Transforming Lesson Study with PHP Learning Application: It's Impact on Students' Digital Literacy

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ABSTRACT: Improving the digital literacy of educators and students is an important element in educational reform to support the achievement of students' academic achievement. This study aims to identify alternative solutions through the development of Hypertext Preprocessor (PHP) application-based learning to improve students' digital literacy. The study used a quasi-experimental method with a one-group pretest-posttest design involving 41 students of the Elementary School Teacher Education Study Program, Makassar Islamic University who were taking the Microteaching course. The study was conducted in eleven meetings, with digital literacy measurements using test instruments and questionnaires based on indicators compiled Referring to Caballé, Cervera, Esteve Mon (2020) and Wang Ng (2012). The results of the study showed a significant increase in digital literacy, with an average N Gain of 45% on the test results and 56% on the questionnaire. The implementation of PHP-based Lesson Study has also been shown to facilitate the implementation of the planning (plan), implementation (do), and reflection (see) stages, as measured by assessment instruments adapted from the UNY Lesson Study Team (2007) and Ibrohim (2009). With these results, the technology-based application shows its effectiveness in supporting the improvement of students' digital literacy and can be implemented widely at various levels of education to improve the efficiency and quality of learning.

KEYWORDS: Digital Literacy, Lesson Study, Hypertext Processor (PHP)

INTRODUCTION

The 21st century is marked by the Industrial Revolution 4.0 and Society 5.0 which bring fundamental changes in various aspects of life, including education. The era of openness and globalization allows access to information and knowledge to be wider without limitations of space or time. The development of information and communication technology is a major factor driving significant transformation in the education system. Learning is no longer limited to conventional classrooms, but can be done flexibly through various digital platforms, thus creating a more inclusive and adaptive learning environment [1], [2], [3].

These changes pose major challenges for the education system, especially regarding the readiness of educators and students in facing the digital era. Digital curriculum, technology-based learning applications, e-books, and other interactive resources have become an integral part of the teaching and learning process. However, one of the main obstacles in implementing technology-based educational transformation is the low digital literacy of educators, which hinders the optimization of technology utilization in learning [4].

In Indonesia, the challenges of 21st century education are increasingly complex due to global competition, the demands of the Industrial Revolution 4.0, and various social aspects that affect the education system. Graduates of higher education personnel are expected to have critical thinking skills, creativity in the use of technology, effective communication, and the ability to collaborate in a digital environment. As a strategic step, education students, who are prospective educators, can be involved in testing technology-based solutions. With their involvement, it is hoped that they will be able to understand and master these innovations early on so that they can be applied effectively when they enter the workforce. This approach is an effort to prepare a generation of educators who are better prepared to face the challenges of technology-based education in the future [5], [6].

Globalization demands the readiness of educators in facing broader challenges and opportunities. The use of technology in learning allows for a more interactive approach, personalization of materials, and access to more diverse educational resources. Therefore, increasing the digital literacy of educators is a crucial factor in supporting the effectiveness of technology-based learning. Digital literacy is not only limited to skills in operating technological devices, but includes the ability to access, analyze, and validate information critically and integrate technology into learning effectively [7], [8], [9].

Educational transformation, especially in the pedagogical process, requires technology integration, because this is not just a response to the demands of the times, but an effort to improve the effectiveness of learning. In the digital era, the use of technology in learning is an urgent need to improve the effectiveness and efficiency of higher education. The success of implementing technology in learning is highly dependent on the level of digital literacy of students. Without adequate mastery of digital literacy, students as prospective educators will face obstacles in optimizing technology as a learning tool. Therefore, an innovative approach is needed that not only encourages the use of technology in education, but also improves the digital literacy of students as prospective educators in the digital era. In line with this, lesson study is an innovative approach that plays a role in developing students' pedagogical skills and the integration of lesson study with digital technology not only increases effectiveness, but also allows students as prospective educators to be more adaptive in designing and implementing learning strategies that are in line with the needs of students in the digital era.

Lesson study serves as a tool to improve the quality of learning. By involving educators in planning and implementing learning collaboratively, lesson study allows for the creation of learning experiences that are more engaging, relevant, and effective. Educators can share effective teaching strategies, evaluate learning outcomes, and refine their teaching plans based on experiences and observations gained from lesson study [10].

