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Blended Learning Based on Science Literacy in Science Concept Learning

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Abstract. The Covid-19 pandemic has changed the process of Science Concepts learning, which was initially being implemented directly into a form of blended learning by combining forms of direct learning and online learning. This research is a mixed-method design with an explanatory sequential type that aims to evaluate the implementation of Science Concept learning which is held in blended learning based on scientific literacy using the CIPP evaluation model consisting of context, input, process, and results. The instrument used is a response questionnaire given to 99 students who were analyzed descriptively quantitatively, and then six students and two lecturers were selected who were interviewed and analyzed qualitatively. Based on data analysis, the results showed that the context aspect was in the very good category, the input aspect was in a good category, the process aspect was in the very good category, and the product aspect was in a good category. These results indicate that implementing the science concept lecture process by applying blended learning has been going well but needs improvement.

INTRODUCTION

Scientific literacy is an important ability that must be possessed in the era of the industrial revolution 4.0. This era requires us to use abilities, scientific knowledge, competencies, and technological skills to compete and adapt to the rapid development of technology. This scientific literacy competence is a provision in this era of rapid technological development [1]. Scientific literacy is a person's ability to analyze, identify and use science in solving problems [2]. This scientific literacy is the target of science education in this era [3]. However, the scientific literacy ability of Indonesian students has bad results [4][5], even though this scientific literacy ability is correlated with student learning outcomes [6]. One of the low scores is due to the role of the teacher. Teachers have a vital role as the foundation of education because teacher competence is related to educator professionalism [7][8]. The increase in teacher competence must begin when taking the teacher program. The teacher training institute's function is to print out prospective teacher graduates, likewise with the Elementary School Teacher Education study program. As a candidate for elementary school teachers, elementary teacher education has an important program to improve the quality of elementary school teacher graduates. Elementary school teachers are considered the spearhead of education because, during elementary school, students get formal education who have learned about content and context. Elementary school teachers have better pedagogical or teaching abilities than secondary teachers [9]. Teacher and student relationships contribute to students' academic success [10].

However, students' scientific literacy skills are in the functional stage [2]. Functional abilities, namely, students can use the terms science and technology and understand the theory but have not been able to explain in more detail the physical meaning of the solution [3]. Likewise, the results of computational thinking students are in the algorithm stage, where students can determine solutions but cannot explain the steps for solving problems systematically [11]. Computational thinking is the most modern scientific literacy ability [12]. Thus, it is necessary to evaluate the implementation of learning in lectures held by lecturers, especially those related to scientific literacy skills. These

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results were caused because students majoring in teacher education at the Muria Kudus University experienced misconceptions.

The misconception is a person's condition where he accepts different concepts that are not like the concept according to experts [13][14][15]. 33.8% of students experience misconceptions in science concept learning [16]. Therefore, it is necessary to reconstruct the learning of science concepts so that students have good abilities. To reconstruct this learning, the allied science lecturers discussed determining the learning outcomes based on the specified learning outcomes. However, in early January 2020, Indonesia and other countries experienced a coronavirus pandemic. In mid-March 2020, the government issued a policy on online learning, thus changing the learning process that was originally carried out offline into online learning. The procedure seemed shocking for educators because the learning provided was not as planned, likewise with the science concept lectures in the elementary teacher education department Universitas Muria Kudus. Initially, it was designed that there would be 16 offline meetings, but at the fourth meeting, learning had to be done online. Lecturers must have quick decisions so that the learning process continues to run well to achieve the student competencies that have been determined. Because of this policy, lecturers change learning to Blended learning. The main problems of science education include inadequate teacher education due to new policy changes, including changes in education policy due to the COVID-19 pandemic [17]. Blended learning is a learning process that combines traditional concepts, namely synchronous and technology-based learning concepts, namely asynchronous [18]. Blended learning is the current learning solution [19].

