problems. The possession of this skill is considered a critical component in the evaluation of geometry competence.

Geometry is a field that utilizes visualization as the primary method for achieving competence and development (Papadopoulos & Dagdilelis, 2008), and it is considered the most significant factor in thinking level (Budiarto & Artiono, 2019). It is a field of mathematics that has been demonstrated to enhance problem-solving skills (Pardimin & Widodo, 2016). This is because geometry problem-solving involves problem clarification in the forms of language, concepts, facts, and arithmetic, which serve as the basis of the solution (Novak & Tassell, 2017). The investigative process involves the analysis of objects, the delineation of their characteristics, the identification of their relationships, and the implementation of these relationships to solve geometry problems (Musa, 2016). Therefore, geometry problem solving is one of the essential factors in achieving and developing learning materials using visualization, language, object investigation, description of objects' characteristics, and the relationships between the objects to solve problems. The efficacy of the

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VAKSIN-based blended learning model implemented in Moodle for problem-solving will be determined by the results of this study. Subsequent research will be conducted to explore the qualitative aspects of the solution process for geometric problems and achieve a more profound and comprehensive understanding.

The problem-solving skill of geometry is imperative to be mastered at each educational level because many objectives can be achieved by students, such as integrating it to improve their reasoning and critical thinking skills to overcome problems, especially in geometry materials (Sukayasa, as cited in Maulana & Yuniawati, 2018). This perspective aligns with the findings of Fauzi and Arisetyawan (2020), who contend that geometry, as a component of mathematics education, is designed to equip students with the cognitive tools necessary to address real-life problems. Furthermore, an active learning style in geometry problem solving is closely related to indicators of creative, flexible, and original thinking (Ferdiani et al., 2022), which is a significant aspect for accepting scientific professionals and technology (Bhagat & Chang, 2015). Moreover, Zhang et al. (2012) posit that problem-solving skills in geometry can facilitate students in attaining higher levels of mathematics classes in fulfilling pass requirements and mastering advanced science skills. The MBKM collaboration program between IKIP PGRI Bojonegoro and Universitas PGRI Madiun was initiated during the pandemic, leveraging blended learning using VAKSIN. The program received funding from the LPDP. Research findings and subsequent recommendations indicate the necessity to perpetuate the efficacy of this model in the post-pandemic era.

It plays a pivotal role in the development of problem-solving skills. However, many students encounter challenges in developing their geometry problem-solving skills. The prevailing sentiment among students is that geometry is a challenging subject, which hinders their ability to develop problem-solving skills (Safrina et al., 2014). As Zhang (2017) asserted, many incongruences have been identified between geometry scores and other academic domains, including mathematics. The analysis findings indicate that the root cause of this phenomenon is attributed to various challenges inherent in geometry, including the calculation of area and volume (Hwang & Hu, 2013). Moreover, traditional learning methodologies appear to prioritize explaining formulas in textbooks or instructional materials (Hwang et al., 2009).

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Consequently, there is a necessity for more creative and innovative learning methods, such as blended learning, which is strategic and practical (Darma et al., 2020).

Blended learning is an instructional approach that combines face-to-face learning with technology, direct instruction, collaborative learning, and individual learning (Gecer & Dag, 2012; Lalima & Lata Dangwal, 2017). This combination is more effective for students. As Hrastinski (2019) explains, the term "blended learning" is a common term that can describe various things. It can represent the combination of instructional methods, pedagogical methods, and technology. As posited by Moskal et al. (2013), a synthesis of the traditional model and the latest model can be posited as access, success, and students' perceptions of the learning environment (Dziuban et al., 2018). Blended learning can be defined as a combination of face-to-face learning and technology utilization, integrating both traditional and novel elements, direct and indirect instructions, and collaborative and individual learning methodologies. The novelty anticipated from this research is the efficacy of VAKSIN-based blended learning in Moodle in the new normal era.