The advantages of lesson study have provided many benefits in significantly improving the teaching skills of educators and the academic achievement of students. However, there are weaknesses in lesson study that result in educators not implementing it in class, such as educators being less familiar with or not fully understanding the concept and process of lesson study [11]. The implementation of lesson study conventionally requires a lot of time from the educators involved. This challenge makes educators who have a heavy workload or limited time in their learning schedules [12]. In addition, lesson study requires additional resources such as discussion rooms, and access to learning materials, which may not always be available in every school [13]. Based on the weaknesses of implementing conventional lesson study that have been explained previously, the latest innovations are needed to overcome possible obstacles and increase the participation of educators in implementing lesson study, such as developing lesson study based on learning applications with programming using Hypertext Processor (PHP).

Lesson study emphasizes ongoing reflection and evidence-based improvement. Collaboration between educators and students in designing and using Hypertext Processor (PHP) digital content allows them to continuously evaluate and improve the effectiveness of learning through data analysis, student feedback, and direct observation. By leveraging collaboration between educators or students, education in lesson study and the wealth of digital content provided by Hypertext Processor has great potential to create innovative, learner-oriented learning environments that are able to overcome the weaknesses of conventional lesson study processes.

The study of the paragraph above is an effort to find alternative solutions in improving the digital literacy skills of education students. Improving the digital literacy of educators and education students is one of the key aspects needed for educational reform for students' academic achievement in schools. Therefore, the main reason for developing lesson study based on hypertext preprocessor learning applications is to improve students' digital literacy.

LITERATURE
Lesson Study

According to Jan D. Vermunt, Maria Vrikki, Pete Dudley, and Paul Warwick (2023), lesson study is a collaborative process that involves teachers in an ongoing intellectual study of what they teach and how they teach. This definition includes four keywords: collaboration, ongoing, what to teach, and how to teach, which are relevant to the sociocultural context in each country [14].

In Indonesia, lesson study is also known as "Kajian belajar" which aims to describe learning from, about, and for learning. Susilo et al. (2009) explained that in lesson study, teachers collaboratively study the curriculum, formulate learning objectives, design learning, implement and observe the learning being studied, and reflect to improve learning [15]. The implementation of learning and teaching theory through lesson study, according to Klara Kager, John Paul Mynott, and Miriam Vock (2023), is a cycle of inquiry by a team of teachers that focuses on "learning research". Elkomy and Nevien H. Elkhaial added that during learning research, the team of teachers collects data on students' thinking and learning as well as aspects of the learning design that enhance or hinder learning. Lesson study is also used to test the effectiveness of technology-based teaching materials products, making it easier for students to understand and apply simple exercises [16], [17].

In conclusion, lesson study is a collaborative approach that aims to develop and improve the quality of learning through joint planning, observation, and reflection between teachers. This approach focuses on developing teacher professionalism and improving student learning outcomes with teachers working together to design, observe, analyze, and improve their teaching practices.

Digital literacy

Digital literacy was first introduced by Paul Gilster in 1997. According to Gilster, digital literacy is the ability to use digital and information technology effectively and efficiently in various aspects of life, including academics, careers, and daily life. Digital literacy includes the ability to use information technology to access, use, and analyze information in the digital world, which is related to critical thinking and decision-making processes (Dharma & Sihombing, 2020). Furthermore, Gilster defines digital literacy as an individual's awareness, attitude, and ability to use digital tools and facilities appropriately to identify, access, manage, integrate, evaluate, analyze, and synthesize digital resources. This includes building new knowledge, creating media expressions, and communicating with others in the context of certain life situations to enable constructive social action and reflect on the process [18]. Digital literacy is the skill of using information and communication technologies to create, evaluate, and communicate data, which requires cognitive and technical skills [19].

Digital literacy is an important skill that modern, technologically savvy society must have [20]. In the world of education, digital literacy is not only about the use of technology but also proper information management, critical thinking skills, and the right online attitude [21]. Digital literacy is very important for students to increase the effectiveness and efficiency of the learning process and to prepare themselves to face a dynamically changing job market [22].

