JURNAL EDUSCIENCE (JES)
p-ISSN : 2303 - 355X | e-ISSN : 2685 - 2217
PUBLISHED BY : LPPM of UNIVERSITAS LABUHANBATU

The Effect of Blended Learning (Individual Rotate, Flex, and Inside-Out) on Digital Literacy Skills in Science Learning

Fitriana[1], Adnan[2]*, Andi Asmawati Azis[3]

[1,2,3]Biology Education, Makassar State University, Indonesia
*Email: adnan@unm.ac.id

ARTICLE INFO

Keywords:
Blended Learning
Digital Literacy
LMS

ABSTRACT

Purpose - Applying a blended learning approach assisted by a Learning Management System (LMS) in science subjects can improve students' digital literacy skills. This study aims to investigate the effect of three types of blended learning, namely individual rotate, flex, and inside-out types, on students' digital literacy skills in science subjects.

Methodology—The study used quantitative research with a pure experimental design (true experiment). The population in the study was all eighth-grade students, and the samples were four classes with a total of 124 students. The instrument used is a questionnaire that aims to assess the impact of blended learning implementation on students' digital literacy skills. The questionnaire was given before and after the application of blended learning.

Findings - The results of data analysis show that the three types of blended learning affect digital literacy skills; this can be proven by the significance value of 0,001, which means that there is a significant difference in digital literacy skills between students taught with individual rotation, flex, and inside-out blended types. The three types of blended learning applied in the experimental class affected digital literacy skills. However, it is not significantly different as evidenced by the individual rotation, flex, and inside-out blended learning types at Sig> 0,05 level.

Contribution—This research shows that blended learning can be a solution in education for learners and educators who utilize internet-based technology in the learning process. However, improvements in the provision of internet facilities are still needed to overcome the existing challenges.

Received 2 January 2025; Received in revised form 12 January 2025; Accepted 25 April 2024.
Journal of Eduscience (JES) Volume 12 No. 2 (2025)
Available online xx April 2025

INTRODUCTION

Education is a learning process that aims to develop an individual's potential, knowledge, skills, and character. This process takes place not only at school but also in everyday life through interaction with the environment and experience. Education has an important role in shaping a person's attitudes, behaviors, and abilities to contribute positively to society and face challenges in life (Nuraisyah et al., 2021). Education has now entered the 21st-century learning era, characterized by the use of technology in all areas of life (Muhria, Fitriati, Suwandi, & Wahyuni, 2022). The 21st-century learning process emphasizes a more interactive, technology-based approach and is oriented toward developing critical skills such as collaboration, communication, creativity, and problem-solving. This learning encourages students to be more active, independent, and flexible in exploring knowledge and using digital technology to access information and innovate. This learning focuses on relevant and contextualized learning; this process aims to prepare students to adapt quickly in a constantly evolving and challenging world. This is to the findings (Salmia, 2021) that in the 21st-century learning era, the education system has developed rapidly where traditional approaches have begun to be marginalized by increasingly sophisticated and rapidly growing technological inventions. It is appropriate for educators to constantly update their competence for learning needs, one of which is mastering and utilizing technology. Educators are no longer the only source of presenting information; learners can also learn through E-Learning. (Abdullah (2012) also said that in a new generation, the use of digital technology is one of their lifestyle characteristics. The young generation is now more interested in learning by using gadgets, smartphones, laptops, android, and the like because they can open Google Search, YouTube, Google Play Store, and others to access various kinds of information connected to the internet (Maulana et al., 2022).

Today's main problem in education is that students are still not proficient in technology. Therefore, various educational institutions in Indonesia still use traditional learning methods. Based on observations made at SMP Negeri 5 Sinjai, students still face difficulties in utilizing digital technology effectively to support learning, lack of understanding of how to use digital tools appropriately and wisely is a significant challenge in improving students' digital literacy (Julianti et al., 2022). Based on this, it is necessary to apply a digital-based learning model so that students will become accustomed to online activities so that digital literacy will increase; in this study, a blended learning model assisted by a Learning Management System (LMS) will be applied to overcome the problem of students' digital literacy which is still lacking due to the use of traditional media which is still often used in class. Educational institutions make changes to learning that initially used traditional or face-to-face learning and then changed to digital-based learning. Currently, there has been a development that utilizes digital technology more. There is not much focus on face-to-face learning between educators and students, but educational practitioners have changed to digital utilization and development (Abdulhak, Ishak, Darmawan 2013). In connection with technological developments, educators must understand that the development of technology, information, and communication impacts the world of education (Ginting, 2023). For digital learning to be maximized properly, it needs the help of e-learning applications, social media, and other virtual applications to support learning (Syarifuddin, 2020). The e-learning approach can encourage learners to participate actively, determine their learning goals, choose ways to achieve them, and independently assess their progress (Kumar & Owston, 2016).

E-learning will not eliminate the impression of face-to-face learning. However, with the help of technology, it will make it easier for students to be more independent in doing assignments, and their digital literacy skills will be well-trained because they will be familiar with the use of the system in the e-learning system. Face-to-face meetings in class will still be utilized to discuss the materials available in the e-learning system (Mutaqin, Marethi, Syamsuri 2016), (Johnson Walton, Strickler, & Elliot, 2023). The development of the world of education today requires the use of technology-based media already is a must so that technological capabilities are now part of the competency demands for professional educators to support the implementation of learning that has innovations in the learning process in order to keep up with the demands of the times in the increasingly advanced world of education. The innovation in question is the application of blended learning (Wirdayani, Kune, & Shaleh, 2023). This encourages students to be able to set the rhythm of

learning not only in the classroom but also outside the classroom through the blended learning system. This is stated by research (Abroto, Maemonah & Ayu, 2021), which states that modern technology can improve the quality of education.

The blended learning approach is one of the solutions to the problems that arise. Blended learning provides excellent educational benefits by combining the advantages of face-to-face and online learning. Blended learning was first introduced in the field of human resource training which aims to overcome space-time limitations, small class sizes, and high costs (Liu, Zhao, Zhong, Ma, & Wang, 2024). This approach allows students to learn more flexibly, access learning materials anytime and anywhere, and increase their engagement through various interactive methods. In addition, blended learning can accommodate various learning styles, increase student independence, and facilitate more personalized teaching according to individual needs. This is to the statement of (Idris, 2011) and (Palennari, Adnan, and Fajrianti, 2018) that blended learning refers to a learning process that combines face-to-face learning and computer-based learning (online). Blended learning is a learning approach that integrates traditional face-to-face learning with distance learning using online learning resources that can be used by educators and students (Maisarah, Azis, Pagarra, 2022). Implementing a blended learning approach can be assisted by using technology-based media to run learning, including virtual learning, distance, e-learning, web-based, or online learning (Johnson, Walton, Strickler, & Elliot, 2023). (Canbulat & Uzun, 2024) & (Bawden, 2001) clarify that online learning will control students' learning, both at home and at school, because they are flexible in accessing learning.