Blended learning in the science concept learning is associated with scientific literacy, where the literacy aspects of content, context, and applications are packaged in online learning that is carried out using a certain platform. Therefore, a learning evaluation is needed to analyze the implementation and evaluate the learning of the science concept because, with the evaluation of learning, the lecturer can analyze weaknesses determine success, and determine follow-up. This evaluation serves to obtain information on the learning carried out [20]. This evaluation can be used as the basis for decision-making and program sustainability strategies [21]. This evaluation can also provide teacher input related to improving teaching pedagogical aspects [22]. Many articles have discussed the evaluation of learning programs, but the evaluations carried out are only limited to quantitative data, including the evaluation of the CIPP program according to Luthfi & Hamdi [23], without paying attention to the qualitative discussion of the evaluation results. However, to obtain valid and more detailed data, the evaluation in this study was explored using quantitative and qualitative approaches. Quantitative data is to obtain an overview of the learning activities of the respondents as a whole, while qualitative data is to analyze more deeply the components of the program being evaluated. Thus, it will obtain more detailed and more valid data. The use of the mixed method will get more detailed results and get a deeper meaning than qualitative and quantitative research [24]. This is because research is needed to evaluate the implementation of blended learning in science concept learning based on scientific literacy using an evaluative method with a mixed-method approach.

METHOD

This study aims to evaluate the implementation of science concept learning using evaluative methods, the CIPP evaluation model consisting of Context (C), Input (I), Process (P), and Product (P) with a mix method approach quantitative descriptive approach. The CIPP model can evaluate the effectiveness of a program in detail and thoroughly based on the input aspect, product process [25][26]. Context evaluation relates to needs that have not been met in learning, which goals are easy to achieve. Input evaluation is related to human resources, supporting facilities and equipment, funds/budget, and various procedures used. Process evaluation relates to the learning implementation process, assessment data determined and applied in learning, the extent to which the plan has been implemented, and what components need to be improved. Product evaluation is related to measuring success in achieving the goals that have been set. The resulting data will determine whether the program is continued, modified, or terminated.

The research design used is a mixed-method with a Sequential Explanatory technique [27]. The advantage of this method is that quantitative results are strengthened by qualitative results so that the proposition is more straightforward [28]. The subjects of this research are two lecturers who teach Science Concept learning and 99 4th semester students of the elementary teacher education department at Muria Kudus University for the 2020/2021 academic year. The instrument used to evaluate Science Concept learning with the CIPP component are a questionnaire, interviews, documentation of literacy test results, and the consequences of practical activities. To measure scientific literacy in the context and context aspects, use scientific literacy questions that are already valid [16], while the scientific competence aspect is measured using a practicum project assessment where the practicum process is uploaded on YouTube, and the practicum results are uploaded on Sunan (official LMS from Muria Kudus University). This

questionnaire was given to all lecturers and students, while interviews were given to lecturers and six students who were taken with the snowball technique, with the criteria of two students with high learning outcomes, two students with moderate learning outcomes, and two students with low learning outcomes. The questionnaire data was then analyzed descriptively quantitatively to see the distribution of respondents' results. Furthermore, the questionnaire data was confirmed by interviews given to the subject of lecturers and students according to the category of learning outcomes. The interview results were cross-checked with the results of the questionnaire and then analyzed qualitatively by means of data reduction, data presentation, and drawing conclusions to obtain valid data. The results of the questionnaire are then categorized in TABLE 1.

TABLE 1. Results of the Learning Evaluation Questionnaire

Total score	Criteria
$80 \leq X \leq 100$	Very good
$60 \leq X < 80$	Good
$40 \leq X < 60$	Enough
$20 \leq X < 40$	Less
$0 \leq X < 20$	Not very good

RESULTS AND DISCUSSION

This study aims to evaluate the Science Concept lecture at the Elementary School Teacher Education Department with the informant of lecturers and students given through a questionnaire instrument according to the CIPP evaluative model. This questionnaire is in the form of a closed questionnaire in which there are statements covering aspects of context, input, process, and product, which are complemented by input suggestions. This questionnaire was given to two lecturers and 99 students after the lecture was completed at the end of the semester. The results of this evaluation are used to analyze strengths, weaknesses and make decisions to improve the following learning.

