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Smart Teaching Based on Lesson Study Promoting Stundent's Digital Literacy in The Rural Area

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Abstract: Education for all and education equality has been an important issue to be payed attention to, especially in the rural areas in Indonesia. Education in rural areas is very underdeveloped due to the lack of the equitable distribution of education services. The main factors behind this problem are the pedagogic competence of teachers and inadequate infrastructure. These factors have a direct impact on the digital literacy of students in rural areas, even though digital literacy is very important in the era of the industrial revolution 4.0. This research is a development research that is aimed at developing a valid, practical and effective Lesson Study (LS)-based smart teaching model. The study was conducted at a junior high school in Jeneponto Regency, South Sulawesi, Indonesia. The results showed that the LS-based smart teaching model developed was valid, practical, and effective to promote students' digital literacy. The development of this teaching model is expected to improve the quality of educators' pedagogic competence in teaching and be able to form educators' creative innovations that can directly have an impact on improving the quality of learning in the classroom.

Keywords: *Digital literacy, education in the rural area, lesson study, smart teaching.*

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Introduction

Students in the rural areas are getting left behind due to the lack of educational services and innovation in the learning process. Many factors caused backwardness in terms of education in rural areas such as the lack of educators' abilities and skills (competence and pedagogics), lack of facilities and infrastructure (application of technology), and educational curricula that do not work properly (Rahmadi, 2020). This problem had an impact on the lack of knowledge of students in some literacy, especially on digital literacy, which is known to be very important in the industrial revolution 4.0 era (Jamaluddin et al., 2023; Kurnia & Astuti, 2017; Rahmah, 2015; Techataweewan & Prasertsin, 2018; Zain, 2017). Digital literacy of students in the rural areas is in crisis because the teachers have not been able to present simple but effective innovations in overcoming these problems. So that serious effort is needed in overcoming these problems, especially in facing the demands of the industrial revolution era.

The demands of the industrial revolution 4.0 on the learning process were to present literacy skills to students (Güneş & Bahçivan, 2018). Literacy skills were an important life skills in the digital era that must be empowered through integrated education starting from the family, school and community (Alt & Raichel, 2020; Blau et al., 2020). Learning processes that empower digital literacy are needed in underdeveloped areas. Without digital literacy, students in the rural areas will be increasingly left behind and will find it increasingly difficult to compete in the industrial revolution 4.0 era in pursuing a career.

Digital literacy was the ability to use technology and information from digital tools in learning or finding the desired information (Techataweewan & Prasertsin, 2018). Digital literacy was also the skill of using media effectively so that the individual can find new and relevant knowledge with the information sought (Lazonder et al., 2020). Therefore, digital literacy was referred to as an effort *to know*, *to search*, *to understand*, *to analyze*, and *to use* digital technology. The existence of digital literacy in students can have an impact on broader insight (Leaning, 2019).

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Wider knowledge could be obtained through the digital literacy process that students have experienced so that they can assist in finding and selecting information, think critically, be creative and collaborate with others (Güneş & Bahçivan, 2018). Research conducted (Tagg & Seargeant, 2021) also showed that digital literacy has a positive impact on academic performance. The digital literacy could contribute to task completion and efficient learning through the use of video, audio and animated learning (Terry et al., 2019). However, in fact in the field, it appears that students' digital literacy had not been optimal and has been paid attention to so that it shows low results (Kurnia & Astuti, 2017).

The low digital literacy of students will have an impact on their digital knowledge (Alt & Raichel, 2020). Lack of knowledge of digital literacy will be a significant obstacle for students when facing the world of work in the future (Febliza & Oktariani, 2020). The low level of digital literacy is generally due to the learning process in schools that have not maximized the technology-assisted learning process (Akiba et al., 2019; Ayyildiz et al., 2021). In addition, the role of educators as drivers and designers in the learning process has not maximized its role. Therefore, it is necessary to carry out a learning design in forming digital literacy that is empowered through the development of Lesson Study (LS)-based smart teaching model. Sugiarti et al. (2021) stated that one effort that could be taken to enhance literacy was the use of the appropriate teaching or learning models. Terry et al. (2019) explained that the teaching of digital literacy skills may be enhanced through a range of methods, including didactic, peer-taught and experiential approaches.

Lesson study (LS) is an approach to improve the quality of learning that is carried out by educators collaboratively, by following the lesson plan, implementing learning, observing the learning process, and doing reflection to discuss the lessons studied for improvement in the next lesson plan. LS-based smart teaching that was developed is expected to improve the quality of students in underdeveloped areas in the learning process. Smart teaching is a learning process that is more meaningful, fun, motivating and attracts students' interest in learning by presenting simple learning technology by the teachers creatively.