Technology development in education requires students to develop 21st-century skills, especially digital literacy skills. According to Gee, 2007 (in Colin Lankshear & Michele Knobel, 2008), digital literacy skills are essential for today's digital world. Using digital learning platforms in education encourages an environment that emphasizes individuals ' independence and increases student engagement through interactive technology (Brown & Harris, 2021). Blended learning provides easy access to materials and improves students' digital literacy skills. Based on Gilster's (1997) research, it is explained that applying a blended learning approach can improve digital literacy skills. The concept of literacy, according to Gilster, is not only about the ability to read but also about reading with meaning and understanding the meaning. Fitriani et al. (2023) research also showed that digital literacy skills with blended learning had improved. Digital literacy, according to (Hairul, 2017), is interpreted as the ability to use digital media such as iPads, tablets, gadgets, laptops, and other types of screen media that no longer use print media (books or paper). Digital literacy does not necessarily replace the importance of traditional literacy (print) as a stage. Thus, digital literacy is more of an ability to read, write, and analyze digital objects usually presented on screens that are not printed. Through the application of technology in blended learning, it provides opportunities for learners to learn using ICT tools, creates conditions that contribute to teaching flexibility, and increases access to learning (Hrechanyk, Koval, Kovalchuk, Slovik, & Zinchenko, 2023), (Dublin, Žalec, Reus, Milano, Athens, Hannove, 2019)

According to Brooke et al. (2015), four models are commonly implemented in blended learning: the Rotation model, the Flex model, the A La Carte model, and the Enriched Virtual model. However, this research quotes Iskandar et al.'s (2023) book that there are eleven types of blended learning: 1) Station rotation blended learning, 2) Lab construction language learning, 3) Remote blended learning, 4) Flex blended learning, 5) Flipped classroom blended learning, 6) Individual rotation blended learning, 7) Project based blended learning, 8) Self-directed blended learning, 9) Inside-out blended learning, 10) Supplemental blended learning, 11) Mastery based blended learning. This research will apply three types of blended learning that will measure their influence on learners' digital literacy skills: the individual rotate, flex, and inside-out types.

This learning emphasizes that students can learn in rotation from one station to another through a schedule determined by the educator or a specific algorithm compiled (Iskandar et al., 2023). The essence of this learning is that each student follows a learning rotation tailored to their needs and pace. This approach supports independent learning and provides opportunities for students to focus on the areas they need while still maintaining social interaction and collaborative learning. In this model, each learner has a unique learning plan, known as the "Individual Learning Playlist," which includes the time and type of activities to be

undertaken, including online learning. This is by Pratama, Syah, & Fauzi, 2023. The individual rotation type in learning emphasizes learners rotating through various learning tasks according to an individually adjusted schedule. The flow of the individual rotation model can be seen in Figure 1.

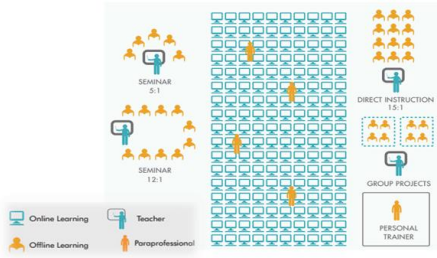
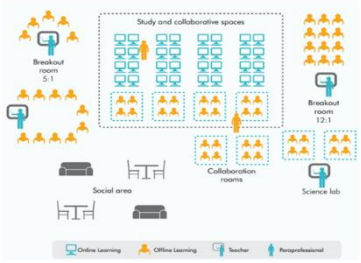


Figure 1. Individual Rotate Model

Learners' learning activities are independent, and they can organize their learning activities freely according to the schedule of the learning module (Wang, Omar, Zakaria, & Zulkifli, 2024). It is formulated by relevant pedagogies, modalities, and technologies, offering learning experiences that involve various factors that make up each modality, such as time, space, path, and speed, through sequential or parallel design (Bozkurt, A. (2022) & (Komur, Kiling, & Okur, 2023). The Flex Model in blended learning emphasizes individualized learning and is more flexible for learners (Dewi et al., 2019). This learning emphasizes online learning, and learners will be more flexible when some material is not understood. The flow of the Flex model can be seen in Figure 2.



This learning emphasizes that learning outcomes can be found outside the classroom but supported by counseling and in-class meetings. This approach is for the learning process in the classroom but for reinforcement by the teacher to take place outside the classroom (online). This approach combines online classroom learning supported by inquiry learning through formal e-learning (Adawiyah et al., 2023). This learning still emphasizes (outside-in) learning (Iskandar et al., 2023); & (FrauMoi & Cabiddu, 2020). This approach can be presented using web assistance so that integrating written communication in electronic media online makes a unique learning experience according to learners' context and educational objectives (Kanuka & Rourke, 2013).

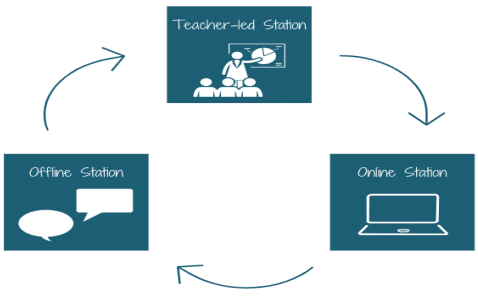


Figure 3. Inside-out model

The blended learning approach will run optimally with a learning management system (LMS) (Astuti & Bakri, 2022). The development of blended learning in educational institutions requires a system (application), one of which is a Learning Management System (LMS), such as Moodle (Krunger-Ross et al., 2013). LMS is a software that makes it easier for educators to organize activities and communicate with

students without being limited by time and space. Examples of LMS platforms include Canvas, moodle, Edmodo, and others (Yana & Adam, 2019). LMS allows educators to track students enrolled in courses, distribute learning materials, create platforms for discussion of ideas, assign and evaluate assignments, provide good feedback, and assess learners. In brief, LMS gives space to educators (both teachers and lecturers) to monitor and facilitate the learning progress of students and students closely so that learners will be motivated. Students with high motivation will tend to participate optimally in learning activities in groups and independently (Aldi, Azis, Adnan, 2024). On the other hand, students and students benefit because they are given space and time to learn tailored to their understanding abilities. In this research, Moodle is the type of LMS used to implement blended learning. The Moodle display can be seen in Figures 3. and 4.