The science concept lecture is compulsory learning in the primary school teacher education program, consisting of 3 credits as a prerequisite learning held by two lecturers but not by team teaching. The results of the questionnaire given to the lecturers show that the elementary school teacher department has various knowledge groups, including science subjects. Lecturers in the science group have a background in physics and biology. However, for student learning, the concept of science is held thematically because of the consideration that elementary school learning is held thematically. The needs analysis results indicate that before the lecture begins, the cognate lecturers discuss the learning outcomes of the teaching, the topics of the material provided, and the learning strategies used. So, the teaching lecturer has the same learning tools even though the classes being taught are different. However, at the fourth meeting, Indonesia experienced a pandemic, so that initially, lectures held offline turned into online. Finally, the learning of science concepts is carried out using various platforms. So, learning still refers to the original plan, but the strategies and methods are adjusted to the conditions. Therefore, an evaluation of this learning was carried out using the CIPP model. Indicators in the assessment of the CIPP model in learning science concepts can be seen in TABLE 2.

TABLE 2. Indicators of Evaluation of the CIPP Model in Science Concept Lectures

CIPP's aspects	Indicators
Context	(1) lecturer's lesson planning, (2) formulation of learning objectives for the Science Concept learning, (3) the nature of science as a scientific product, scientific process, scientific application, and scientific attitude
Input	(1) readiness of lecturers in the implementation of learning, (2) readiness of learning tools (lesson plan, teaching materials, evaluation tools), (3) blended learning support systems and devices
Process	(1) learning strategies and variations used by lecturers, (2) implementation of practical activities, (3) Implementation of evaluation activities, (4) the effectiveness of the implementation of blended learning
Product	achievement of student scientific literacy results (content and context aspects are measured by a test instrument, while competence aspects are measured by project assessment using observation sheets)

The indicators for the evaluation of the CIPP model were then compiled in a questionnaire given to lecturers and students and then analyzed descriptively quantitatively to obtain the results as shown in TABLE 3.

TABLE 3. Results of the Learning Evaluation Questionnaire

CIPP aspects	Score	Criteria
Context	87.83	Very good
Input	77.58	Good
Process	82.67	Very good
Product	79.89	Good

TABLE 3 shows that the evaluation of the Science Concept with the CIPP component has good results, where the context aspect has the highest score, and the input aspect has the lowest score. The discussion and explanation of the evaluation results are as follows

Context Aspect

The context aspect in the evaluation of the CIPP model is related to the planning stage of the Science Concept learning. The concept of science is a compulsory subject for prospective elementary school teaching students who must master various disciplines. In learning science, the essence of science is related to scientific literacy, which consists of material content, competence, context, and attitude. Students' scientific literacy skills need to be improved so that learning is inserted with scientific literacy skills. Before the teaching is held, the supporting lecturer discusses determining learning objectives, formulating learning outcomes for the Science Concept learning, material topics that will be given in one semester, to making learning tools, so that although lectures are not carried out in team teaching, students get a uniform learning experience. Before conducting learning, the teacher plans a lesson plan with an effective learning plan and the achievement of student competencies. Before determining to learn, teachers should evaluate learning outcomes and know student characteristics and student learning styles so that the appropriate steps will be taken to achieve student competence [29]. Learning planning and instructional design are important because the alignment between these instructional sections must be considered in designing learning [30]. Teacher meetings and workshops in determining lesson plans are viewed positively and helpful in learning [31].