The objective of this study is to ascertain the efficacy of VAKSIN-based blended learning in Moodle in enhancing student problem-solving skills in the context of the new normal era, with the overarching goal of ensuring the success of the MBKM program. A body of research on blended learning has emerged in support of the MBKM program (Risdianto & Mayub, 2022; Susiyawati et al., 2024). This research is expected to develop a collaborative and participatory learning design involving lecturers, students, and university partners through the VAKSIN-based blended learning in the LMS Moodle. In light of the shifting educational landscape, educational institutions must adopt the blended learning model, a strategy that has been proven to be effective, efficient, and conducive to success in this new era (Sakina et al., 2020; Sohaya, 2020; Sukirman et al., 2022; Thahir et al., 2023). This research is distinct from previous studies in two primary ways. Firstly, it was conducted in the new normal era, a period that has seen significant changes in both academic and societal contexts. Secondly, the material presented in this study differs from the material typically covered in the bisector sub of the geometry course.

Integrating technology into the teaching and learning process through implementing blended learning has been identified as a key strategy to enhance student

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engagement and facilitate self-directed learning (Zumor et al., 2013). This approach enables students to interact and engage with content in various settings and at their own pace (Dakhi et al., 2020). Furthermore, the efficacy of students' learning experiences has been enhanced (Dwiyogo, 2018). Blended learning, a technological framework, has been shown to improve the effectiveness of classroom learning by providing access to superior educational resources (Rao, 2019). This technological framework has been demonstrated to facilitate the creation of effective learning materials and address the needs of the digital age (Tshabalala et al., 2014). Blended learning has been shown to offer numerous advantages for both students and teachers, particularly in terms of facilitating effective learning.

The merits of blended learning include its ability to enhance teaching and learning processes, ensure the attainment of learning objectives, and facilitate students' comprehension of learning materials. Many blended learning combinations in delivering material have been demonstrated to be more valuable than other learning models (Bouilheres et al., 2020). These models have been viewed from the perspective of work results, satisfaction, motivation, and involvement (Smith & Hill, 2019). Rasheed et al. (2020) described how implementing blended learning can facilitate the development of students' and teachers' self-regulation and technological skills. It is also more flexible in adjusting the location, time, and material needs (Macaruso et al., 2020) and enables more efficient communication among students (Groen & Li, 2005).

Blended learning offers numerous advantages due to its versatility, allowing for implementation through diverse media and methods. When employed with the "Hands-on Activity" learning model, it has been demonstrated to enhance student engagement, prompting active participation in inquiry, exploration, data collection, and analysis (Ho et al., 2016). Blended learning can also be applied using multimedia applications online (Yapici & Akbayin, 2012). Additionally, the application can be facilitated through Google Classroom, a platform accessible via smartphones (Inggriyani et al., 2019). Furthermore, blended learning can be facilitated by implementing online learning through a website or platform technology (Köse, 2010). Ndlovu & Mostert (2018) posit that one of the platforms that can be utilized as a management system for blended learning is the LMS Moodle. This learning management system is modular, object-oriented, and dynamic.

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Moodle is defined as software that supports online learning. It is rooted in the virtual learning concept, which serves as the foundation for social construction pedagogy (Dhika et al., 2020) and development projects involving the delivery of courses to facilitate learning (Shchedrina et al., 2021). Consequently, it has gained widespread international adoption (Cabero-Almenara et al., 2019). Moodle has been described as a platform with published programming code for creating effective online learning sites (Moodle, as cited in Carvalho et al., 2011) and as an application program that modifies learning media in the form of an online website (Retnoningsih, 2017).

The most salient advantage of the Moodle platform is its capacity to facilitate the development of online courses and websites. A notable benefit of this approach is integrating a system with multiple spatial contexts (Kerimbayev et al., 2017), facilitating the storage of information and evaluating learning activities reviewed by students (Zhang et al., 2020). Moodle has been demonstrated to promote the development of online courses, thereby complementing traditional classroom learning models (Martín-Blas & Serrano-Fernández, 2009). In this case, the teacher inputs the learning materials, conducts discussions, and provides quizzes or assignments through Moodle (Wicaksono & Kusuma, 2021). The learning duration is determined by the teacher, who provides an interactive quiz menu (Hamdi, 2013).