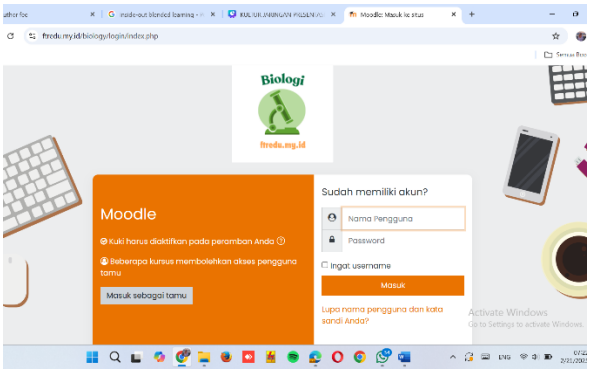


Figure 3. LMS login view (Moodle)

Figure 3 shows the initial display when learners log in to their Learning Management System (LMS) account. Each learner is given a username and password to enter the system so they can access online learning. In the LMS, learners access materials prepared by educators. Educators direct learners to access the LMS in the classroom.

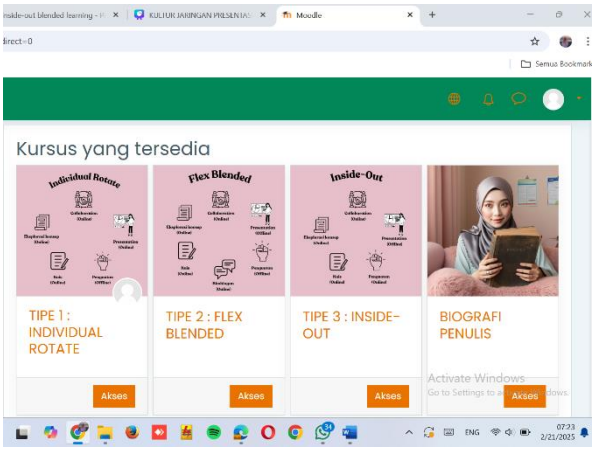


Figure 4. The main view of the LMS for accessing

Figure 4 shows the prominent display of the LMS for learners to access their respective classes. Experimental class 1 will access type 1: Individual Rotate, Experimental class 2 will access type 2: Flex Blended, and experimental class 3 will access type 3: Inside-Out. Learners will not access the class if the username is not registered in the class, so learners will access foreign-foreign classes and cannot access other classes.

The novelty of this study is that researchers offer novelty in the application of blended learning of individual rotate, flex, and inside-out types to digital literacy skills in the field of education, especially in science learning. Previous studies only measured one type of blended learning and only measured the effect of blended learning in general. This research measures digital literacy skills to make a new contribution to the application of learning oriented to the development of the 21st century. Learners must be familiarized with e-

learning to keep up with increasingly sophisticated technological developments. This is by (Brown Harris, 2021) that the use of digital learning platforms in education encourages a learning environment that emphasizes individuals ' independence and increases student engagement through interactive technology

Based on the theoretical studies and the problems described above, this study aims to determine the effect of the application of individual rotate, flex, and inside-out blended learning on students' digital literacy skills. Blended learning with individual rotate, flex, and inside-out types is expected to improve students' digital literacy skills by providing a more flexible and adaptive learning experience. Blended learning in individual rotate type, students can interact with various digital learning resources, broadening their horizons in using technology. The flex type allows students to access materials independently as needed, facilitating the development of digital literacy skills more intensively and purposefully. While in the inside-out type, students are involved in a project or research-based learning that encourages them to utilize technology critically and creatively so that their digital literacy skills are further developed, the application of these three types of blended learning is expected to overcome the problems of students who still face difficulties in utilizing digital technology effectively. Based on this concept, this study hypothesizes that there is a statistically significant effect at the Sig. > 0.05 level on learners' digital literacy skills due to the application of individual rotate, flex, and inside-out blended learning types.

METHODOLOGY

Research Design

This research utilizes quantitative actual experiment or pure experiment research method. The true experiment design was chosen to measure the impact of blended learning implementation because this research design allows researchers to strictly control external variables and ensure a cause-and-effect relationship between the blended learning implementation and the measured outcomes. With randomly selected experimental and control groups, this design provides more valid and objective evidence on the effectiveness of blended learning in improving learners' digital literacy skills. This study systematically collects and analyzes data to explain the effect of three types of blended learning, namely individual rotate, flex, and inside-out types, on digital literacy skills. Design This study used a pretest-posttest control group design (the research design can be seen in Figure 5.

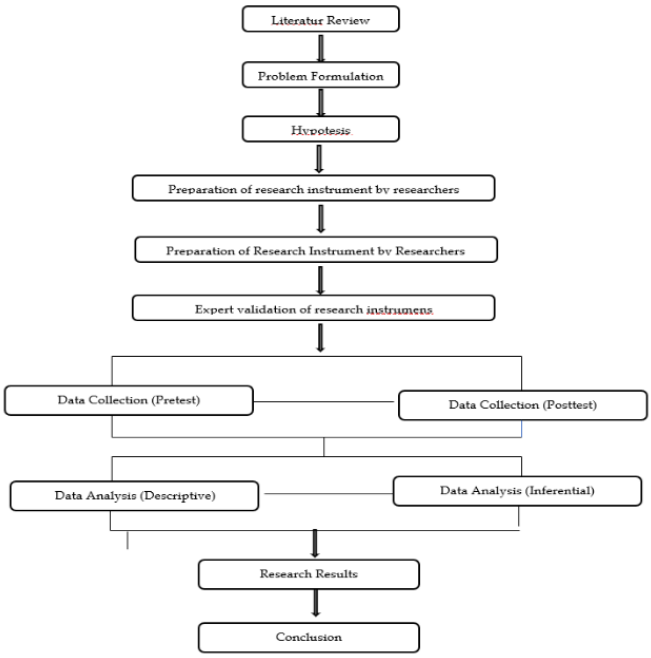


Figure 5. Research design

Participant

The population in this study was all VIII-grade students in as many as five classes, with a total of 155 students. The number of samples in this study consisted of four classes with a total of 124 students. The control class is class VIII.1, with 31 students, while the experimental classes are class VIII.2, VIII.3, and VIII.4, with a total of 93 students. Sampling was done by random sampling method. This research was conducted at SMP Negeri 5 Sinjai, South Sulawesi, Indonesia. The sample selection was only from one school, specifically SMP Negeri 5 Sinjai. This study was conducted to minimize the variability that could arise from differences in the school context, curriculum, and technological infrastructure in various places. By focusing on one school, this study can more deeply analyze the impact of blended learning implementation on digital literacy skills so that it will be more controllable and consistent. In addition, selecting a single school allows the researcher to manage resources and factors that influence the research results more efficiently and ensure that relevant variables can be observed more focused and accurately.

