

THE RELATIONSHIP BETWEEN STUDENTS' PERCEPTION TO THE LEARNING MEDIA, DIGITAL LITERACY SKILLS, AND SELF-REGULATED LEARNING WITH STUDENTS' LEARNING OUTCOMES IN THE RURAL AREA

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Received October 2023

Accepted February 2024

Abstract

This study aims to determine the relationship between students' perception to the learning media, digital literacy skills, and self-regulated learning with students' cognitive learning outcomes in the rural area. This study was the ex post facto with quantitative data. The method used was differential causal comparative with multiple linear regression analysis. The three variables were measured using a questionnaire, cognitive learning outcomes was measured by test. The results showed that students' perception to the learning media, digital literacy skills, and self-regulated learning on students' cognitive learning outcomes had a moderate simultaneous relationship. The findings also showed that the contribution of self-regulated learning to the cognitive learning outcomes was the higher (71.42%). The contribution of the three variables to cognitive learning outcomes was 86.41%. Based on related facts, research recommendations can be expanded by measuring from several other rural areas and examining several other variables, especially those that support the learning process oriented towards empowering 21st century competencies by utilizing the latest technological developments and that can reach all regions of Indonesia, especially in rural areas so as to minimize the gap in the quality of education in Indonesia.

Keywords – Self-regulated learning, Literacy skills, Perception of learning media, Education in the rural area.

To cite this article:

Bahri, A., Hidayat M, W., Putra, K.P., Ainun, N.A., & Arifin, N. (2024). The relationship between students' perception to the learning media, digital literacy skills, and self-regulated learning with students' learning outcomes in the rural area. *Journal of Technology and Science Education*, 14(2), 588-606. <https://doi.org/10.3926/jotse.2513>

1. Introduction

A very significant gap between the central region and other regions, especially in underdeveloped regions, which will result in the quality of education in underdeveloped regions will increasingly lag behind (Bahri,

Jamaluddin, Arifin & Saparuddin, 2022; Karaçoban & Karakuş, 2022; Lagakos, 2020; Liang, Wang & Li, 2019). This makes it impossible to realize the Golden Indonesia in 2045. The vision of a Golden Indonesia is to achieve the ideals of national life, including Indonesia becoming the center of education, technology, and world civilization and the development of inclusive and equitable infrastructure throughout Indonesia (Anggara, Harahap & Thoriq, 2022). Accelerating the equitable development of education of the Indonesian people and the need to increase the contribution of science and technology in development (Bahri, Sahribulan & Hidayat, 2022; Gulo, 2021). Technological developments that can reduce physical limitations and distance so that students are facilitated to develop competencies according to their needs and potential.

The potential of students must be directed towards the competencies needed in the 21st Century, which has entered the era of digitalization (Özdemir, Çoban & Bozkurt, 2020; Rahmatullah, Mulyasa, Syahrani, Pongpalilu & Putri, 2022). Optimizing technology in the learning process in the current digitalization era is a right that must be developed so that the learning process becomes meaningful (Camacho, Villacís, Isabel & Carlos, 2023; Kapucu, Avci & Sural, 2021; Moro, Phelps, Redmond & Stromberga, 2021), so that students can more easily understand about abstract and complex concepts that are difficult to understand just by reading or hearing. Education plays a very important role in human life related to aspects of life (Arisanty & Riyah, 2019). Effective teaching is key to the advancement of the education system (Jamal, Ibrahim & Surif, 2019) The key to the progress of the education system must be in line with the times. This has been studied by several researchers before, including regarding digital literacy.

Digital literacy influences the education process, allowing schools and local governments to design education programs that are more effective and relevant to the demands of today's digital world. It can also help understand how technology can be used positively to improve the quality of education (Anthonysamy, Koo & Hew, 2020; Goodwin, Cho, Reynolds, Brady & Salas, 2019; Özüdoğru & Çakir, 2020; Puniatmaja, Parwati, Tegeh & Sudatha, 2023; Rafi, JianMing & Ahmad, 2019; Singh, 2021; Sinha & Ugwulebo, 2022). However, many of these studies have been conducted in urban areas and very few have been conducted in underdeveloped areas, resulting in a gap in the quality of education.

Accelerating the improvement of education quality is the main program of the Government of Indonesia, which has conducted literacy improvement programs, especially in primary and secondary schools. However, there are still not many studies conducted on digital literacy in Indonesia, especially in rural areas. This shows that digital literacy in rural areas has not received enough attention. The phenomenon of digital literacy in rural areas is influenced by various factors (Acilar & Sæbø, 2021; Tytova & Mereniuk, 2022). One of the main challenges is the lack of adequate digital infrastructure, which hinders the integration of digital literacy in these areas against basic competencies (Soekamto, Nikolaeva, Abbood, Grachev, Kosov, Yumashev et al., 2022; Yuliana, Hermawan, Prayitno, Ratih, Adhantoro, Hidayati et al., 2021).