The integration of Moodle has been demonstrated to enhance the value and appeal of learning activities, thereby facilitating improvements in student achievement (Escobar-Rodriguez & Monge-Lozano, 2012). This integration enables optimizing novel learning models and accommodating students' diverse educational requirements (Sánchez & Hueros, 2010). Furthermore, it has been demonstrated to facilitate higher-order thinking skills (Gunawan et al., 2021) and to address the challenge of limited direct interactions between students and teachers (Herayanti et al., 2015). Consequently, this approach has the potential to offer numerous advantages in addressing direct interaction challenges during the learning and evaluation processes. Nonetheless, using Moodle presents challenges, as students often lack the necessary skills to access learning materials, particularly in activities such as annotation, comparison, and academic analysis (Rymanova et al., 2015). Hasan (2019) reveals that the most significant challenges in implementing Moodle stem from the students' perspective. It is associated with subjective challenges, such as students' failure to

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fulfill their responsibilities due to the materials' inadequacy in aligning with their needs (Horvat et al., 2015). Conversely, Despotović-Zrakić et al. (2012) posit that the disadvantage associated with this phenomenon is contingent upon the adjustment process. It is incumbent upon the educator to cultivate students' competencies to facilitate this adjustment. Teachers have the capacity to devise supplementary pedagogical innovations that address this challenge. One method of achieving this objective is to provide animated videos (Achmad et al., 2021). Consequently, it can be concluded that Moodle exhibits certain disadvantages in catering to students' diverse needs. Consequently, educators must devise novel learning innovations when implementing Moodle to facilitate its integration. Using animated video constitutes a particular learning innovation with the potential to facilitate online learning. This study is referred to as VAKSIN *(Video Animasi Sistem Pembelajar Online*), which translates to "Animated Videos for Online Learning.".

VAKSIN represents a significant innovation with the potential to enhance teaching effectiveness in long-distance learning contexts. As Widyaningrum et al. (2022) have noted, the current millennial generation exhibits a heightened interest in information and technology. Animation is an effective pedagogical tool, integrating auditory elements with visual media to offer dual functions, namely as an instructional instrument and a medium for learning (Liu & Elms, 2019). Animated video has been demonstrated to be an effective medium for learning (Wouters et al., 2008) because it can animate, move, or show (Imamah, 2012) a set of images by displaying one image after another (Widiyasanti & Ayriza, 2018).

Animated video is frequently employed to illustrate phenomena and abstract concepts that are challenging to comprehend or visualize (Pate et al., 2020). It offers a high degree of flexibility, allowing straightforward modification based on the language or characters required for revising the materials (Karakolidis et al., 2021). The selection of animated video in online learning (VAKSIN) is appropriate because students tend to be more interested in the learning process that provides illustrated graphics (Camfield et al., cited in Greenlaw et al., 2021). It substantially influences students' level of engagement in the teaching and learning process (Jumaheni et al., 2021). Furthermore, it has been demonstrated to assist educators in cultivating motivation in the context of online learning (Bendou et al., 2017). Consequently,

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integrating animated videos in delivering complex materials is a suitable strategy to enhance teachers' effectiveness in motivating students and fostering their engagement in online learning environments.

VAKSIN has been demonstrated to offer numerous advantages, particularly in enhancing students' comprehension. The platform is pedagogical, with the understanding that information contributes to positive educational input and output (Bello-Bravo & Baoua, 2012). It can be viewed repeatedly (Bello-Bravo et al., 2018) and has enhanced students' interest in the material presentation (Cooper et al., 2019). Moreover, the integration of animation has been demonstrated to improve the efficacy of teaching and learning processes, particularly in the context of complex material presentation (Lin & Tseng, 2012). Animated videos are an alternative to learning videos (Lucas & Rahim, 2017).