In terms of context, this goes well. This can be seen from the questionnaire results, which showed a score of 87.83 or in the very good category. Before the lecture begins, the lecturer gives RPS and lecture contracts to students, informing the learning that will be held, the topic of the material to be studied, and the reference sources used. Students can use this information to prepare and learn the material in advance. However, the lack of lecturers based on the suggestions provided in the questionnaire, namely, learning activities, is not in accordance with the planned strategy due to the pandemic. The implementation of lectures is in accordance with each lecturer and the characteristics of students in the class. One of the problems of science education is that teachers do not play an active role in preparing learning programs [17].

Input Aspect

This input aspect is related to the readiness of lecturers in the implementation of learning, the readiness of learning tools (lesson plan, teaching materials, evaluation tools), the enthusiasm of learning facilities, and infrastructure sources, including systems and equipment to support learning Science Concepts. The results of the response questionnaire show that this component has the lowest score of 77.58 even though it is in a good category. The low results include the readiness of lecturers in implementing this learning related to human resources, both lecturers and students. The lecturer in the elementary teacher education department Universitas Muria Kudus has an educational background in Physics education and Biology Education at the undergraduate level, even though at postgraduate the teaching lecturer has a scientific background in science education. In this Science Concepts learning, science topics are studied thematically so that there are physical concepts, biological concepts, and chemical concepts in it. The results of input from students are not a problem related to the lecturer because students are satisfied with the lecturer's explanation, but input from the lecturer explains that teaching and learning activities should be carried out by team teaching. In the aspect of readiness of learning tools, the questionnaire results showed very good results because the learning tools consisted of lessons, lesson plans, and the learning system used. The teaching materials provided are in the form of hard files, and the evaluation tools used are adjusted to the material and depend on each lecturer. The

questionnaire results on this aspect got very good results, and the results of interviews with lecturers and students showed that there were no problems related to the readiness of learning tools.

The lowest indicator in this aspect is blended learning support systems and equipment. On the part of systems and learning, support equipment gets good results. The learning management system used by Muria Kudus University is Sunan. This Sunan is an LMS in the moodle category. Still, this Sunan can only be used to upload materials, upload assignments, upload quizzes, upload questions but cannot be used for teleconferences. For the teleconferencing feature, use other applications that are synchronized in Sunan. So, it is not in sync between Sunan and the asynchronous learning feature in Sunan.

Regarding the assignment, it is in sync with the system but related to practicum activities, and the system does not cover practical activities that are carried out virtually. So, the lecturer only gives the project in writing, then the results of the practicum activities are uploaded on social media such as Instagram or YouTube so that the lecturer sees the process through videos and the results through reports that have been uploaded to Sunan. The results of the questionnaire show that this component is good enough, and the effects of interviews with lecturers indicate that a learning system is needed that can accommodate the implementation of Science Concept lectures which includes concrete packaged material, virtual lab-based inquiry activities, quizzes, and two-way discussion activities so that there is virtual interaction between lecturers and students, especially practicum activities. Lecturers are required to be skilled in the field of pedagogy and be able to use technology in learning [32]. Students' interview results also showed that students wanted an LMS platform that fully accommodated lectures so that students did not need to install many programs. Moodle and e-learning are beneficial in learning [33]. We realize that developing platforms with advanced technology requires high costs and qualified skills. The application of blended learning using a good platform requires great accuracy, effort, and cost and a complex mode of arrangement requiring more readiness [18]. Therefore, a student LMS is needed that can accommodate Science Concept learning activities.