Optimizing educators through LS-based smart teaching is a creative effort that aims to present a learning process that is meaningful, fun, motivating and attracts students' learning interest through a simple but effective learning technology (Huang et al., 2013; Saunders et al., 2017). In addition, various studies on lesson study show that there is a positive influence in changes in the teaching style of educators that have an impact on improving the quality of students (Halvorsen et al., 2021; Skoot & Møller, 2020; Schipper et al., 2020; Wolthuis et al., 2020). However, from some of these studies and currently available, they are still limited to research that discusses developing literacy skills in general. As for research on digital literacy, it only focuses on the urban areas, and does not try to conduct research on digital literacy in rural areas, even though the goal of Indonesian education is to educate the Indonesian generation equally. So, it is necessary to conduct a study in the rural areas with a different touch in promoting students' digital literacy.

Based on these problems, it is necessary to properly design a learning model that is able to promote the students' digital literacy skill in the rural areas in a creative, simple but effective manner. Development of LS-based smart teaching can be an alternative learning model in overcoming the digital literacy crisis of students in the rural areas that suitable with the need assessment conducted before. The need assessment was the important step to ensure that the teaching model that will be developed later can be carried out by the needs and characteristics of the target community (Daud et al., 2021). This research is expected to be an effective model in growing the students' digital literacy skill in the rural areas. In addition, it can increase the number and quality of reputable publications at the international level. This research is also expected to make a major contribution to the development of educators throughout Indonesia and the world in the learning process in the rural areas.

The ability of educators in rural areas is a challenge in itself in bringing up creative learning ideas with simple technology nuances in growing the digital literacy of their students. This is important so that students from the rural areas can also have digital literacy. Therefore, the use of simple technology in the learning process in underdeveloped areas needs to be presented creatively so that the learning process can be a little more advanced and little by little can catch up.

Methodology

Research Design

This research was a research and development that aimed at developing a LS-based smart teaching model that is valid, practical, and effective in improving the digital literacy of students in the rural areas. The development of the learning model refers to the Akker et al. (2007) model, which consists of preliminary research, prototyping stage, and assessment phase. Preliminary research included needs analysis, student and educator analysis, content analysis, structure analysis, and objective analysis. Needs analysis was carried out through field studies and literature studies, namely: (a) problem analysis that fosters a desire to develop and provide solutions to overcome the problems faced, (b) compare the gaps between ideal conditions and reality, (c) analysis of causes problems in the field, (d) knowing that this development is not an existing development.

Analysis of students and educators is done by analyzing the digital literacy of students by giving a questionnaire. In addition, an analysis was also conducted on educators using a questionnaire that aims at finding out empirical facts

related to the implementation of learning, educators' perceptions of digital literacy, and the urgency of developing a LS-based smart teaching model. Content analysis is carried out through reviewing material on simple technology media that refers to the existing curriculum by reviewing existing materials and can be used to develop strategies and see conformity with learning outcomes.

This structural analysis aims to analyze the structure of the material concepts that will be included in the lesson plans, worksheets and simple technology media. Analysis of the concept structure to taught through the LS-based smart teaching model. Objective analysis is the formulation of learning objectives based on basic competencies and learning indicators. This analysis is the last stage of analysis and becomes the main focus for achieving development goals. At this stage includes the assessment of learning outcomes of basic competencies, indicators, and learning objectives.

Prototyping Stage: Emphasizes prototype development and product validation. Design prototype results (LS-based smart teaching strategy syntax, simple technology media, learning tools and instruments) from analyzes at an early stage, which is an important consideration. The results of the first prototype will be validated to determine the quality of the developed product.

Assessment phase: This is a phase that is aimed at determining the practicality and effectiveness of the developed strategy after being validated. The activities carried out in this phase are products that have been valid at the prototype stage, tested on students in the villages of SMP class VIII who are left behind in Jeneponto Regency in South Sulawesi to see their practicality and effectiveness. The limited trial was conducted in a pre-experimental research design. The design of this study used a pretest and posttest design. Furthermore, an evaluation is carried out to revise the overall product development, which is carried out after seeing the results of the validity, practicality and effectiveness of the product.

Samples and Data Collection

The sample in this study consisted of 28 junior high school students in class VIII in Jeneponto Regency, which is identified as one of the rural areas in South Sulawesi, Indonesia. The sample was a product trial sample that has been valid at the prototype stage to see its practicality and effectiveness. The product validation data was collected by using expert validation sheet. The trials in this study used a pre-experimental research design. This research design used pretest and posttest to measure early digital literacy before and after LS-based smart teaching treatment. The effectiveness data was collected by using learning tools, student worksheets, observation sheets, and digital literacy instruments with questionnaire form (internet searching, hyper-textual navigation, content evaluation, and knowledge assembly) to obtain digital literacy data. The practicality data was collected by using students' response questionnaire. The instrument used is an instrument that has been previously developed by the researcher.