The low level of basic competencies in rural education indicates the low quality of rural schools (Yuli, Ghufon & Haryanto, 2021). These include limited internet access, inadequate electricity availability and insufficient technology resources. Without the necessary infrastructure, individuals in rural areas face difficulties in acquiring and utilizing digital skills.

The utilization of digital development, especially in the field of education, can help individuals access and understand the information found in digital media. with a good understanding of the media, individuals can develop a critical perception of the information they receive. Digital literacy is one of the competency dimensions of digital teaching competence (Sumarmi, Aliman & Mutia, 2021). In addition, self-regulated learning can be enhanced through good digital literacy, as individuals can use digital technology to access learning resources and develop effective learning strategies. Learning independence is important in education, referring to an individual's ability to organize and manage learning without over-reliance on classroom learning, enabling individuals to overcome challenges and maintain interest in long-term learning. As such, learning independence not only supports high academic achievement, but also forms an

important basis for personal development and professional attitudes of learners to achieve desired learning outcomes.

Digital learning has significantly impacted self-regulated learning (Lin, Chen & Liu, 2017). The results also confirm the importance of self-regulated learning in digital learning environments (Han & Ellis, 2023). In addition, developing student digital modules through self-regulated learning positively affects student learning outcomes (Kusmaharti & Yustitia, 2022). The results of this study show the positive impact of digital learning on self-regulated learning, emphasizing the potential of digital learning platforms to improve student experience and learning outcomes in disadvantaged areas.

Research conducted by (Afifulloh & Sulistiono, 2023; Anisimova, 2020; Churchill, 2020) showed that strengthening digital literacy through making learning media can improve teachers' skills in making digital media that can be applied in the learning process. Digital literacy emphasizes the use of tools (Soeprijanto, Diamah & Rusmono, 2022). This tool is known as learning media which must always be developed. One of the variables related to media perception is students' perceptions of the learning media used by teachers in the learning process. Students who have a positive perception of the media used by teachers tend to have good learning motivation.

The development of digital literacy skills through learning media can play an important role in providing access to diverse learning resources and enabling students to develop self-regulated learning skills. The students' independence affects their critical problem-solving skills (Haryati, Siswanto, Sukarno, Muhlisin & Trisnowati, 2022). Students' ability to access, evaluate and use information independently through digital technology is important. Digital literacy enables students to develop their self-regulated learning by utilizing available digital resources while improving cognitive learning outcomes (Acut & Antonio, 2023). With good digital literacy, students can search for information, learn new concepts, and develop problem-solving skills independently.

Based on multiple correlation studies, it can be seen the contribution of each factor to cognitive learning outcomes, both students' perception to the learning media, digital literacy skills, and self-regulated learning, as well as the simultaneous contribution of the influence of students' perception to the learning media, digital literacy skills, and self-regulated learning on cognitive learning outcomes. The results of this study can provide information to teachers and lecturers related to learning media innovations that empower students literacy skills so as to increase their self-regulated learning.

2. Methodology

2.1. Research Design

This study uses an ex post facto research design to investigate the relationship between students' perception to the learning media, digital literacy skills, and self-regulated learning with student learning outcomes in rural areas. The ex post facto research design is a type of observational research conducted after the independent variables have occurred (Rosalina & Junaidi, 2020). The independent variables are students' perception to the learning media, digital literacy skills, and self-regulated learning, while the dependent variable is student learning outcomes.

2.2. Participants

The sample size of this study was 134 students for the senior high school level in Jeneponto Regency which is a disadvantaged school. The research instrument used a survey in the form of a questionnaire and a learning outcome test. The questionnaire was developed from four variables of students' perception of media, digital literacy skills, self regulated and student learning outcomes. The questionnaire instrument used a 5-point Likert scale, 5-strongly agree, 4-agree, 3-neutral, 2-disagree, 1-strongly disagree. The questionnaire instrument was then distributed directly to willing respondents voluntarily.

2.3. Research Instrument

2.3.1. Media Perception Instrument

The media perception instrument adopted instrument (Febriani & Ansori, 2023) consisting of: Media use, attitude towards media, frequency of media use, benefits of media use.

2.3.2. Digital Literacy Instrument

The digital literacy instrument uses modified instruments from Monteiro and Leite, (2021) and Bergdahl, Nouri & Fors (2020) including: Finding information, Using various sources of information, Selecting information, Evaluating information, Considering the source and effect of information messages, and Using information to produce original work.

2.3.3. Self-Regulated Learning

The Self-Regulated Learning instrument uses an instrument modified by (Zimmerman, 2002) namely: (1) forethought which contains two sub processes including task analysis and self motivational belief; (2) performance which contains two sub processes including self control and self observation; and (3) self reflection which contains two sub processes including self judgment and self reaction.

2.3.4. Student Learning Outcomes

The learning outcomes instrument was obtained through a multiple choice instrument sheet that had been developed by the researcher in accordance with the levels of Bloom's taxonomy that had been revised by Anderson (2009). The multiple choice questions consisted of 50 questions that had been developed by the researcher.

