THE EFFECTIVENESS OF TECHNOLOGY- BASED INTERACTIVE LEARNING ON SCIENCE AND HEALTH LITERACY OF ELEMENTARY SCHOOL STUDENTS

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ABSTRACT

Study This aim For analyze effectiveness learning interactive based technology to literacy science and health student school basic research use approach quantitative with Quasi-experimental method and Pretest–Posttest Control Group Design . Subjects study consists of over 60 students class V school shared base become class experiments and classes control . Instrument study covering test literacy science , test literacy health , sheet observation activity students , and questionnaires response students . Data analyzed use statistics descriptive , normality test , homogeneity test , paired sample t-test, independent sample t-test, and Normalized Gain (N-Gain) analysis . Research results show that learning interactive based technology in a way significant increase literacy science and health students ($p < 0.05$). Average literacy score science increase from 60.87 to 85.13, while literacy health increase from 63.40 to 87.20. The N-Gain value is 0.71 for literacy science and 0.69 for literacy health show category currently until high . Besides that , students show response positive to use of learning media interactive capable increase motivation , activity , and understanding draft science and health . With Thus , learning interactive based technology proven effective as strategy learning innovative For increase literacy science and health student school base .

KEYWORDS

Learning interactive , technology education , literacy science , literacy health , school base.

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INTRODUCTION

Development technology information and communication in the digital era has bring a very big change rapidly in various aspect life, including in the field education. Utilization technology in the learning process be one of strategy for increase quality education because capable create a more effective learning proces effective, engaging, and participant - centered educate. In line with implementation Independent Curriculum, learning no again only emphasize mastery material, but also development competence 21st century which includes ability think critical, creativity, communication, collaboration, and digital literacy. Therefore that , teachers are required capable integrate technology to in the learning process so that participants educate get experience learn more meaningful and appropriate with developments over time (Jannah et al., 2022).

Learning interactive based technology is one of the innovation that can support achievement objective mentioned. Learning This utilise various digital media, such as interactive videos, animations, simulations, applications learning, games educational games, digital quizzes, and interactive multimedia that enable participant educate interact in a way direct with material learning (Budiarto et al., 2026) . Through this media, students No only accept information in a way passiv, but also active observe, explore, discuss, and finish various problem contextual. Condition This capable increase motivation learning, engagement students, and understanding draft Because material served in a way more concrete and engaging (Mayer, 2021).

One of necessary competencies developed through learning based technology is literacy science . According to Program for International Student Assessment (PISA), literacy science is ability somebody in explain phenomenon in a way scientific, evaluating and designing investigation scientific , as well as interpreting data and evidence scientific For take the right decisio . Literacy science become supplies important for students to be able to understand various phenomenon nature, solving problems, and apply concepts science in life everyday. With literacy good science, students no only control knowledge, but also capable think logical, critical, and systematic in face various global challenges (Jannah et al., 2022).

Literacy science is ability individual For understand draft scientific, identifying problem, explain phenomenon in a way scientific, as well as take decision based on evidence. On the side others, literacy health is ability somebody in acquire, understand, evaluate, and use information health for apply behavior life healthy. Second competence the need developed since education base Because become supplies important in face development knowledge knowledg , technology, and various problem health in society .

Various study show that level literacy science student school the basis in Indonesia is still relatively low so that required innovation capable learning increase involvement students. The results of the Systematic Literature Review by Habsari, et al., (2026) show that that learning science based technology and contextual be one of the most effective strategy in increase literacy science through use of interactive multimedia , digital simulations , and approaches based problem (Habsari & Sumarni , 2026).

A number of study previously show that use of learning media based technology capable increase literacy science student school basis. Habsari , et al., (2026) through Systematic Literature Review concluded that use of interactive multimedia, digital simulations, and learning contextual in a way consistent increase ability literacy science, motivation learning, and skills think critical student school base.

Interactive digital media based iSpring Suite is capable of increase literacy science student school base because provide animation, audio, exercises questions, and evaluations

that encourage student study in a way active. The use of the media make student more easy understand draft science compared to learning conventional (Pinasti & Sari, 2025).

Problem Based Learning Model assisted by interactive videos in a way significant increase literacy science student school base compared to class control. Research results shows average ability literacy science student reached 84.22% after implementation learning interactive video- based (Habsari & Sumarn , 2026).