Data Collection

Data collection was conducted through questionnaires after applying the blended learning approach. The questionnaire refers to digital literacy indicators, namely practical and functional skills, creativity, digital collaboration, proficient digital communication, curated information, critical thinking and evaluation, cultural and social understanding, and E-Safety. The data obtained were then analyzed using two types of analysis techniques, namely descriptive statistical analysis and inferential statistical analysis. Descriptive data analysis techniques were obtained in the form of digital literacy skills tests, then analyzed to determine the presentation of the scores of the averages that have been collected, and then tabulated through Microsoft Excel to produce data that can describe the digital literacy skills of students (more detailed results can be seen in table 4). Then, inferential tests, namely normality and homogeneity tests, were conducted. The normality test aims to test whether digital literacy skills' pre-test and post-test data are typically distributed. The basis for taking the normality test is that if the significance value of students' digital literacy skills is more significant than 0.05, then the data is usually distributed. Conversely, if the significance value of students' digital literacy skills is smaller than 0.05, the data is not normally distributed (more detailed results can be seen in Tables 5 and 6). The normality test uses the Kolomogrov-Smirnov technique through the SPSS type 27 application.

Furthermore, the homogeneity test is carried out; the purpose of the homogeneity test is to test the data variance and determine whether the sample groups have the same variance (more detailed results can be seen in Tables 7 and 8). The basis for decision-making in the homogeneity test is if the significance value is less than 0.05, then it is said that the variance of two or more population groups is not the same. Meanwhile, if the significance value is more than 0.05, it is said that the variance of two or more population groups is the same. Then, hypothesis testing is carried out; hypothesis testing aims to make decisions about the value of a population parameter based on data samples taken from that population. This analysis can be done using the ANCOVA (Analysis of Covariance) test through the statistical analysis program SPSS version 27. This study chose the ANCOVA test to measure the effect of blended learning on digital literacy skills because this test allows researchers to analyze differences between experimental and control groups while controlling for confounding variables or covariates that may affect the results. Thus, Ancova can provide a more accurate picture of the impact of blended learning on digital literacy skills, by minimizing the effects of other unwanted variables and ensuring more valid and controlled results. Hypothesis testing was conducted to determine whether or not there was an effect of individual rotate-type blended learning, flex-type blended learning, and inside-out type blended learning on digital literacy skills results (more details can be seen in Table 9). Then, I continued with the LSD (Least Significant Difference) test. LSD (Least Significant Difference) test was chosen in this study because it allows researchers to directly compare the average differences of several types of blended learning, namely individual rotate, flex, and inside-out. The LSD test was used to determine which

treatment specifically showed a significant difference. Knowing which type of blended learning is most effective in improving learners' digital literacy skills (more detailed results can be seen in Table 10).

Instrument

The instrument used to assess digital literacy skills is a questionnaire. This questionnaire obtained information about students' digital literacy skills before and after applying blended learning. The digital literacy questionnaire refers to the digital literacy indicators designed by (Kuncoro et.al. 2022). The indicators in the questionnaire are Practical and Functional Skills, Creativity, digital collaboration, Proficient digital communication, curated information critical thinking and evaluation, Cultural and Social Understanding, and e-safety. The questionnaire consists of twenty-four statements with a structured or closed questionnaire type, meaning that the answers to the statements have been provided so that respondents can choose the answers strongly agree, agree, disagree, and strongly disagree by giving a checkmark according to their circumstances. The number of respondents was 124 students divided into four classes. Examples of digital literacy skill instruments researchers developed can be seen in Table 1.

Table 1. Digital Literacy Skills Instrument

No.	Digital Literacy Indicators	Question
1	Functional Skills and Beyond	I can operate the smartphone by turning it on and off.
2	Creativity	I can create products in various formats and models by utilizing digital technology.
3	Collaboration	I can share learning information with my study group online.
4	Communication	I can communicate through digital technology media.
5	The ability to find and select information	I was able to find references in Wikipedia, blogs, articles, and YouTube.
6	Critical Thinking and Evaluation	I can make strong arguments based on the information I have.
7	Cultural and Social Understanding	I understand that there are different views on things, primarily when they are based on culture.
8	E-Safety	On the online learning platform, I use my real profile picture, full name, class ID, and school.

To ensure clarity and validity, the media and instruments were checked by two experts from academia who provided feedback and input. The validity results of the LMS and digital literacy questionnaire can be seen in Table 2 and Table 3.

FINDINGS

LMS Validity Test and Digital Literacy Skills Questionnaire

Table 2. Validity of LMS (Blended Learning) media

Assessment Aspect	Assessment Score	Category
Practical and Functional Skills	4,87	Very Valid
Creativity	4,25	Very Valid
Digital Collaboration	4,25	Very Valid
Proficient digital communication	4,50	Very Valid
Curate Information critical thinking and evaluation	4,25	Very Valid
Cultural and Social Understanding	4,50	Very Valid
	4,50	Very Valid

e-safety	4,50	Very Valid
Average	4,45	Very Valid

Table 3. Validity of digital literacy questionnaire

Assessment Aspect	Assessment Score	Category
Format	4,87	Very Valid
Digital Literacy Content/ Indicators	4,55	Very Valid
Language	4,25	Very Valid
Average	4,55	Very Valid

The results of the LMS validation and digital literacy questionnaire show that the LMS media and digital literacy questionnaire that will be used in blended learning are categorized as valid and feasible to be used and applied in the classroom. Furthermore, descriptive statistical analysis and inferential statistical analysis consisting of a normality test, hypothesis test (ANCOVA), and LSD test (further test) will be conducted.