Analyzing of Data

Data analysis of the validity and practicality of the product uses descriptive analysis techniques based on the results of the instrument that has been validated. Meanwhile, the effectiveness test data were analyzed using N-Gain.

Findings/Results

The result of this research was a product of the smart teaching stage based on lesson study that is valid, practical and effective. The stages of LS-based smart teaching are shown in Table 1.

Table 1. Stages of Lesson Study-based Smart Teaching

Lesson Study Stages	Teacher Activities	Information
Plan	The teacher analyzes learning problems. Can pass a diagnostic test using the google form application.	Conducted in collaboration involving teachers in the field or outside the field
	Teachers develop learning tools based on the results of problem analysis and/or diagnostic test results. The learning devices that are arranged integrate the use of simple technology as a learning media.	
Do	Teachers stimulate students	Other teachers observe to see gaps and errors from the stages of the plan and do process that occur in educators and students.
	The teacher provides material and problem orientation by utilizing simple technology as a medium of learning.	
	The teacher guides students in the problem solving process together using simple technology media The teacher evaluates the material and the learning process using media games	

Table 1. Continued

Lesson Study Stages	Teacher Activities	Information
Check	The teacher discusses to reflect the learning process that has been carried out. The discussion process is very dependent on the sharpness of the analysis of the results of observations of the implementation of learning, which refers to the tools that have been developed together.	Done in collaboration
Act	Check stage can be obtained a number of new knowledge or important decisions for improvement of the learning process in the next lesson.	Done in collaboration

a. Validity Test Results

1) Learning Model Validation Results

The LS-based smart teaching model that has been developed further validated by two experts. The results of the product validation of the LS-based smart teaching model and learning tools are shown in Table 2.

Table 2. Feasibility Validation Results of Lesson Study-based Smart Teaching Model

No	Aspect	Validator			
		Val. 1	Val. 2	Average	Category
1	Supporting Theory	3.67	4	3.84	SV
2	Model Structure	4	3.5	3.75	SV
3	Learning Syntax	3.8	3.9	3.85	SV
4	Social System	3.5	4	3.75	V
5	Reaction Principle	4	4	4	SV
6	Support System	4	3.5	3.75	V
7	Instructional Impact and Accompaniment Impact	4	3.5	3.75	SV
8	Learning Implementation	3.67	4	3.84	SV
9	Evaluation	3.8	3.8	3.8	SV
	Total Average			**3.81**	**SV**

Description: V: Valid, SV: Strongly Valid

Table 2 shows that the LS-based smart teaching model, in terms of objectives, supporting theories, learning syntax, reaction principles, social systems, instructional impacts, support systems, and accompaniment impacts, can be categorized as strongly valid with a mean validity value of 3.81.

2) Learning Tool Validation Results

The learning tools developed are: (a) lesson plan, (b) observation sheets on the implementation of LS-based smart teaching syntax, and (c) response questionnaires on the application of the learning model as attached. Lesson plan, which refers to the LS-based smart teaching model that has been developed further validated by two experts. The results of the lesson plan validation are as shown in Table 3.

Table 3. Results of Validation of Lesson Plan

No	Indicator	Validator			
		Val. 1	Val. 2	Average	Category
1.	Fill in the lesson plan identity	4	4	4	SV
2.	Contains basic competencies (Attitudes, Knowledge, and Skills)	3.5	3.5	3.5	V
3.	Contains the formulation of indicators that describe the basic competencies with operational verbs that can be measured and observed as a reference for assessment	3.5	3.5	3.5	V
4.	Identification of materials that support the achievement of basic competencies	3.7	3.3	3.5	V
5.	The development of learning activities	3.75	3.8	3.78	SV
6.	The learning experience for students is formulated according to the characteristics of students	3.5	3.5	3.5	V

Table 3. Continued

No	Indicator	Validator			
		Val. 1	Val. 2	Average	Category
7.	The assessment is carried out based on certain criteria and indicators.	3	4	3.5	V
8.	Determination of time allocation	4	4	4	SV
9.	Can be used as a reference in the preparation of Student Worksheets, and assessment instruments.	4	3	3.5	V
	Total Average			**3.66**	**SV**

Description: V: Valid, SV: Strongly Valid

Table 3 shows that the lesson plan that has been developed, in terms of various indicators of validity, can be categorized as strongly valid with an average validity value of 3.66.

3) Student Worksheet Validation Results

The application of the LS-based smart teaching model will be supported by the use of student worksheets that refer to the model. The validation results are shown in Table 4.