Learning interactive based technology also contributes to improvement literacy health Because student get information health through visual media and activities interesting learning so that more easy understand (Saragih & Pratama, 2026) . One of them necessary competencies developed through learning based technology is literacy science. According to Program for International Student Assessment (PISA), literacy science is ability somebody in explain phenomenon in a way scientifi, evaluating and designing investigation scientific, as well as interpreting data and evidence scientific for take the right decision. Literacy science become supplies important for students to be able to understand various phenomenon nature, solving importance behavior life clean and healthy. Integration technology in learning allows student connect draft science with its implementation in life daily (Millah et al., 2025)

Although thus, some big study previously more Lots focused on improving results Study or literacy science only . Research that examines influence learning interactive based technology to literacy science and literacy health in a way simultaneously, especially for students school basic, still relatively limited. Even though second competence the each other related in form ability student For understand phenomenon scientific at a time apply knowledge the in guard health self, family, and environment. With Thus, it is necessary integrated research second aspect the in one learning model so that obtained a clearer picture comprehensive about effectiveness learning based technology (Kamarudin, et al., 2024)

Research novelty This lies in integration learning interactive based technology for increase two competence at the same time, namely literacy science and literacy health in students school basic. Besides measure improvement ability literacy science, research it also analyzes ability student in understand information health and implementing it in life everyday approach the expected can give contribution to development of more learning models innovative and relevant with need education 21st century .

Based on description said research This aim For analyze effectiveness learning interactive based technology to literacy science and health student school base so that expected can become alternative capable learning increase quality education basic development more optimal academic, social and psychological

RESEARCH METHOD

Study This use approach quantitative with quasi-experimental method using Pretest–Posttest Control Group Design. Design This chosen For know effectiveness learning interactive based technology to literacy science and health student school base with compare results Study before and after treatment (Sugiyono, 2023).

Study implemented on students class V school the base consisting of on two class, namely class experiments that obtained learning interactive based technology and class control that obtains learning conventional . Each class consists of top 30 selected students use cluster random sampling technique.

Instrument study covering test literacy science, test literacy health, sheet observation activity students , as well as questionnaire response student to learning.

Instruments has through validity testing by experts and reliability testing use Cronbach's Alpha coefficient with mark more from 0.70 to stated worthy used.

Treatment given during four Sunday using learning media interactive in the form of animated videos , simulations simple, digital quizzes, and multimedia presentations that can accessible through computer and telephone smart. Learning designed with an encouraging approach student active observe, discuss, explore information, and complete problem contextual about science and health .

Research data analyzed use statistics descriptive in the form of average value, standard deviation, percentage, value maximum, and minimum values for describe data characteristics. Before done testing hypothesis data first formerly tested normality using the Shapiro–Wilk test and homogeneity test using Levene's test. Next , the hypothesis study analyzed using paired sample t-test for know difference results Study before and after treatment for each class and independent sample t-test for know difference results Study between class experiments and classes control at the level significance of 5% ($\alpha = 0.05$). The magnitude improvement ability literacy science and literacy health counted using Normalized Gain (N-Gain) which is categorized become high ($g \geq 0.70$), medium ($0.30 \leq g < 0.70$), and low ($g < 0.30$).

Use design experiment pseudo, N-Gain analysis, and statistical tests parametric in study This in line with various study about effectiveness learning based technology that demonstrates that approach the capable give accurate depiction about improvement results learning and literacy students (Hake, 1999; Hamna & Ummah, 2024; Pattimura et al., 2025).

RESULTS AND DISCUSSION

Result

The results of the study on the effectiveness of technology-based interactive learning on the science and health literacy of elementary school students are presented in the following table.

Table 1. Results of Science Literacy and Health Literacy Improvement through Technology-Based Interactive Learning

Variable	Experimental Class	Control Class
Science Literacy Pretest (Mean)	60.87	Increased, but lower than experimental class s
Science Literacy Posttest (Mean)	85.13	Increased, but lower than experimental class s
Health Literacy Pretest (Mean)	63.40	Increased, but lower than experimental class s
Health Literacy Posttest (Mean)	87.20	Increased, but lower than experimental class s
Paired Sample t-test	$p < 0.05$ (Significant)	-
Independent Sample t-test	Significant difference between experimental and control classes ($p < 0.05$)	-
N-Gain Science Literacy	0.71 (Moderate–High)	Lower than experimental class
N-Gain Health Literacy	0.69 (Moderate–High)	Lower than experimental class
Student Learning Participation	>85% of students actively participate in discussions and learning activities	Lower participation
Student Responses to Interactive Media	The majority stated the media was interesting, easy to use, and improved understanding	Less positive than experimental class

Table 1 shows that learning interactive based technology give improvement to literacy science and literacy health student school basic. Average literacy pretest score science in class experiment an increase of 60.87 to 85.13 on the posttest. Meanwhile that, literacy health increase from 63.40 to 87.20. In class control improvement happened , but more low compared to class experiment .