Statistical Analysis

Table 4. Results of descriptive analysis of digital literacy skills for each treatment

Type	Test Type	Sample Quantity	Average	Standard Deviation	Highest Score	Lowest score	Range	Variance
Individual Rotate	Pre-test	31	48,34	8,27	61,45	31,25	30,20	68,53
	Post-test	31	82,67	3,28	87,00	75,00	12,00	10,80
Flex	Pre-test	31	56,58	7,91	72,92	41,66	31,25	62,60
	Post-test	31	82,27	3,49	88,54	75,00	13,54	12,24
Inside-Out	Pre-test	31	51,27	9,81	69,79	35,41	34,38	21,07
	Post-test	31	82,97	4,48	90,62	73,95	16,67	5,24
STAD	Pre-test	31	53,76	9,79	78,12	40,62	37,50	96,00
	Post-test	31	79,48	5,06	88,54	67,80	20,74	25,62

Based on Table 2, it is known that the pre-test results of the digital literacy skills of the Individual rotate type blended class (experiment 1) obtained an average value of 48.34, a standard deviation of 8,27, the highest value of 61,45, the lowest value of 31,25, a range of 30,20 and a variance of 68,53. The post-test results obtained an average value of 82,67, a standard deviation of 3,28, the highest value of 87,00, the lowest value of 75,00, a range of 12,00, and a variance of 10,80. The flex-type blended class (experiment 2) pre-test results obtained an average value of 56,58, a standard deviation of 3,28, the highest value of 72,91, the lowest value of 41,66, a range of 31,25, and a variance of 62,60. The post-test results obtained an average value of 82,27, a standard deviation of 3,49, the highest value of 88,54, the lowest value of 75,00, a range of 13,54, and a variance of 12,24. The inside-out blended class (experiment 3) pre-test obtained an average value of 51,27, a standard deviation of 9,81, the highest value of 69,79, the lowest value of 35,41, a range of 34,38, and a variance of 96,42. The post-test results obtained an average value of 82,97, a standard deviation of 4,48, a highest value of 90,62, the lowest value of 73,95, a range of 16,67, and a variance of 20,07. The STAD (control) class pre-test obtained an average value of 53,76, a standard deviation of 9,79, the highest value of 78,12, the lowest value of 40,62, a range of 37,5, and a variance of 96,0. The post-test results obtained an average value of 79,48, a standard deviation of 5,06, a highest value of 88,54, the lowest value of 67,80, a range of 20,74, and a variance of 25,62.

Inferential Statistical Analysis

Normality Test

The following are the normality test results, which were analyzed using the SPSS version 27 application. The normality test tables for the pre-test and post-test research data can be seen in Tables 5 and 6 below:

Table 5. Normality Test of Research Data (Pre-test)

Class	Kolmogorov-Smirnov			
	Statistic	Db	Sig.	Description
Experiment Class 1 (Individual Rotate)	0,144	31	0,200*	Normal
Experiment Class 2 (Flex)	0,101	31	0,104	Normal
Experiment Class 3 (Inside-out)	0.110	31	0,200*	Normal
Control Class (STAD)	0.128	31	0,200*	Normal

Based on the Normality test in Table 5, it shows that the sample class pre-test data is usually distributed with a significance value of more than 0,05 (Sig. > 0,05

Table 6. Normality Test of Research Data (Post-test)

Class	Kolomogrov-smirnov			
	Statistic	Db	Sig.	Description
Experiment Class 1 (Individual Rotate)	0,141	31	0,122	Normal
Experiment Class 2 (Flex)	0,143	31	0,104	Normal
Experiment Class 3 (Inside-out)	0,139	31	0,131	Normal
Control Class (STAD)	0,091	31	0,200*	Normal

Based on the Normality test in Table 6, it shows that the post-test data of the sample class is normally distributed with a significance value of more than 0,05 (Sig. > 0,05).

Homogeneity Test

The homogeneity test aims to test the data's variance and determine whether the sample groups have the same variance. The results of the homogeneity test, as detailed in Table 7, show that the sample group data or sample group variance is homogeneous with a significance value of more than 0,05 (Sig. > 0,05).

Table 7. Homogeneity test of research data (Pre-test)

Variable	Levene Statistic	Db	Sig.	Description
Literacy Skills Digital	1,613	3	0,180	Homogeneous

Based on the homogeneity test in Table 7, it shows that the pre-test data of the experimental class taught with individual rotation, flex, and inside-out blended types are equal or homogeneous with a significance value of more than 0,05 (Sig. > 0,05).

Table 8. Homogeneity test of research data (Post-test)

Variable	Levene Statistic	Db	Sig.	Description
Digital Literacy Skills	1,058	3	0,184	Homogeneous

Based on the homogeneity test in Table 8, it shows that the post-test data of the experimental class taught with blended individual rotation, flex, and inside-out types are the same or homogeneous with a significance value of more than 0,05 (Sig. > 0,05).

ANCOVA Test

After the prerequisite test is fulfilled, the next step is to test the hypothesis using the Ancova Test (Analysis of Covariance). ANCOVA test aims to test the effect of blended learning types of individual rotation, flex, and inside-out on digital literacy skills. The LSD test results can be seen in Table 9.

Table 9. ANCOVA test results of the effect of different types of blended learning

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Three Types of Blended Learning	215,755	3	71,918	4,162	0,00

Based on Table 9, the results of the ANCOVA Test on the model with a value of F = 4,162 and a significance value of less than 0,05 (0,00 < 0,05), the hypothesis proposed by the researcher can be accepted. This means there is a significant difference in digital literacy skills between students taught with individual rotation, flex, and inside-out blended types. Based on the ANCOVA test analysis results, the application of blended learning affects digital literacy skills, so the analysis is continued using the LSD (Least Significant Difference) test.

LSD (Least Significant Difference) Test

After the Ancova test, which showed that there was an effect of blended learning on digital literacy skills, the analysis was continued using the LSD (Least Significant Difference) Test to see which type of blended learning between individual rotation, flex, or inside-out gave significant effect on improving digital literacy skills. The results of the LSD test with a significant level of 0,05 can be seen in Table 10.

Table 10. LSD test results of the effect of three types of blended learning on literacy skills

Variables	Class	Average difference	Sig.	Description
Digital literacy skills	BL Individual Rotation and BL Flex	-0,099	0,929	Not significantly different
	BL Individual Rotation and BL Inside-out	-0,373	0,726	Not significantly different
	BL Flex and BL Inside-out	-0,099	0,029	Real Differences
	BL Individual rotate and STAD	-2,960	0,009	Real Differences
	BL Flex and STAD	-3,060	0,001	Real Differences
	BL Inside-out and STAD	-3,333	0,003	Real Differences

Based on Table 10, the results of further test analysis show the mean difference between the three types of blended (individual rotation, flex, or inside-out) on students' digital literacy skills. The basis for decision-making is seen from the mean difference and significant values. Suppose the mean difference value has an asterisk and the significance value is less than 0,05. In that case, the decision is significant or significantly different. At the same time, if the mean difference value has no asterisk and the significance value is greater than 0,05, then the decision is not significant or not significantly different. The three types of blended learning and STAD have different Sig. differences. If the information is significantly different, it means there is a significant effect on digital literacy skills. However, if it is not significantly different, the effect is not significant on students' literacy skills. Furthermore, determining the best-blended learning application for digital literacy skills can be seen based on the value in each estimated marginal means value. The results of the further test

for applying individual rotation, flex, or inside-out blended learning on digital literacy skills can be seen in Table 11.