The efficacy of animated videos in facilitating learning has been a subject of numerous studies examining the outcomes of their implementation. A learning model employing VAKSIN can potentially enhance students' learning achievements. It has been demonstrated to facilitate students' comprehension of fundamental material, including those with limited literacy proficiency (Maredia et al., 2018). It can also be utilized as individual learning media without having face-to-face meetings with the teacher (Arifin et al., 2018). The study indicates that animated videos can enhance students' comprehension and optimize their reading intention, attributable to integrating audio-visual elements (Dewi et al., 2021). This approach has been demonstrated to improve the efficacy of online learning, as evidenced by numerous studies (Samihah & Savitri, 2021). The present study addresses a significant gap in the existing research by examining how online learning optimizes synchronous and asynchronous collaborative learning in a cooperative and independent manner. Consequently, the program employs a blended learning approach, integrating VAKSIN in Moodle. This study aims to ascertain the efficacy of VAKSIN-based blended learning in Moodle on student problem-solving in the new normal era, thereby ensuring the success of the MBKM program.

RESEARCH METHODS

This study was conducted at IKIP PGRI Bojonegoro and Universitas PGRI

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Madiun using a posttest-only control design, with the research subjects being fourth-semester students enrolled in geometry courses during the 2023/2024 academic year. The study employed a saturated sampling technique. According to Budiyono (2003), saturated sampling is a method where all population members are selected as samples. The sample consisted of all fourth-semester students enrolled in the geometry course at IKIP PGRI Bojonegoro and Universitas PGRI Madiun during the 2023/2024 academic year, selected through a saturated sampling technique. A total of 60 students were selected as the sample from a population of 118 students in this study.

Data collection was carried out using documentation and testing techniques. The documentation/data collection technique was used to gather data on the final semester exam scores in Basic Mathematics, a prerequisite for the geometry course. These final exam scores were used to assess the sample class's normality, homogeneity, and balance prior to the treatment. The testing technique involved essay questions for quizzes before the UTS (mid-semester exam), consisting of five questions, to collect data on the fourth-semester students' problem-solving in the geometry course. The goal was to assess their ability to analyze and apply bisector problems.

Samples of this study were students of the mathematics education department in the fourth semester taking Geometry courses in IKIP PGRI Bojonegoro and Universitas PGRI Madiun. The data is collected using tests to understand concepts in geometry problem-solving skills on bisector problems, and interviews to clarify the test results. Researchers developed the research instruments (tests). Figure 1 is a sample of a geometry test question to determine the number of angles; from this test, one of the interview questions is about how well you understand this material.