Table 4. Validation Results of Student Worksheets

No	Assessment Aspect	Validator			
		Val.1	Val.2	Average	Category
1	Content	3.75	3.75	3.75	SV
2	Presentation	3.75	3.5	3.62	SV
3	Language	4	4	4	SV
4	Graphics	3.5	3.5	3.5	V
	Average			**3.71**	**SV**

Description: V: Valid, SV: Strongly Valid

4) Results of the Observation of Learning Implementation Validation

Practical use of the model LS-based smart teaching can be measured using questionnaires and the observation sheets of learning implementation. The results of the validation of the learning implementation observation sheet are shown in Table 5.

Table 5. Validation Results of Learning Implementation Observation Sheet

No	Assessment Aspect	Validator			
		Val.1	Val.2	Average	Category
1	Instructions	4	3.75	3.86	SV
2	Presentation of Observation Sheet	3.75	3.5	3.62	SV
3	Language	4	4	4	SV
	Average			**3.83**	**SV**

5) Digital Literacy Instrument Validation Results

The effectiveness of the LS-based smart teaching model is seen from the increase in students' digital literacy skills. The results of the validation and the level of reliability of the instrument used to measure students' digital literacy skills are shown in Table 6.

Table 6. Average Value of Validity and Reliability of Digital Literacy Instruments

No	Assessment Aspect	Validator				Average Reliability Score
		Val.1	Val.2	Average	Category	
1	Instructions for use	3.75	3.8	3.78	SV	88.89
2	Digital Literacy Content and Indicators	3.5	3.5	3.5	V	88.89
3	Language	4	4	4	SV	94.80
	Average			**3.76**	**SV**	**90.86 (Reliable)**

Description: V: Valid, SV: Strongly Valid

b. Practicality Test Results

A limited-scale trial was conducted to obtain the data of practicality of product. The results of the practicality test of the LS-based smart teaching model obtained from the responses of students are shown in Table 7.

Table 7. The Average Value of Student Responses to the LS-based Smart Teaching Model on a Limited-Scale Trial

No	Aspect	Average Frequency (%)			
		SP	P	N	SN
1	Ease of following the LS-based Smart Teaching model	35.67	59.31	5.02	0
2	Benefits of LS-based Smart Teaching model	57.16	40,13	2.71	0
3	Use of Teaching Resources in the LS-based Smart Teaching model	46.96	48.34	4.70	0
4	The teacher's role in the LS-based Smart Teaching model	59.70	37.95	2.35	0
	Average	**49.87**	**46.43**	**3.70**	**0**

Description: SP=Strongly Positive, P= Positive, N= Negative and SN= Strongly Negative

In addition to using a questionnaire to record students' response data of the learning process, the practicality test of the LS-based smart teaching model is also supported by the results of observing the implementation of the model. The object of observation was the teacher activities in four stages of LS as shown in Table 8.

Table 8. Results of Observation of the Implementation of the LS-based Smart Teaching Model on a Limited-Scale Trial

Lesson Study Stages	Teacher Activities	Information	Score	Category
Plan	The teacher analyzes learning problems. Can pass a diagnostic test using the google form application.	Conducted in collaboration involving teachers in the field or outside the field	5.00	WD
	Teachers develop learning tools based on the results of problem analysis and/or diagnostic test results. The learning devices that are arranged integrate the use of simple technology as a learning medium.		4.70	WD
Do	Teachers stimulate students	Other teachers observe to see gaps and errors from the stages of the plan and do process that occur in educators and students.	5.00	WD
	The teacher provides material and problem orientation by utilizing simple technology as a medium of learning.		4.70	WD
	The teacher guides students in the problem solving process together using simple technology media		4.70	WD
	The teacher evaluates the material and the learning process using media games		4.70	WD
Check	The teacher discusses as an effort to reflect on the learning that has been carried out. At this stage, the discussion process is very dependent on the sharpness of the analysis of the results of observations of the implementation of learning, which refers to the tools that have been developed together.	Done in collaboration	4.30	E
Act	Check stage can be obtained a number of new knowledge or important decisions for the improvement and improvement of the learning process in the next lesson.	Done in collaboration	4.70	WD
	Average		**4.72**	**WD**

Description: E= Executed, WD = Well Done

Based on the result of observation the implementation of the LS-based smart teaching model on a limited-scale trial showed that the plan, do, and act stage were conducted well done, but the check stage only executed. In the check stage, the teacher discusses as an effort to reflect on the learning that has been carried out. At this stage, the discussion process is very dependent on the sharpness of the analysis of the results of observations of the implementation of learning which refers to the tools that have been developed together. The observation sheet showed that the teacher

doing discussion but only focussed on the weakness of the learning process. The observation process should also focus on the strengths that exist in the learning process, which can still be maintained in the next learning.

c. Effectiveness Test Results

The effectiveness of the LS-based smart teaching model was seen from the acquisition of digital literacy scores of students on a limited scale trial. The LS-based smart teaching model was implemented to class VII junior high school in Jeneponto Regency. The data from the test results of the effectiveness of the model are shown in Table 9.