Table 11. Mean scores of the effects of three types of blended learning

Blended Mean Type	
Inside out	82,917[a]
Flex	82,643[b]
Individual Rotate	82,544[c]
STAD	79,584[d]

Based on Table 11. shows that there are significant differences between the three classes. Numbers followed by the same letter are categorized as insignificant/not significantly different because they are at the Sig> 005 level. Blended learning of individual rotates, flex, and inside-out types are categorized as not significantly different. The difference can be seen in the mean value, meaning the difference in the effect of blended learning on improving digital literacy skills in each class. The three experimental classes affect digital literacy skills but are not significantly different based on the resulting mean. The three blended learning types have similar averages because they use the same media. In this research, the media used to help the implementation of blended learning is the Learning Management System (LMS). This (Kemdikbud, 2017) shows that with the application of E-Learning, students can improve their understanding of digital literacy, namely the ability to understand and use information in various forms from various sources accessed through computers. The application of blended learning is used to solve problems students face in the learning process that require them to be connected to technology. The STAD treatment does not have a low average score because this learning is only through the students' textbooks, so they are less familiar with technology than in blended learning.

DISCUSSION

Students' digital literacy skills have increased after implementing a blended learning approach in the experimental class. This is evidenced by the increased post-test results in the experimental class compared to the control class. The results of the inferential test showed three types of blended learning with a value of F = 4,162 and a significance value of less than 0,05 (0,00 < 0,05), so the hypothesis proposed by the researcher was accepted. It can be interpreted that there is an effect of applying the blended learning approach of individual rotate, flex, and inside-out types on students' digital literacy skills. This shows that applying the blended learning approach positively affects digital literacy skills.

Based on the results of further testing (LSD), it is known that the blended learning approach presented in each experimental class has the same effect on students' digital literacy skills and is significantly different from the control class that uses the STAD approach. This is because blended learning is a learning approach that can help students improve their digital literacy skills. The application of blended learning can help learners improve digital literacy because, in learning, they will use various digital platforms (such as learning applications, online discussion forums, and digital learning resources) both directly and independently. This forces students to get used to using technology in the learning process, improving their digital literacy skills; online learning also allows students to interact with peers and teachers through digital platforms. This (Kemendikbud, 2017) shows that with the application of E-Learning, students can improve their understanding of digital literacy, which is the ability of students to understand and use information in various forms from a wide range of sources accessed through computers. The application of blended learning is used to solve problems students face in the learning process that require them to be connected to technology. According to Tour in Harjono (2018), e-learning is applied to assist learners in processing and utilizing various information and creating and sharing information on social media. Digital literacy skills emphasize the ability of individuals to use digital technology, communication tools, and the internet effectively and critically (Rohana, Rahmi, 2023). This is by (Hazmi, Tahir, and Turmuzi, 2021) believe that the application of blended

learning can improve students' digital literacy skills because they can find out how to send files, photos, and learning videos from WhatsApp so that there is no time limit in the learning process.

Blended learning with individual rotate, flex, and inside-out types have the same effect. These three blended types have the same benefits, emphasizing learning that hones learners to think individually and collaborate more actively. This is to Albion's (2008) research that blended learning is learning that results in students being able to learn independently so that learning is more effective and efficient and can increase accessibility in learning. The similarity in the results of digital literacy skills is also due to the application of blended learning using the LMS (Learning Management System) application so that the features contained in the LMS are the same even though the flow or stages of learner activities of the three types of blended learning individual rotation, flex, and inside out are different.

Another result obtained is that space and time in the learning process are not limited because students can access learning anywhere, and they can also ask about tasks that are not understood. (Guspriadi, Suhaili, 2021) Also, it argues that the blended learning approach can be used to improve students' understanding of digital literacy. In particular, the use of interactive media in the implementation of services provides an increase in understanding of digital literacy provides more understanding. This research needs to be done because understanding digital literacy is a basic need that must be met now, especially in education. Many factors are the reason why digital literacy is needed in students, including being able to get used to information and communication technology, the flow of information development, and opportunities for community empowerment in the digital world (Rizkinaswara, 2020), (Lee & McCluskey, 2017).

CONCLUSION

Based on the results of this study, the application of blended learning types of individual rotate, flex, and inside-out influences students' digital literacy skills in class VIII SMP Negeri 5 Sinjai, especially in science material. The ANCOVA test results show a significant effect of the three types of blended learning applied. In contrast, the LSD test results show that the three blended learning types, namely individual rotate, flex, and inside-out, have the same effect but are different when compared to the application of the STAD approach. The effect of the three types of blended learning on digital literacy skills is evidenced by the significance value of 0,001, which means a significant difference in digital literacy skills between students taught with individual rotation, flex, and inside-out blended types. The three types of blended learning applied in the experimental class affected digital literacy skills. However, it is not significantly different; this is proven because the blended learning types of individual rotation, flex, and inside-out are at the Sig> 0,05 level. Meanwhile, the STAD treatment did not affect digital literacy skills, as evidenced by the Sig < level of 0,05. The findings of this study provide a reference for educators related to blended learning, which has a scientific impact on education in the future. One of the impacts is that students can access learning materials anytime and anywhere, reducing educational disparities in schools, and more flexible learning will support the development of 21st-century skills, especially digital literacy skills, which are very important to prepare students for global challenges. The researcher suggests that future researchers conduct research using Learning Management System (LMS) media assistance because it has the benefit of providing access to information that can be tailored to the needs of specific learners. The limitation of this study is that the focus is only on implementing blended learning with individualized rotate, flex, and inside-out types without considering other types of blended learning. This research was also only conducted in one school, SMP Negeri 5 Sinjai, so the results obtained cannot be generalized to all schools. While conducting the research at SMP Negeri 5 Sinjai, some of the researcher's challenges were network limitations. Not all students have the same access to technological devices and a stable internet connection, which could affect the success of blended learning implementation. This challenge could create a gap in the use of technology and affect the digital literacy skills they develop.