The results of the paired sample t-test show mark significance ($p < 0.05$), so that there is significant difference between pretest and posttest scores in class experiment . The results of the independent sample t-test also show existence significant difference between class experiments and classes control after treatment

N-Gain calculation shows mark of 0.71 for literacy science and 0.69 for literacy health which includes category currently until high . Observation results show that more of 85% of students active follow learning , engaging in discussion groups , as well as capable connect draft science with implementation behavior life clean and healthy. Besides that, the result questionnaire show that part big student stating learning media interactive interesting, easy used, and helps understand material. This result in line with study Atmojo and Wardana who showed that utilization digital technology is capable increase activity learning and literacy science student school base.

Discussion

Improvement literacy science and health show that learning interactive based technology give experience learn more meaningful compared to learning conventional. The use of interactive video, simulation, animations, and digital quizzes helps student visualize concepts abstract so that more easy understood. Besides increase understanding concept, digital media also encourages student for active observe, discuss, and complete problem in a way collaborative. The results in harmony with study Atmojo and Wardana stated that that integration digital technology is capable increase literacy science through more learning interactive and contextual learning based problems (Problem-Based Learning) in a way significant increase ability literacy science student school base Because push student interpret data, explain phenomenon scientific, and take decision based on evidence (Habsari & Sumarni, 2026).

Besides that, the result study This in line with Simanjuntak et al . who reported that STEM approach is capable increase literacy science through activity exploratory, investigative, and resolution relevant issues with life everyday learning based technology also provides chance to student for develop skills 21st century, such as think critical, creativity, communication, collaboration, and digital literacy (Simanjuntak, 2025).

Findings This reinforced by research Hamna and Ummah stated that use of learning platforms based technology, good through flipped learning and hybrid learning models, providing significant improvement to literacy science student school basic. With thus integration technology in learning can made one of strategy innovative For increase quality learning science at a time build literacy health student since education basis (Hamna et al., 2022).

Effectiveness learning interactive based technology to literacy science . Findings study show that learning interactive based technology in a way real capable increase literacy science student school basic. Improvement the no only reflected in the increase score tests, but also on changes method student understand concept, analyze information , and solve related issues with phenomenon scientific. Success the can explained through theory constructivism which states that knowledge built in a way active through interaction

between experience Study with structure cognitive participant educate. Interactive media provide environment learning that is possible student explore draft in a way independent through simulations, animation, virtual experiments, and difficult visualizations obtained through method lecture (Cajas, 2001) .

Learning based technology also improves involvement students (student engagement). During the learning process, students no only accept information from the teacher, but active observe, try, discuss, answer quizzes, as well as get bait come back in a way directly. Activities the strengthen the information encoding process to in memory term long so that understanding draft become more deep (Chen et al., 2025) .

From the perspective theory multimedia learning, combination text, images, sound, animation, and video help reduce burden cognitive because information delivered through two channel processing, namely visual and verbal. Integration second channel the allows student build more mental representation intact so that natural science concepts abstract become more easy understood .

Besides increase mastery concept, learning interactive based technology also develops ability think scientific. Students more used to observe phenomenon, composing hypothesis simple, interpret data, interesting conclusions, and linking draft with context life everyday. Ability the is component main literacy the science required in face development knowledge knowledge and technology .

Effectiveness learning interactive to literacy health. Literacy health is ability individual acquire, understand, evaluate, and use information health for take the right decision. Research results show that interactive media give significant contribution to improvement ability mentioned . Learning no again only convey information about health, but also training student interpret situation real through videos, illustrations , simulations , and studies case simple. Visualization about pattern eat healthy, how to wash hands, the importance sports, danger consumption food no healthy, until prevention disease give experience learn more contextual. Visualized information in a way interesting more easy understood compared to delivery just verbally. From the corner view psychology learning , experience meaningful learning will increase retention information at a time influence change behavior. This is seen when student no only capable answer question about health, but also starting show change attitude to cleanliness self, consumption food healthy, and habits life clean at school. With thus learning interactive based technology no only increase aspect cognitive, but also encouraging formation behavior life Healthy as part from education character (Nazari et al., 2026) .