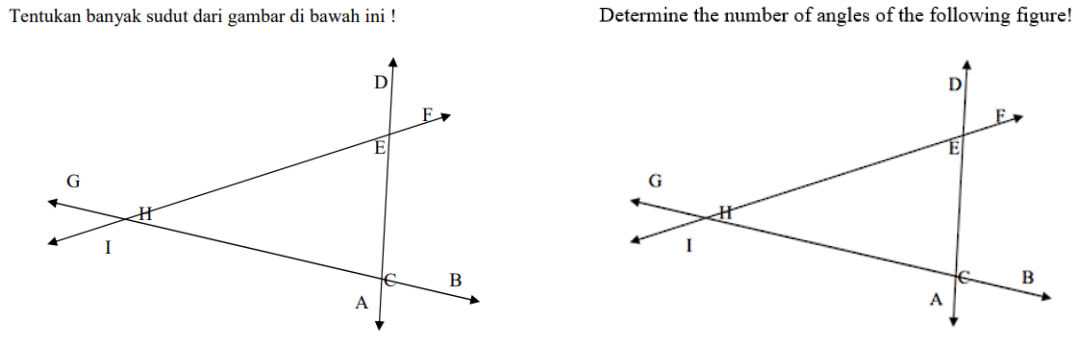

Figure 1. Sample of Geometry Test Question

Figure 1 explains that problem-solving indicators in this study were designed to

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measure students' cognitive processes in solving geometry problems, specifically in the context of the bisector sub-topic. These indicators were developed based on the stages of mathematical problem solving, which include: (1) understanding the problem, where students are expected to identify and interpret relevant information from the given problem; (2) devising a plan, where they are required to select appropriate strategies or formulas based on geometric concepts; (3) carrying out the plan, which involves the accurate and systematic execution of the chosen strategy to arrive at a solution; and (4) reviewing or evaluating the solution, in which students reflect on the results to verify their correctness and coherence. These indicators were embedded in the essay test items used to assess students' abilities in solving bisector-related geometry problems. The depth of students' responses was further explored through follow-up interviews to determine how well they internalized the concepts and applied them in various contexts. Through this process, the study aimed to not only measure performance outcomes but also gain insights into students' analytical and reasoning abilities during problem-solving tasks.

The data used for the prerequisite test was a single dataset, so normality was tested using the Lilliefors method. The homogeneity test was conducted using the Bartlett method. A t-test was employed to assess balance and test hypotheses. Hypothesis testing was performed to determine the effectiveness of blended learning using VAKSIN on student problem solving in geometry courses at IKIP PGRI Bojonegoro and IKIP PGRI Madiun. The research instruments were prepared according to a scheduled plan based on the research design developed by the researcher. The research instruments were created based on the syllabus and lesson plans for the geometry course, specifically for the Bisector sub-chapter. Before using the instruments in the experimental and control classes, a trial was conducted with sixth-semester students from the Mathematics Education Study Program at IKIP PGRI Bojonegoro, who had previously taken the geometry course. The trials conducted by the researchers included tests for validity, reliability, difficulty level, and discriminating power.

RESULTS AND DISCUSSION

Blended learning in this study is not face-to-face learning or online learning. It

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is more emphasized on implementing online learning that optimizes virtual synchronous and collaborative or individual asynchronous (Bendou et al., 2017, A. D. Utami et al., 2023, 2024). The development concepts of blended learning using *VAKSIN* can be viewed in Figure 2.

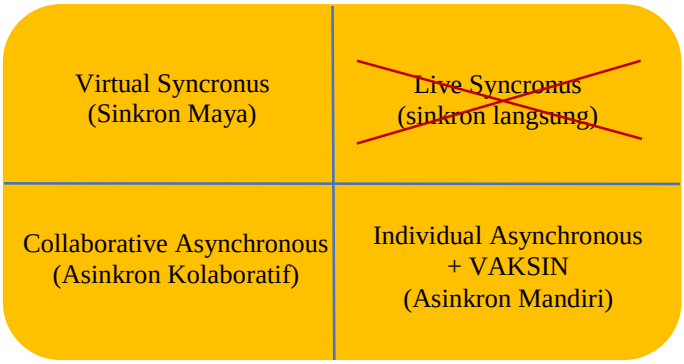

Figure 2. Learning Quadrants of Blended Learning using VAKSIN

Figure 1 explains that VAKSIN is developed based on the Moodle application so that it can optimize collaborative asynchronous discussions in asynchronous blended learning. Individual learning development can be optimized through learning videos and student assignments included in VAKSIN. According to the opinions of several experts, Moodle is a dynamic learning platform (Bojiah, 2022; Munir, 2012) that enables the formation of learning communities (Hidayati, 2016; Li, 2021) because it is simple, efficient, and compatible with various browsers (Ally, 2022; Amiroh, 2012). Moodle has online discussion forums (Syahriningsih et al., 2018), online tests (Abar & de Moraes, 2019), and exercises (I. R. Pratiwi & Silalahi, 2021), so it can be achieved by students (Y. I. Pratiwi et al., 2014). Moodle can add animated videos from teachers (Mufidah, 2014). Animated videos are considered an independent tool in learning models, including blended learning (Ali-Masri et al., 2018; A. M. Utami & Amaliyah, 2022), which serves to support curriculum implementation in blended learning (Krishnan, 2021). Rochmawati et al. (2021) stated that the use of animated videos in online learning is suitable for blended learning. (Hrastinski, 2019) explained that blended learning is a general term with multiple meanings and can describe a combination of instructional, pedagogical, and technological methods.