ACKNOWLEDGMENT

This research did not receive special grants from any public, commercial, or non-profit funding agency. The researcher is grateful to the extended family of SMP Negeri 5 Sinjai who have participated in this research, especially the 8th-grade science teacher and the principal, who have given permission and provided assistance during the research. Thank you also to the 8th-grade students who have actively participated and helped in my research. For the implementation process using the blended learning approach to take place well, an educator must pay attention to the availability of facilities and infrastructure, especially when students use smartphones or laptops.

REFERENCES

A.S. Syarifudin. (2020). Impelementasi pembelajaran daring untuk meningkatkan mutu pendidikan sebagai dampak diterapkannya social distancing. Jurnal Pendidikan Bahasa Dan Sastra Indonesia Metalingua, 5(1). https://doi.org/10.53860/losari.v4i1.90

Abdulhak, Ishak, darmawan. 2013. Teknologi Pendidikan,Bandung : Remaja

Abroto, A., Maemonah, M., & Ayu, N.P. (2021). Pengaruh Metode Blended Learning Dalam Meningkatkan Motivasi dan Hasil Belajar Siswa Sekolah Dasar. Edukatif: Jurnal Ilmu Pendidikan, 3(5), 1993-2000. https://doi.org/10.31004/edukatif.v3i5.703)

Akbar, M. F., & Anggaraeni, F. D. (2017). Teknologi dalam pendidikan: Literasi digital dan self-directed learning pada mahasiswa skripsi. Indigenous: Jurnal Ilmiah Psikologi, 2(1). https://doi.org/10.23917/indigenous.v1i1.4458

Albion, P. R. (2008). Web 2.0 in teacher education: Two imperatives for action. Computers in the Schools, 25(3-4), 181–198. https://doi.org/10.1080/07380560802368173

Aldi, S., Adnan, & Azis, A. A. (2024). The Influence of SaLDI Learning Model (Stimulation, Learning Community, Discovery, Inferring) on Activity, Motivation, and Learning Outcomes of Biology of High School Students. Jurnal Penelitian Pendidikan IPA, 10(11), 9064–9077. https://doi.org/10.29303/jppipa.v10i11.9379

Astuti, N. P., & Bakri, R. (2022). Pelatihan Learning Management System (LMS) Untuk Peningkatan Kualitas Pembelajaran Blended Learning Pada Praktikum Perbankan Bagi Dosen Dan Mahasiswa. LOSARI : Jurnal Pengabdian Kepada Masyarakat, 4(1). https://doi.org/10.53860/losari.v4i1.90

Bawden. (2001). Information And Digital Literacies: A Review Of Concepts", Journal of Documentation, Vol. 57. https://doi.org/10.1108/EUM0000000007083

Bozkurt, A. (2022). A retro perspective on blended/hybrid learning: Systematic review, mapping, and visualization of the scholarly landscape. Journal of Interactive Media in Education, 2022(1). http://doi.org/10.5334/jime.751

Brooke, R., Fabretto, M., Pering, S., Switalska, E., Reeks, L., Evans, D., & Murphy, P. (2015). Diffuse color patterning using blended electrochromic polymers for proof-of-concept adaptive camouflage plaques. Journal of Applied Polymer Science, 132(26). https://doi.org/10.1002/app.42158

Brown, S., & Harris, E. (2021). Digital learning platforms and their impact on 21st-century skills development in K-12 education. Educational Technology Research and Development, 69, 233–249. https://doi.org/10.1007/s11423-021-09922-0

Canbulat, G., & Uzun, S. (2024). A content analysis of blended learning studies in science education. Turkish Journal of Education, 13(2), 136-157. https://doi.org/10.19128/turje.1345182

Dewi, D. A., Hamid, S. I., Annisa, F., Oktafianti, M., & Genika, P. R. (2021). menumbuhkan karakter siswa melalui pemanfaatan Literasi Digital. Jurnal Basicedu. 5(6). 5-9. https://doi.org/10.31004/basicedu.v5i6.1609

Dublin, Ž., Reus, M., Athens, H. (2019). Blended Learning Helpful tips for starting into a combination of classroom and online teaching. Hosang Communications, Pingelshagen : Germany

Fitriani, F., Yulis, P. A. R., Nurhuda, N., Sukarni, S., Gunita, A., & Cholijah, S. (2023). Peningkatan literasi digital guru dalam pembelajaran blended learning. Jurnal Pengabdian UNDIKSHA, 4(1). 140-147. https://doi.org/10.33394/jpu.v4i1.6536

Frau, M., Moi, L., & Cabiddu, F. (2020). Outside-in, inside-out, and blended marketing strategy approach: a longitudinal case study. International Journal of Marketing Studies, 12(3), 1–13. http://dx.doi.org/10.5539/ijms.v12n3p1

Gilster. (1997). Digital Literacy. New York: Wiley

Ginting, S. (2023). Membangun Budaya Organisasi Membentuk Karakter Tangguh. Gorontalo: Ideas Publishing

Guspriadi, Y., & Suhaili, N. (2021). Pelaksanaan layanan informasi dengan metode blended learning dan presentation tools visme untuk meningkatkan pemahaman literasi digital peserta didik. Counseling and Humanities Review, 1(2), 44-51. http://dx.doi.org/10.24036/00598kons2023

Harjono, H. S. (2018). Literasi Digital: Prospects and Implications for Language Learning. Jurnal Pendidikan Bahasa dan Sastra. 8(1). 1-7. https://online-journal.unja.ac.id/pena/article/view/6706.

Hazmi, H. Y., Tahir, M., & Turmuzi, M. (2021). Implementasi blended learning pada proses pembelajaran 4.0 dalam rangka meningkatkan literasi digital peserta didik kelas 5 SDN 5 cakranegara. Renjana Pendidikan Dasar, 1(2), 109-115.

Hrechanyk, N., Koval, D., Kovalchuk, I., Slovik, O., & Zinchenko, L. (2023). Exploring benefits and models of blended learning technology in modern professional training. AmazoniaInvestiga, 12(67),54-65. https://doi.org/10.34069/AI/2023.67.07.5.

Husni Idris. (2011). Pembelajaran Model Blended Learning. Jurnal Iqra' 5(1). http://dx.doi.org/10.30984/jii.v5i1.562

Indust, F. T., & Barat, J. Pengaruh Penggunaan Blended Learning Berbasis. No. 100, 249-260.

Ishak Abdulhak, Deni dermawan. (2013). Teknologi pendidikan. Bandung : PT roda Karya.