METHOD

Sample and procedure

Measuring the effectiveness of application-based lesson study on students' digital literacy is assessed by UIM PGSD Study Program students who are taking MK. Microteaching with the number of trial subjects according to Field, A. (2013) at least 41 people. The quasi-experiment was carried out in eleven meetings with a one-group pre-treatment and post-treatment design. The effectiveness trial was carried out with a quasi-experiment using the One-group pretest-posttest design type.

Digital literacy is measured using indicators that have been synthesized and compiled by the author referring to indicators from Anna Sánchez Caballé, Mercè Gisbert Cervera and Francesc Esteve Mon (2020) and Wang Ng (2012). The assessment using a question measuring instrument consists of six sub-indicators and 20 question items in the form of multiple-choice questions with correct (score 1) and wrong (score 0) values. The assessment using a questionnaire measuring instrument consists of 10 sub-indicators and 36 statement items with a Likert scale measuring instrument with STS values (score 1), TS (score 2), N (score 3), S (score 4), and SS (score 5). All measuring instruments are filled in by students. The following is a description of the digital literacy indicators.

The assessment sheet for the implementation of each stage of lesson study, namely plan, do, and see, was developed by the UNY Lesson Study Team (2007) and adapted by Ibrohim (2009). The assessment of the plan stage consists of 10 question items and the do and see stage consists of 13 question items filled in by the lecturer with the answers yes (score 1) and no (score 0).

Instruments

The following indicator formulation for each instrument can be seen in table 1.1.

Table 1.1 Indicator Formulation

No.	Instrument	Indicator	Evaluation Tools	Data analysis
1.	Digital literacy	1. Attitudes towards ICT for Learning such as accessing and evaluating information critically 2. Developing collaborative digital content creation skills 3. Building students' critical thinking and efficient problem solving.	1. Digital Literacy Knowledge Questions 2. Digital Literacy Questionnaire	The digital literacy scores of students obtained were then analyzed statistically using the average N gain value.

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2.	Assessment of the implementation of Lesson Study with PHP Learning Application (filled in by the lecturer)	**Plan** 1. Learning Design 2. Learning Resources and Media 3. Learning Management 4. Collegality **Do** 1. Learning Planning and Presentation 2. Classroom Management and Interaction 3. Learning Effectiveness and Media **See** 1. Managing Activities and Discussions 2. Reflection and Feedback 3. Focus and Acceptance of Feedback 4. Active Participation	Observation Sheet	Average presentation of each component

RESULT AND DISCUSSION

Result

The results of the implementation of lesson study based on Hypertext Applications were carried out using observation sheets filled out by lecturers to monitor the implementation of lesson study. The results of the observation sheets are presented in the following table.

Table 1.2 Observation Results of Lesson Study Implementation Based on Hypertext Preprocessor Application

Kelompok	Plan	Do	See
I	80 %	77%	76,95 %
II	70 %	77 %	84,61 %
III	70 %	70 %	84,61%
IV	80 %	76,9 %	84,61%
V	80 %	84,61%	84,61%
Average	76 %	76,98%	83,08%

(**Source:** Personal Data)

Based on the observation results above, the implementation of Lesson Study Based on Hypertext Preprocessor (PHP) Applications is concluded that overall lesson study activities show positive results. Group V is the most prominent group with consistently high scores on all observed indicators. This group obtained a Plan score of 80, Do 84.61, and See 84.61. The highest score on the Do and See aspects (84.61) reflects that this group has succeeded in implementing the learning plan effectively during the implementation process and is able to conduct a good evaluation after the learning activity. Group V's ability to design, implement, and analyze learning effectively using PHP applications. Compared to other groups, group V showed more stable performance, so it can be considered as the best model or example in implementing application-based lesson study.

Digital literacy results are measured using digital literacy ability questions and pretest and posttest questionnaires. The analysis of effectiveness data on the digital literacy questionnaire used is through normalized average gain value data (N-Gain). The following are the results of the effectiveness of digital literacy on the Pretest and Posttest questions and questionnaires.

Table 1.3 Results of the Effectiveness of Lesson Study Questions and Questionnaires Based on Hypertext Preprocessor Applications to Improve Students' Digital Literacy

Measuring instrument	S*Pretest*	S*Post*	N-Gain	Category
Question of Knowledge	47	71	0.45	Moderate effectiveness
Questionnaire	58	81	0.56	Moderate effectiveness

(**Source:** Personal Data)

The use of two measuring instruments, namely questions and questionnaires, provides a more comprehensive approach in evaluating the improvement of digital literacy skills. Questions are used to assess cognitive aspects, such as technical knowledge and digital literacy concepts, while questionnaires measure students' perceptions and attitudes towards digital literacy.