Table 9. Distribution of N-Gain Criteria for Digital Literacy of Students

N-Gain Value	Criteria	Number of Students
g > 0.7	High	6
0.3 < g < 0.7	Medium	22
g < 0.3	Low	0

Based on Table 9 above, as many as 22 students are in the "medium" N-gain category and 6 people are in the high category. The results show that the LS-based smart teaching model was effective in improving students' digital literacy. The digital literacy competency category on each indicator are shown on Table 10.

Table 10. Digital Literacy Competency Category on Each Indicator

No	Digital Literacy Competency Indicators	Pretest		Posttest	
		Average	Category	Average	Category
1	Internet searching	48.5	Low	80.6	Very Good
2	Hyper-textual navigation	37.2	Low	68.5	Good
3	Content evaluation	38.8	Low	68.8	Good
4	Knowledge assembly	30.4	Low	67.2	Good
	Average	38.7	Low	71.3	Good

The effectiveness of the LS-based smart teaching also shown by the result of students' worksheets as shown on Table 11.

Table 11. The Result of Students' Worksheet

No	Aspect	Results
1	Student engagement	Students are actively involved in learning activities including working on worksheets and discussion activities
2	Completion timeliness	Students work on each stage of learning in the worksheet on time
3	Quality of students' activities	Each stage of the activity was carried out by the students very well
4	Students' digital literacy training	Worksheets could train students' digital literacy skills which include internet searching, hyper-textual navigation, content evaluation, and knowledge assembly

Table 11 showed that the LS-based smart teaching model was effective to enhance students' engagement and could train the students to work on time. Each stage of the LS-based smart teaching could improve the quality of students' activities and could train students' digital literacy skills.

Discussion

The current learning process could be said to only focus on urban areas, but pay less attention to the education process in underdeveloped areas so that it had an impact on the learning process (Meilinda et al., 2020). Rural areas referred to in accordance with President of Republic of Indonesia Regulation No. 63 of 2020 concerning the Determination of Underdeveloped or Rural Areas. Underdeveloped or rural areas in the context of education are areas that are lagging behind in terms of human resources (HR) and infrastructure in the learning process. The problem of human resources (teacher is one of them) and infrastructure (application of technology) has an impact on the digital literacy abilities of students who are increasingly left behind.

The solution needed to overcome these problems is to present a learning model that is creative, meaningful, fun and motivating so that the learning process can be more lively. It is also necessary to present a technology-based learning that is simple but effective in growing digital literacy of students in the rural areas. In addition, it was necessary to improve the quality of learning carried out by the teachers in the learning process so that the competence and pedagogy of educators are of quality and have a positive impact on the development of students (Fitria et al., 2019). Smart teaching with the use of technology and lesson study is considered to have a significant influence in growing

digital literacy of students in the rural areas. The previous study from List (2019) found that the pre-service teachers' conception of digital literacy skill development as autonomously developed, project based, or technology driven.

Smart teaching is a model developed by researchers in overcoming the problem of the learning process in areas that are very limited in the use of technology or known as the rural areas. Smart teaching consists of a learning process that requires educators to present learning that is meaningful, fun, motivating and attracts students' interest in learning by presenting simple but effective learning technology. The points on smart teaching were important to apply considering the condition of students in the rural areas is slightly different from urban areas. Several previous studies have also proven that these points could make a real contribution to the development of students during the learning process (Febliza & Oktariani, 2020; Güneş & Bahçivan, 2018; Rahmadi, 2020). The points of smart teaching are then integrated into lesson study, and it was different from previous research, which has not integrated LS with smart teaching.

Based on this research, lesson study was an approach to improving the quality of learning that was carried out by educators collaboratively, by following the lesson plan, implementing learning, observing the learning process, and reflecting to discuss the learning being studied for improvement in the next lesson plan. This is in line with the research from Akiba et al., (2019), Ario (2020), and González and Deal (2019) that also studied about lesson study. In this research, the lesson study used was modified Lesson Study from Slamet Mulyana, and Bill Cerbin and Bryan Kopp which consists of the planning stage (*plan*), the implementation stage (*do*), the reflection stage (*check*) and the follow-up stage (*act*). The four stages of lesson study are then inserted important points of smart teaching in overcoming the digital literacy problems of students in underdeveloped areas, resulting in a new stage, namely PDCA (plan, do, check and action).