Process Aspect

This aspect of the process contains the strategies and variations of learning used by lecturers, the implementation of practicum activities, and the implementation of evaluation activities. In this aspect of the process, the questionnaire data obtained 82.67 results with a very good category. The lecturer interviews on aspects of learning strategies and variations, lecturers provide synchronous and asynchronous learning, including project-based learning, exploring the environment, peer tutoring, and group discussions. In the first three meetings, the lecturers gave face-to-face learning. Then due to the pandemic, learning was carried out in a blended learning manner through various platforms, including Sunan, an LMS from UMK, google classroom, google meet, zoom meeting, learning videos, and discussions via Whatsapp groups. In addition, lecturers also use social media for learning, such as YouTube and Instagram. Students are given topics and discussion projects such as mind mapping, collaboration projects, and mini-research, the results of which must be uploaded on YouTube or Instagram. The use of technology media and web-based communication advice makes it easier for lecturers and students to learn in this digital era, and blended learning is an effective method in higher education [34]. The use of technology in education is indeed important in learning, but what is more important is the benefits obtained from this application, so it is not just knowing and being able to use it. Still, teachers must use it well to maximize learning [35]. The use of social media such as Facebook and Instagram can increase student participation, allow students to learn independently, exchange ideas, provide comments, and increase knowledge [36]. The variety of learning used depends on the connection between lecturers and students. As much as possible, the lecturer provides direct explanations, but if there are things that are not understood, the lecturer opens a discussion forum at Sunan and WhatsApp group. Teachers must use various strategies to increase student engagement in learning, including proactive classroom management strategies [37].

There are so many student complaints related to this online learning. The most complaints are quotas and internet connections. At the beginning of online learning, students have not received quota assistance. They complain a lot when they have to spend a lot of money to buy quotas. Problems with blended learning include the time spent preparing for learning, effort, and large costs [18]. The stability of the internet connection affects student learning outcomes [38]. But then the government provides subsidies that are very useful for students. Apart from the quota problem, the connection is important in online learning. To see the quality of student connections, they were given a questionnaire so that the lecturers could better understand the condition of the students, the area they were in so that sometimes students did not turn on the video or could not join the synchronous class, which could be understood by the lecturers so that it became lecturer's input for conducting effective learning. Internet speed and electrical stability are determining factors in online learning [39]. Therefore, lecturers use learning models that vary according to the characteristics of the material & student conditions. In addition, the implementation of learning the concept of science

is associated with components of scientific literacy, namely science content, scientific competence, scientific context, and scientific attitude. Science content is fulfilled through textbooks and e-book given by lecturers to students to study independently, the context of science is met through discussion topics given before lectures, and material implementation projects in various contexts that are related to students' daily lives, including discussion topics and the results, are in the form of a mind-mapping project that is done collaboratively. The initial stage of mind mapping is made individually; after that, the results are collected in large groups so as to get a unified mind mapping from various contexts. Therefore, a collaboration of every student is needed to get the best results. Communication and collaboration are the primary keys to successful learning [40]. Learning activities occur when lecturers provide problems that are in accordance with students' daily lives, challenging questions outside of student habits [41]. Aspects of scientific competence are met through mini-research activities conducted by students. Students' scientific attitude activities can be seen from the evidence of recorded practicum activities and projects that have been done, which are uploaded on YouTube, Instagram, and other social media. However, the scientific attitude aspect assessment has not yet obtained maximum results because it cannot be assessed directly. A scientific attitude is a logical attitude based on scientific data and facts before making decisions [42]. This scientific attitude is able to form critical thinking and objective assessment of something [43]. If the teacher has limitations in measuring students' scientific attitudes, peer assessment is one solution to measure it [44].

Science is closely related to practical activities. Even though it is conducted online, students are still provided with practical activities. This practicum activity begins with the lecturer giving practicum instructions at Sunan, then students do practicum independently, where students propose topics and titles to be researched. After the lecturer agrees on the topic, the students look for the materials needed and do the practicum independently in their respective homes. The process of their practicum activities was recorded and uploaded on YouTube, and they had to make an activity report uploaded to Sunan. The limitations experienced by lecturers are not being able to control practicum activities, not assessing students' generic skills related to the use of tools, science process skills related to the variables studied, and students' scientific attitudes. Lecturers cannot control the manipulation or external factors that influence this practicum activity. However, during the practicum process, students must report the progress of the weekly report at Sunan before the final results are obtained. This activity has been going well, but to monitor student activities directly related to practicum activities, the limitations of the types of investigation carried out by students due to constraints of tools and materials, it is necessary to have virtual labs provided by lecturers so that each student is able to carry out all practicum activities according to their achievements. Future learning design considers whether students collaborate and emphasizes how students collaborate [45]. This laboratory activity can improve scientific literacy and develop students' scientific abilities [46]. Thus, scientific investigation activities must be provided even though they are virtual [47].