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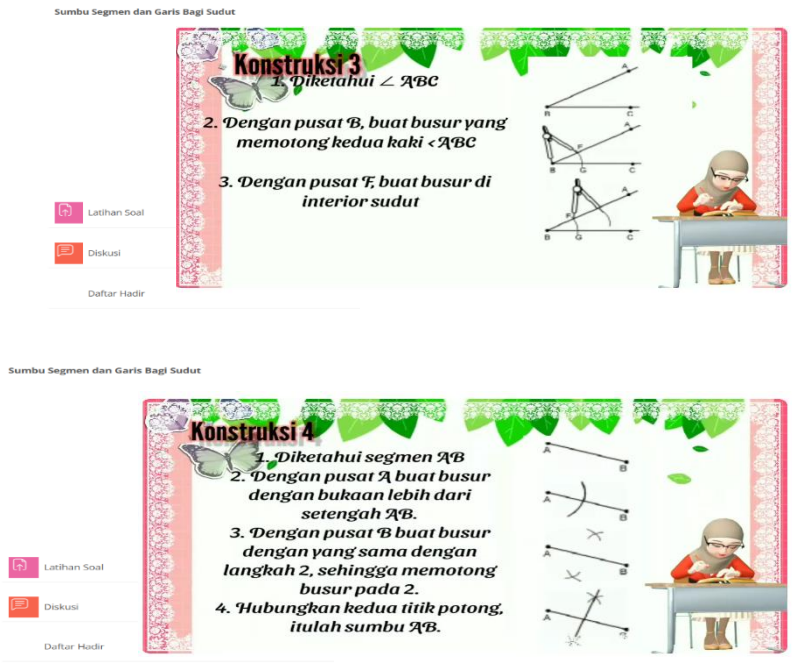

Figure 3. Homepage of Individual Asynchronous Using VAKSIN

Figure 3 explains that blended learning using VAKSIN is an effective learning model in the 5.0 Revolution Era to support problem-solving skills through the MBKM program. Discussions about virtual synchronous learning can be conducted simultaneously, unlike debates about collaborative asynchronous learning, which take place at different times. This study develops blended learning using VAKSIN in Moodle to produce the prototype of collaborative and participative learning between students, lecturers, and universities. In line with previous research on blended learning, blended learning is an approach to guide a more effective learning process towards students' problem-solving abilities (Gecer & Dag, 2012) by combining face-to-face learning using technology, direct instruction, collaborative learning, and individual learning, problem-solving abilities can be improved (Lalima & Lata Dangwal, 2017).

The result of the normality test using the Lilliefors method is carried out before the sample is given treatment in each group, with the significance level $\alpha = 5$ %, for experimental group L_{obs} is 0,098391689 and L_{table} is 0,140089 so the decision test Ho failed to be rejected, for control group L_{obs} is 0,087252889 and L_{table} is 0,140089 so the decision test Ho failed to be rejected. The value of $L_{obs} < L_{table}$ in each group, so Ho fails to be rejected. Samples come from a normally distributed population. The Bartlett

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method's homogeneity test is carried out before treatments are given in both groups, with the significance level α = 5%. The results of the homogeneity test were that the variances of both groups were homogeneous because $\chi^2 < \chi^2$table, the value of χ^2 is 1,127724, and the value of χ^2 table is 3,841. After the normality test and homogeneity test are fulfilled, the balance test is carried out. The balance test used a t-test with a significance level of α = 5 % in this study. The calculation results obtain the value of t_{count} = 1,93752331. The critical area was DK = {t | t <-1,99084707 or t > 1,99084707}. The value of $t_{count} \in$ DK, so Ho is accepted. Based on the balance test analysis result, the experimental and control groups had the same initial ability. After conducting prerequisite tests (normality, homogeneity, and balance tests), the next step is for the samples to be given treatments. The experimental group implements blended learning using *VAKSIN*. The control group implements an online learning model. According to Budiyono (2003), to investigate the effectiveness of blended learning using *VAKSIN* in Moodle, the researchers conduct prerequisite tests, including normality tests, homogeneity tests, and balance tests.