Based on this research, in the plan stage, the teachers collaborate to analyze the needs of existing problems on the learning process. Then from the results of the needs analysis, simple learning tools and technology were compiled that were centered on students in growing digital literacy. In learning devices and simple technology media that are compiled, educators collaborate in compiling smart teaching points in them so that the learning process is carried out, educators always motivate, present a fun learning process, encourage creativity and encourage students' interest in learning. In the next stage of technology, educators carry out learning to practice learning tools and simple technology media that have been prepared. Broadly speaking, the learning steps taken are 1) stimulating students, 2) the process of providing material and introducing problems with simple technology, 3) the process of solving problems together using simple technology media and 4) evaluating the material and learning process using media *games* simple technology. At the same time, other educators made observations to see the gaps and errors from the stages of the technology *plan process* and technology *practice* that occurred to educators and students.

Check stage, a discussion process is carried out as an effort to improve the learning process that has been implemented. At this stage, the discussion process is very dependent on the sharpness of the analysis during the observation process on the implementation of the learning process on the use of learning devices and simple technology media that have been developed together. At the act stage, the results of the check stage can be obtained a number of new knowledge or important decisions for improvement of the learning process at the next meeting.

The entire process that has been carried out from the stage of the technology plan to the act is arranged as well as possible to produce the students' digital literacy skill in underdeveloped areas. In addition, these stages are also able to shape the competence and pedagogy of the teachers during the learning process, which has a positive impact on the empowerment of students, especially to optimize digital literacy skills in the teaching and learning process.

Based on the results of the validation of models, devices, and instruments, the smart teaching model with lesson study-based technology is classified as very valid. This means that this development model is very accurate in empowering digital literacy in the rural areas. So it is hoped that students who are in the rural areas can have one of the important competencies in the industrial era 4.0. Digital literacy enhancement for students in the rural areas in balancing technological developments in the world of education in remote areas in order to increase potential and achievement (Maruti et al., 2021). Achievements achieved by students were able to make them wiser. This digital literacy certainly needs to be given so that they can use and utilize information appropriately and wisely (Asyarotin et al., 2018). The current digital literacy phenomenon affects the attitude and mindset of the Indonesian nation's human resources. The digital era is a new hope to encourage the improvement of public common sense, and to create an argumentative society. It is in this interest that literacy grows in favor of national education. More than that, globalization, if used for literacy purposes, was the answer, that globalization increases generation literacy (Sartini, 2018). Digital literacy is empowered by integrating it with lesson study, which has many advantages.

Lesson study held is very useful to change and improve the way of teaching and learning both from the students and the teachers to be better than previous lessons. Lesson study also increases professionalism in teaching. The benefits gained by students are that students are more enthusiastic in learning in the classroom and for schools, lesson studies that are carried out will help school programs in improving the quality of the learning processes and outcomes. Lesson study was one way to overcome the problem of ineffective learning practices (Sairo, 2021). Lesson study also could enhance social dimension of teacher. Bahri et al. (2021) stated that the social dimension of learning was an important aspect of the learning experience. Another advantage of implementing lesson study has a number of benefits, especially

for the teachers to improve professional and pedagogical competencies and the learning process (Ifrianti, 2018). So that the development of a LS-based smart teaching model is very appropriate to empower students' digital literacy skills in the rural areas. But Scott and Møller (2020) suggested that in order to adapt lesson study, it was necessary to address the overriding cultural aspects because there was the potency of conflicts that emerge when teachers involve in lesson study.

Conclusion

The development of LS-based smart teaching is very accurate to empower students' digital literacy in the rural areas because the learning process is more meaningful, fun, motivating and attracts students' learning interest by presenting simple learning technology by the teachers creatively. The results of this research also contributed to the knowledge development especially for the biology teaching model. The results of this research also can be the reference for the relevant study.

Recommendations

It is recommended for teachers to use the LS-based smart teaching model to improve the quality of learning to empower students' digital literacy skills. For further researchers, it is necessary to conduct research to compare the effectiveness of the LS-based smart teaching model with other teaching models in improving digital literacy skills and other students' abilities.

Limitations

This research is limited to science learning in rural areas and is still in the small-scale trial stage, so large-scale trials are needed before dissemination.

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Authorship Contribution Statement

Bahri: Concept and design. Arifin: Data acquisition and data analysis/interpretation. Jamaluddin: Drafting manuscript and critical revision of manuscript. Muharni: Admin and technical support. Hidayat: Statistical analysis and final approval.