In the implementation of evaluation, activities were carried out through various platforms, including Kahoot, Quiziz, google forms, and responses through zoom meetings. This evaluation activity has been going well, but there are several obstacles, including those related to students' honesty in doing the test because even though the instructions are a closed book, sometimes there are students who do not obey. In addition, many platforms provide multiple-choice tests. Therefore, a final exam is needed that is able to measure students' cognitive abilities in detail to obtain data related to misconceptions experienced by students. Appropriate online assessment techniques can produce appropriate results [48]. In general, this aspect of the process has been going well. Still, it is necessary to improve the e-learning system used in learning that can carry out varied learning, both synchronous and asynchronous has virtual labs so that students' competence and scientific attitude are measured. It is necessary to have a place to upload the final project. This final exam feature is able to measure students' cognitive aspects in detail. The use of various technologies that are integrated with social media for learning requires extra time and effort, but the learning outcomes are very satisfying, and students are able to achieve the specified competencies [49]. The use of social media can improve students' communication and active participation [50]. The use of online learning and online assessment presents many advantages, including carrying out direct learning, providing direct feedback, saving time and teacher staff, and encouraging higher-order thinking [51].

Product Aspect

This product aspect is related to the results of evaluating student learning outcomes and the effectiveness of the implementation of blended learning. The results of the questionnaire show that this product aspect gets a score of 79.89. This evaluation activity was carried out using various platforms, but the evaluation results were only able to measure the general thinking ability of students/low-level thinking because most platforms used objective questions. When the lecturer wants students' high-level thinking skills, the lecturer gives essay questions which are done

manually and monitored through zoom meetings. Many complain about this because it is wasteful of quotas. Likewise, lecturers must use the exam time and manually correct the work results so that the time is not effective to measure students' higher-order thinking skills, which is equipped with feedback from students so that lecturers know what students have not understood. Knowledge transfer and knowledge construction are the main concepts in learning, so an evaluation is needed to measure their absorption [52]. Higher-order thinking skills is an important competency that must be possessed by students because it can improve performance and reduce student weaknesses [53].

The results of the questionnaire and interview show that actually learning has been going well, but students feel that they do not fully understand the material given by the lecturer because when learning takes place, there are many obstacles faced, including poor connections, quotas, and learning that uses various different platforms. They provide input that they want an e-learning system that is able to accommodate the nature of science in learning science concepts. The student's suggestions were due to internet connection problems, internet quotas, practicum activities, material that could not be understood optimally, and the need for an integrated learning e-learning system. Improving teaching through the technology used gives visual attention, involves students in learning, and interaction between students and between students and teachers [54]. Internet connection, family support, and the environment affect the effectiveness of the implementation of online learning [55]. Therefore, it is necessary to improve the learning system so that lectures on science concepts can run optimally and students have the specified learning outcomes.

CONCLUSION

This scientific literacy-based blended learning activity has been going well because the lecturer inserts a scientific literacy component in learning. Still, the aspects of competence and scientific attitude have not been appropriately fulfilled. This is related to the input aspect of system readiness, programs, and learning equipment based on the evaluation carried out. The results of the CIPP evaluation show that the input aspect gets the lowest score, while the context aspect gets the highest score. The results of the questionnaire were then strengthened by the results of interviews with lecturers and students and got the results that they needed an integrated learning e-learning system so that they were able to carry out online learning, material delivery, virtual discussions, virtual labs activities to an evaluation system that was able to measure higher-order thinking skills. Students and are equipped with feedback from students as material for lecturer evaluation.

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