The average score for students' problem-solving ability in blended learning using vaccine media in the experimental class was 76.43, higher than the control class's 73.30. Garrison & Kanuka (2004) and Müller et al. (2023) stated that blended learning is an effective strategy or approach for low-risk university learning. Technological innovation applied to blended learning is an alternative to increase the pass rate of university-level exams (López-Pérez et al., 2011). Blended learning has been proven to overcome the limitations of face-to-face learning and is able to provide positive support for problem-solving skills (Alamary et al., 2014). Furthermore, Waha & Davis (2014) explained that the majority of respondents (students) chose blended learning over other learning models; 80% chose additional videos to support learning, and 97% chose videos as a fun learning tool. One video that can be used as an alternative media in online learning is animated videos (VAKSIN). Animation improves students' learning achievement (Puspaningtyas & Ulfa, 2020).

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Table 1. Results of the independent t-test

Test Component	Value
Number of samples	60
Control class average	72.50
Experimental class average	82.13
Lowest score of control class	40
Highest score of control class	95
Lowest score of experimental class	60
Highest score of experimental class	100
Control class standard deviation	10.88
Experimental class standard deviation	12.51
Siginificance level (α)	0.05
t-table value	1.99084707
t-calculated value	3.191084707

In this study, hypothesis testing used a t-test with separate variances. Based on Table 1., the significance level was α = 5%. The t-table value = 1.99084707. The t-calculated value = 3.191084707. The t-calculated value > t-table, so Ho is rejected, and H1 is accepted. The results of the hypothesis testing indicate that blended learning with VAKSIN is more effective than online learning on the problem-solving abilities of third-semester students majoring in Mathematics Education. Blended learning through the development of VAKSIN involves contextual problems so it is believed to be able to improve problem-solving abilities. Contextualized tasks help learners connect abstract concepts to real situations (Papadopoulos & Dagdilelis, 2008), while animated explanations in VAKSIN reduce cognitive load and support deeper conceptual understanding (Wouters et al., 2008; Orton, as cited in Barham, 2020). Moreover, previous studies show that animation-based learning significantly enhances analytical skills and procedural reasoning (Ahdhianto et al., 2020), which are essential components of problem solving. In accordance with several research results, blended learning supports the MBKM program and provides positive support for problem-solving abilities (Eko, 2023; Susiyawati et al., 2024). Schools should implement blended learning models because they are effective, efficient, and more successful in the new normal era, supporting problem-solving skills (Sukirman et al., 2022; Thahir et al., 2023; Sakina et al., 2020; Sohaya et al., 2020).

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CONCLUSION

This study concludes that student problem-solving skills are improved with blended learning using VAKSIN in Moodle compared to the online learning model. Based on the explanation above, to optimize student problem-solving in online learning, one approach that can be taken is to develop a blended learning model supported by learning videos that facilitate independent asynchronous activities for students. A well-designed blended learning approach, combining virtual synchronous sessions with collaborative and independent asynchronous activities supported by videos, can effectively enhance online learning and implement MBKM (*Merdeka Belajar Kampus Merdeka*) in Indonesia. A limitation of this study is the narrow scope of the sample, so it is hoped that future research can broaden the subject scope, allowing for conclusions that contribute to the development of learning theories that can be applied more widely, based on the findings of this study and future research. The students' learning achievement in the experimental group that implements blended learning using *VAKSIN* is better than that in the control group. It means that blended learning using *VAKSIN* is effective for the learning process. Using VAKSIN in Moodle, blended learning allows students to build collaborative skills in groups or through teamwork. Moreover, students were more interactive during face-to-face learning than when learning online. Recommendations for future research: Blended learning using VAKSIN in Moodle can develop, adapt, or adopt a suitable strategy, approach, or model with the class conditions.

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