Based on the results, both measuring instruments showed effectiveness in the moderate category. For the question measuring instrument, the average N-Gain value of 0.45 indicated an increase in digital literacy in students after the implementation of PHP-based Lesson Study. The questionnaire showed higher results with an N-Gain of 0.56 which was in the moderate effectiveness category, indicating that students not only experienced cognitive improvements, but also improvements in their perceptions of learning.

DISCUSSION

The effectiveness test of the PHP application-based lesson study developed is a measurement to determine the achievement of objectives in the developed product. The effectiveness test in this study was carried out during implementation. The implementation of the PHP application-based lesson study was carried out offline and online, this study has two dependent variables, namely digital literacy. To determine the effectiveness of the product developed. The following is a description of the variables.

The results of the digital literacy skills measurement tool show that the effectiveness of Lesson Study based on the Hypertext Preprocessor application in improving students' digital literacy has an average N-Gain of 0.45 and the questionnaire measurement tool has an average N-Gain value of 0.56 which is categorized as moderate effectiveness.

The results of the study showed that the PHP application-based lesson study intervention succeeded in significantly increasing students' digital literacy, which was measured using a question measuring tool through three indicators: attitudes towards ICT for learning, skills in creating digital content collaboratively, and critical thinking and efficient problem solving. Of the three indicators, attitudes towards ICT for learning were the most superior, indicated by the highest N-Gain value of 51% (moderate category) and an average posttest of 75%, higher than other indicators.

The superiority of the attitude indicator towards ICT for learning can be explained by the focus of learning that provides students with direct experience in accessing, evaluating, and using information critically. These activities involve basic digital literacy skills, as emphasized in Gilster's (1997) research, which states that digital literacy is the ability to think critically when using information technology. With a structured approach, students find it easier to understand the importance of ICT as a learning tool that supports them in evaluating information critically. This indicator is superior because the learning approach is relevant to the needs of students in the digital era. These findings are in line with several previous studies, which show that the integration of technology in learning is effective in improving students' critical thinking skills towards the use of information technology [23], [24]. This success is proof that students' digital literacy can be improved through learning that emphasizes direct experience and practical context.

The indicator of critical thinking and efficient problem solving has an N-Gain value of 47% (moderate category), with an average increase from 45% in the pretest to 71% in the posttest. These results indicate effective learning in helping students develop critical thinking skills and problem-solving abilities, although not as high as the first indicator. Becnel's (2024) research states that case study or simulation-based exercises can strengthen these abilities. Therefore, learning can be improved with a real-world problem-based approach [25].

One of the advantages of the developed product is the significant improvement experienced by several students with an N-Gain of 0.74 (74%) with questions and 0.87 (87.04%) for the questionnaire measuring instrument which shows that Lesson Study based on PHP applications can have a positive impact on the development of digital literacy. However, the weakness is in the uneven effectiveness, because some students only experienced a slight increase with an N-Gain of 0.21 (21.05%) for the question measuring instrument and for the questionnaire only reaching an N-Gain below 40%. Based on the results of interviews with students, they admitted that there was a significant increase in value, which was caused by the action of looking at answers from friends and searching for answers on the internet to solve questions. This caused a significant difference in value, with the lowest value reaching minus and the highest value. Although Lesson Study based on PHP applications is generally effective, improvements are needed to achieve more even results among students.

Several previous studies have found that the use of technology-based learning can improve digital literacy, but the main challenge is the lack of consistency in the results of improvements between individuals. Web-based learning technology can improve

students' digital skills, but adjustments to teaching methods are needed to ensure that all participants get balanced benefits from the use of technology [26], [27], [28].

CONCLUSION

The implementation of PHP-based Lesson Study can improve students' digital literacy, with results showing a significant increase. Based on measurements carried out using question and questionnaire instruments, this application has been proven to be able to improve students' digital literacy with an average N Gain of 45% on questions and 56% on questionnaires. Technology-based Lesson Study provides convenience and efficiency in the planning, implementation, and reflection stages of learning, so that this application can be implemented effectively at all levels of education.

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