References

Akiba, M., Murata, A., Howard, C. C., & Wilkinson, B. (2019). Lesson study design features for supporting collaborative teacher learning. *Teaching and Teacher Education*, *77*, 352-365. https://doi.org/10.1016/j.tate.2018.10.012

Akker, J. V., Bannan, B., Kelly, A. E., Nieveen, N., & Plomp, T. (2007). References and Sources on Educational Design Research. In T. Plomp & N. Nieveen (Eds.), *An introduction to educational design research*, 23-26. SLO: Netherlands Institute for Curriculum Development. https://bit.ly/3ye1flN

Alt, D., & Raichel, N. (2020). Enhancing perceived digital literacy skills and creative self-concept through gamified learning environments: Insights from a longitudinal study. *International Journal of Educational Research*, *101*, Article 101561. https://doi.org/10.1016/j.ijer.2020.101561

Ario, M. (2020). Application of lesson study in the calculus I lecture in mathematics education study program. *Apotema: Jurnal Pendidikan Matematika, 6*(2), 112-122. https://bit.ly/3T9Lztg

Asyarotin, E. N. K., Maulidya, N. I., & Dewanti, Y. A. (2018). Literasi digital: Perilaku digital native dalam memanfaatkan cloud library. *Proceeding National Seminar of UM Library Science Study Program*, 154-161. https://bit.ly/41Jt3vQ

Ayyildiz, P., Yilmaz, A., & Baltaci, H. S. (2021). Exploring digital literacy levels and technology integration competence of Turkish academics. *International Journal of Educational Methodology*, *7*(1), 15-31. https://doi.org/10.12973/ijem.7.1.15

Bahri, A., Palennari, M., Hardianto, Muharni, A., & Arifuddin, M. (2021). Problem-based learning to develop students' character in biology classroom. *Asia-Pacific Forum on Science Learning and Teaching, 20*(2), Article 7. https://bit.ly/3ZFHoIc

Blau, I., Shamir-Inbal, T., & Avdiel, O. (2020). How does the pedagogical design of a technology-enhanced collaborative academic course promote digital literacy, self- regulation, and perceived learning of students? *The internet and higher education*, *45*, Article 100722. https://doi.org/10.1016/j.iheduc.2019.100722

Daud, F., Adnan, Bahri, A., Arifin, A. N., & Pratiwi, A. C. (2021). Characteristics of disaster mitigation training model in South Sulawesi. *Journal of Physics: Conference Series*, *1752*, Article 012090. https://doi.org/10.1088/1742-6596/1752/1/012090

Febliza, A., & Oktariani, O. (2020). Pengembangan instrumen literasi digital sekolah, siswa dan guru. *Jurnal Pendidikan Kimia Universitas Riau*, *5*(1), 1-10. https://doi.org/10.33578/jpk-unri.v5i1.7776

Fitria, H., Kristiawan, M., & Rahmat, N. (2019). Upaya meningkatkan kompetensi guru melalui pelatihan penelitian tindakan kelas. *Abdimas Unwahas Jurnal Pengabdian Masyarakat Unwahas*, *4*(1), 14-25. https://doi.org/10.31942/abd.v4i1.2690

González, G., & Deal, J. T. (2019). Using a creativity framework to promote teacher learning in lesson study. *Thinking skills and creativity*, *32*, 114-128. https://doi.org/10.1016/j.tsc.2017.05.002

Güneş, E., & Bahçivan, E. (2018). A mixed research-based model for pre-service science teachers' digital literacy: Responses to "which beliefs" and "how and why they interact" questions. *Computers & Education*, *118*, 96-106. https://doi.org/10.1016/j.compedu.2017.11.012

Halvorsen, A. L., Harris, L. M., Doornbos, L., & Missias, M. T. (2021). Lesson study in historical inquiry: Teachers working across rural communities. *Teaching and Teacher Education*, *97*, Article 103206. https://doi.org/10.1016/j.tate.2020.103206

Huang, R., Yang, J., & Zheng, L. (2013). The components and functions of smart learning environments for easy, engaged and effective learning. *International Journal for Educational Media and Technology*, *7*(1), 4-14. https://bit.ly/smartlearningIJMT

Ifrianti, S. (2018). Membangun kompetensi pedagogik dan keterampilan dasar mengajar bagi mahasiswa melalui lesson study. *Terampil: Jurnal Pendidikan dan Pembelajaran Dasar, 5*(1), 1-18. https://doi.org/10.24042/terampil.v5i1.2748

Jamaluddin, A. B., Zubaidah, S., Mahanal, S., & Bahri, A. (2023). SIRI (Stimulation, Investigation, Review, and Inference) learning model to promote creative thinking. *AIP Conference Proceedings, 2569*, Article 020020. https://doi.org/10.1063/5.0112382

Kurnia, N., & Astuti, S. I. (2017). Peta gerakan literasi digital di Indonesia: Studi tentang pelaku, ragam kegiatan, kelompok sasaran dan mitra [Map of the digital literacy movement in Indonesia: Studies on actors, various activities, target groups and partners]. *Informasi*, *47*(2), 149-166. https://doi.org/10.21831/information.v47i2.16079

Lazonder, A. W., Walraven, A., Gijlers, H., & Janssen, N. (2020). Longitudinal assessment of digital literacy in children: Findings from a large Dutch single-school study. *Computers & Education*, *143*, Article 103681. https://doi.org/10.1016/j.compedu.2019.103681