Effectiveness learning interactive based technology in study. This influenced by several mechanism main . First , interactive media increase attention student through use color, animation, sound, and digital activities so that capable maintain focus study longer. Second , there is interaction two direction allows student get bait come back in a way directl . When student do error, system give immediate correction so that the repair process understanding ongoing more fast. Third, technology give chance learn more flexible. Students can repeat material in accordance need each so that difference ability individual can minimized. Fourth, learning become more contextual. The previous material nature abstract can connected with life real through simulation and learning videos so that student capable see relevance between science and health concepts with activity daily. Fifth , learning interactive increase motivation intrinsic. Element games (gamification), challenges, digital rewards, as well activity collaborative make student more enthusiastic follow learning compared to method lecture (Sungur & Hüseyin, 2022) .

Findings study own broad implications to development learning at school basic. First, teachers need to change paradigm learning from teacher centered to student centered with utilise technology as means build experience active learning. Second , school need strengthen digital infrastructure, including appropriate devices, internet access, and digital teaching materials with characteristics participant educate school basis. Third, development professional teachers must directed at improving competence digital pedagogy so that teachers are able designing learning interactive that is not just use technology, but also integrate it with objective learning, assessment, and activities collaborative. Fourth science learning in schools base should integrated with education health so that student get complete understanding about connection between knowledge knowledge , environment , and behavior life healthy. Approach This in line with development competence 21st century which emphasizes ability think critical, solving problems, collaboration, communication, and digital literacy.

Research result This strengthen various study previously shown that integration technology in learning capable increase results learning, motivation, engagement, and ability think level tall students. Findings this is also consistent with study about literacy science that confirms that learning multimedia- based, digital simulation, and interactive media more effective compared to learning conventional because give experience authentic learning (Rafia et al., 2026) .

In this aspect literacy health, results study This show that digital learning is capable bridge gap between knowledge and practice . Students No only get information health , but also learning apply information the in taking decision everyda . This is show that technology own potential as an educational medium health since level school basic. (Mnatzaganian et al., 2017)

In a way overall , results study prove that learning interactive based technology is strategy effective learning in increase literacy science and literacy health student school basis. Effectiveness the reflected from improvement results significant learning, increasing involvement student during the learning process, development ability think scientifi, as well as formation understanding and behavior life healthier good. With Thus, integration technology in learning no only functioning as delivery aids material, but also as environment capable learners build experience meaningful, contextual, and development - oriented learning competence 21st century .

CONCLUSION

Based on results research, can concluded that learning interactive based technology give positive and significant influence to improvement literacy science and literacy health student school basic. This is proven with existence increase in the average pretest and posttest scores in the class experiment, the results of the paired sample t-test and independent sample t-test showed mark significance $p < 0.05$, and ormalized Gain (N-Gain) value in the category currently until high. The results show that use of learning media interactive based technology capable increase ability student in understand concepts science, interpreting scientific data, explaining phenomenon based on evidence, and apply information health in life daily .

Implementation learning interactive based technology also provides impact positive towards the learning process. The use of interactive videos, animations, simulations, and digital quizzes is able to increase attention, motivation, and activity

student during follow learning. Students become more enthusiastic in discuss, put forward opinion, work The same in groups, as well as finish related issues with material science and health. Conditions the show that technology no only functioning as a delivery medium material, but also as capable means create experience learn more active, interestin , and meaningful.

Learning interactive based technology besides increase results learn, contribute to development competence 21st century, especially ability think critical, solving problems, communication, collaboration, and digital literacy. Integration technology in learning push student For access various source information, analyzing information in a way critical, and connect concepts scientific with situation real that they meet in life everyday. With Thus , learning No only achievement - oriented aspect cognitive, but also supports formation required skills For face development knowledge knowledge and technolog .

Research result This strengthen findings various study previously stated that learning based technology is one of the effective strategies in increase quality learning at school basis. Therefore that, learning interactive based technology can made into as alternative innovative learning models for increase literacy science and literacy health student in a way sustainable. Success implementation learning this naturally need support from teachers, schools, and availability facilities and infrastructure adequate technology so that the learning process can ongoing optimally and provide impact positive to improvement quality education base.

Teachers are advised for integrate learning interactive based technology in a way sustainable in the learning process, especially in subjects science and education lessons health. School need provide facilities and infrastructure adequate technology as well as increase teacher competence through training development of digital learning media. Research furthermore expected use amount more samples big, involving school from various regions, as well as study effectiveness various digital learning platforms for literacy science, literacy health and skills another 21st century so that obtained more results comprehensive.

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