Iskandar, A., Parnawi, A., Sangena, U., Kurdi, M.S., Fitra, D., Nusrofah, Haryati, S., Riska, F.M., Arianto, T., Kurdi, M.S., Hartatik, Fitriana, Agus Rofi'i, Putra, P., Baun, N., Rahmi, H. (2023) Transformasi digital dalam pembelajaran. Malang: PT. Literasi Nusantara Abadi Grup.

Johnson Walton, Strickler, & Elliot, (2023). Online Teaching in K-12 Education in the United States: A Systematic Review. American Educational Research Association. 93(3). https://doi.org/10.3102/00346543221105550

Johnson, C. C., Walton, J. B., Strickler, L., & Elliott, J. B. (2023). Online teaching in K-12 education in the United States: A systematic review. Review of Educational Research, 93(3), 353–411. https://doi.org/10.3102/00346543221105550

Kanuka, H., & Rourke, L. (2013). Using Blended Learning Strategies to Address Teaching Development Needs: How Does Canada Compare? Canadian Journal of Higher Education, 43(3), 19–35. https://doi.org/10.47678/cjhe.v43i3.184741

Kemdikbud. (2017). Panduan Implementasi Keterampilan Abad 21 Kurikulum 2013 di SMA. Jakarta: Dit. PSMA Ditjen Pendidikan Dasar dan Menengah

Kruger, M. J., dan Waters, R. D. (2013). Predicting online learning success: applying the situational theory of publics to the virtual classroom. Computer & Education 61, 176–184. https://www.learntechlib.org/p/132220/10.1016/j.compedu.2012.09.015

Kumar, K. L., & Owston, R. (2016). Evaluating e-learning accessibility by automated and student-centered methods. Educational Technology Research and Development, 64, 263–283. https://doi.org/10.1007/s11423-015-9413-6

Lee, SH, & McCluskey, K. (2017). Blended learning in higher education: A global review. International Journal of Educational Technology

Li, M., Han, X., & Cheng, J. (2024). Handbook of educational reform through blended learning (p. 418). Springer Nature.

Maisarah, I., Azis, A. A., & Pagarra, H. (2022). Pengaruh Penerapan Model Blended Learning Terhadap Hasil Belajar Peserta Didik Materi Sistem Ekskresi. Jurnal Biology Teaching and Learning, 5(2), 43-50

Mlambo, P., Maeko, M., & Khoza, S. (2023). Teacher Readiness for Integration of Information and Communication Technology in Teaching and Learning of Engineering Design and Graphics in KwaZulu-

Natal. Research in Social Sciences and Technology, 8 (3), 176-195. https://doi.org/10.46303/ressat.2023.26

Muhria, L., Fitriati, S. W., Suwandi, S., & Wahyuni, S. (2022). Penguatan Literasi Digital Melalui Penerapan Model Blended Learning Dalam Pembelajaran Bahasa Inggris. In Prosiding Seminar Nasional Pascasarjana. 5(1). 605-609

Mutaqin, A., Marethi, I., & Syamsuri, S. (2016). Blended learning model in UNTIRTA mathematics education study program. Jurnal Cakrawala Pendidikan, 35(1). https://doi.org/10.21831/cp.v1i1.8384

N. P. Astuti and R. Bakri,(2022). Pelatihan Learning Management System (LMS) Untuk Peningkatan Kualitas Pembelajaran Blended Learning Pada Praktikum Perbankan Bagi Dosen Dan Mahasiswa,. LOSARI: Jurnal Pengabdian Kepada Masyarakat, 4(1). https://doi.org/10.53860/losari.v4i1.90

Palennari, M., Adnan, A., & Nur, F. (2018). Pembelajaran Sistem Reproduksi Manusia Menggunakan Blended Learning Terintegrasi Discovery Learning. Jurnal Sainsmat, 7(1), 47-56. https://doi.org/10.35580/sainsmat7164762018

Pratama, S., Syah, L. Y., & Fauzi, F. (2023). Implementing blended learning in distance learning during the COVID-19 pandemic at SMK Negeri 2 Lahat. Jurnal Bisnis, Manajemen, Dan Ekonomi, 4(1), 55-81. https://doi.org/10.47747/jbme.v4i1.1020

Prensky, M.(2001). Digital Natives, Digital Immigrants Part 1, On the Horizon, Vol. 9. https://doi.org/10.1108/10748120110424816

Riduwan. (2018). Skala Pengukuran Variabel-variabel Penelitian. Bandung: Alfabeta.

Rizkinaswara, L. (2020). Revolusi Industri 4.0. Jakarta: Kementerian Komunikasi dan Informatika RI.

Rohana, S., & Rahmi, R. (2023). Model Pembelajaran Literasi Pada Mata Pelajaran Pai Berbasis Digital. Bidayah : Studi Ilmu-Ilmu Keislaman, 155-173. https://doi.org/10.47498/bidayah.v14i2.1688

Sagala, Syaiful. (2006) Konsep dan Makna Pembelajaran. Bandung: Alfabeta.

Salmia, and A. Muhammad Yusri. (2021) "Peran Pendidik Dalam Pembelajaran Abad 21 Di Masa Pandemik Covid-19." Indonesian Journal of Primary Education. 5(1).

Syarifudin, A.S. (2020. Prospects and). Implementing online learning to improve the quality of education as the impact of social distancing Implications in Language Learning. Jurnal Pendidikan Bahasa Dan Sastra Indonesia Metalingua, 5(1), 31-34. https://doi.org/10.21107/metalingua.v5i1.7072

Wang, L., Omar, M. K., Zakaria, N. S., & Zulkifli, N. N. (2024). Differential Reactions of Urban and Rural Teachers to Blended Learning: Evidence From Chinese Secondary Schools. International Journal of Mobile and Blended Learning (IJMBL), 16(1), 1-19. http://dx.doi.org/10.4018/IJMBL.337492

Watson, W. R., & Watson, S. L. (2007). An argument for clarity: What are learning management systems, what are they not, and what should they become? In TechTrends. 51(2). 28–34.

Wirdayani, A., Kune, S., & Shaleh, S. F. (2023). Pengaruh Model Pembelajaran Blended Learning Berbasis Literasi Digital Terhadap Motivasi Dan Hasil Belajar Ipa Kelas V Sekolah Dasar. Jurnal Pendidikan Glasser. 7(1). 133-142.

Yana & A. Adam. (2019). The Effectiveness of Using the LMS Platform as a Blended Learning-Based Learning Media on Student Learning Outcomes. Jurnal Dimens. 8(1). https://doi.org/10.33373/dms.v8i1.1816