Leaning, M. (2019). An approach to digital literacy through the integration of media and information literacy. *Media and Communication*, *7*(2), 4-13. https://doi.org/10.17645/mac.v7i2.1931

List, A. (2019). Defining digital literacy development: An examination of pre-service teachers' beliefs. *Computers & Education*, *138*, 146-158. https://doi.org/10.1016/j.compedu.2019.03.009

Maruti, E. S., Isticomah, B., Yustiwa, G. M., Khoiru, U., & Huda, N. (2021). Program literasi digital bagi anak-anak kampung Wonopuro, Dusun Sudowayah, Kabupaten Ponorogo [Digital literacy program for children in Wonopuro Village, Sidowayah Hamlet, Ponorogo Regency]. *Amalee: Indonesian Journal of Community Research and Engagement*, *2*(2), 97-107. https://doi.org/10.37680/amalee.v2i2.861

Meilinda, N., Malinda, F., & Aisyah, S. M. (2020). Literasi digital pada remaja digital (sosialisasi pemanfaatan media sosial bagi pelajar sekolah menengah atas.) *Jurnal Abdimas Mandiri*, *4*(1), 62-69. https://doi.org/10.36982/jam.v4i1.1047

Rahmadi, I. F. (2020). Pendidikan di daerah kepulauan terpencil: Potret siswa, guru dan sumber belajar. *Jurnal Pendidikan Edutama, 7*(1), 75-84. http://dx.doi.org/10.30734/jpe.v7i1.756

Rahmah, A. (2015). Digital literacy learning system for Indonesian citizens. *Procedia Computer Science*, *72*, 94-101. https://doi.org/10.1016/j.procs.2015.12.109

Sairo, M. I. (2021). Pelaksanaan lesson study menggunakan metode pembelajaran mind mapping. *Journal for Lesson and Learning Studies*, *4*(1), 26-32. https://doi.org/10.23887/jlls.v4i1.32188

Sartini, S. (2018). Literasi digital solusi generasi milenial [Digital literacy is a millennial generation solution]. In *Prosiding Seminar Nasional: Disruption in the library: Inovasi dan kreativitas pustakawan di era digital* [National Seminar Proceedings: Disruption in the library: Innovation and creativity of librarians in the digital era] (pp. 99-107). ISI Press. http://repository.isi-ska.ac.id/3141/

Saunders, G., Oradini, F., & Clements, M. (2017). SMART teaching in new and old classrooms. *IAFOR Journal of Education*, *5*(1), 85-109. https://doi.org/10.22492/ije.5.1.05

Schipper, T. M., Van der Lans, R. M., de Vries, S., Goei, S. L., & van Veen, K. (2020). Becoming a more adaptive teacher through collaborating in Lesson Study? Examining the influence of Lesson Study on teachers' adaptive teaching practices in mainstream secondary education. *Teaching and Teacher Education*, *88*, Article 102961. https://doi.org/10.1016/j.tate.2019.102961

Skott, C. K., & Møller, H. (2020). Adaptation of lesson study in a Danish context: Displacements of teachers' work and power relations. *Teaching and Teacher Education*, *87*, Article 102945. https://doi.org/10.1016/j.tate.2019.102945

Sugiarti, Mulbar, U., Adnan, & Bahri, A. (2021). Students' scientific literacy skill: The starting point of chemistry learning in the junior high school. *Asia-Pacific Forum on Science Learning and Teaching, 20*(2), Article 8. https://bit.ly/scientificliteracyAPFSLT

Tagg, C., & Seargeant, P. (2021). Context design and critical language/media awareness: Implications for a social digital literacy education. *Linguistics and Education*, *62*, Article 100776. https://doi.org/10.1016/j.linged.2019.100776

Techataweewan, W., & Prasertsin, U. (2018). Development of digital literacy indicators for Thai undergraduate students using mixed method research. *Kasetsart Journal of Social Sciences*, *39*(2), 215-221. https://doi.org/10.1016/j.kjss.2017.07.001

Terry, J., Davies, A., Williams, C., Tait, S., & Condon, L. (2019). Improving the digital literacy competence of nursing and midwifery students: A qualitative study of the experiences of NICE student champions. *Nurse Education in Practice*, *34*, 192-198. https://doi.org/10.1016/j.nepr.2018.11.016

Wolthuis, F., van Veen, K., de Vries, S., & Hubers, M. D. (2020). Between lethal and local adaptation: Lesson study as an organizational routine. *International Journal of Educational Research*, *100*, Article 101534. https://doi.org/10.1016/j.ijer.2020.101534

Zain, I. M. (2017). The collaborative instructional design system (CIDS): Visualizing the 21st century learning. *Universal Journal of Educational Research*, *5*(12), 2259-2266. https://doi.org/10.13189/ujer.2017.051216