2.3.5. Validity and Reliability of Instruments

The validity scores of media perception, digital literacy, independence and learning outcomes show scores of 3.55, 3.70, 3.61, and 3.80 respectively (Scale 1-4). while the reliable scores show scores of media perception, digital literacy, independence and learning outcomes of 87, 84, 86, and 92 respectively (Scale 1-100). All instruments used were valid and reliable (Drost, 2011).

2.4. Data Analysis Technique

This study used multiple regression inferential techniques. Multiple regression is used to study the effect of several independent variables on one dependent variable. Before that, a pre-requisite test was carried out, namely the normality test and linearity test. In addition, this study also used descriptive analysis to describe the characteristics of the research sample. Descriptive analysis was used to provide an overview of the variables observed in this study, such as students' perception to the learning media, digital literacy skills, self-regulated learning, and student learning outcomes.

3. Findings and Discussion

3.1. Result

The description of the results shows that the learning independence score has the highest value compared to media perception and digital literacy. While the lowest variable is the media perception variable. The results of the research description are presented in Table 1.

A summary of the regression analysis of the relationship between students' perception to the learning media and students' cognitive learning outcomes is presented in Table 1 to Table 3. Table 1 shows that the results of the analysis of variance are highly statistically significant (0.000), which indicates that the correlation between students' perception to the learning media and cognitive learning outcomes is very strong. The variable B value (media perception) is presented in Table 2, and the constant is 71.464. It can be seen that the simple regression equation is $y = 0.241X_1$.

Descriptive Statistics							
Variable	N	Min.	Max.	Sum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Perception media	134	65.00	66.00	8746.00	65.2687	.03844	.44492
Digital literacy	134	69.00	70.00	9281.00	69.2612	.03809	.44093
Self-regulated learning	134	76.00	77.00	10219.00	76.2612	.03809	.44093
Cognitive learning outcomes	134	88.00	89.00	11827.00	88.2612	.03809	.44093

Table 1. Research Description Statistics

ANOVA ^a						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	20.628	1	20.628	67.558	.000 ^b
	Residual	40.305	132	.305		
	Total	60.933	133			

a. Dependent Variable: s

b. Predictors: (Constant), students’ perception

Table 2. Analysis of variance summary of correlation between students’ perception to the learning media and cognitive learning outcomes

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	71.464	2.010		35.559	.000
	Students’ perception	.241	.029	.582	8.219	.000

a. Dependent Variable: Learning Outcomes

Table 3. Regression coefficient of correlation between students’ perception to the learning media and cognitive learning outcomes

Table 3 shows that the R square is very weak (0.056), indicating that it is related to media perception. The contribution of students’ perception to the learning media to the cognitive learning outcomes is 5.63%. Cognitive learning outcomes are also influenced by other factors that are not detected as much as 94.37%.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.068a	.056	.053	.55258

a. Predictors: (Constant), Students’ Perception to The Learning Media

Table 4. Regression summary of the relationship between students’ perception to the learning media and cognitive learning outcomes

The summary of the regression analysis of the relationship between digital literacy and students’ cognitive learning outcomes is presented in Table 4 to Table 6. Table 4 shows that the results of the analysis of variance are highly statistically significant (0.000), which indicates that the correlation between digital literacy and cognitive learning outcomes is very strong. The variable B value (digital literacy) is presented in Table 5, and the constant is 66.139. It can be seen that the simple regression equation is $y = 0.316X_2$.

ANOVA ^a						
	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	23.118	1	23.118	80.700	.000 ^b
	Residual	37.814	132	.286		
	Total	60.933	133			

a. Dependent Variable: Learning Outcomes

b. Predictors: (Constant), Digital Literacy

Table 5. Analysis of variance summary of correlation between digital literacy and cognitive learning outcomes

Coefficients ^a						
	Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	66.139	2.431		27.201	.000
	Digital literacy	.316	.035	.616	8.983	.000

a. Dependent Variable: Learning Outcomes

Table 6. Regression coefficient of correlation between digital literacy and cognitive learning outcomes

Table 6 shows that the R square is very weak (0.093), indicating that it is related to digital literacy. The contribution of digital literacy to student cognitive learning outcomes is 9.36%. Cognitive learning outcomes are also influenced by other undetected factors as much as 90.64%.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.086 ^a	.093	.081	.53523

a. Predictors: (Constant), Digital Literacy

Table 7. Regression summary of the relationship between digital literacy and cognitive learning outcomes

Table 7 shows that the results of the analysis of variance are highly statistically significant (0.000), which indicates that the correlation between self-regulated learning and cognitive learning outcomes is very strong. The variable B value (self-regulated learning) is presented in Table 8, and the constant is 83.216. It can be seen that the simple regression equation is $y = 0.064X_3$.

ANOVA ^a						
	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	4.639	1	4.639	10.878	.001 ^b
	Residual	56.294	132	.426		
	Total	60.933	133			

a. Dependent Variable: Learning Outcomes

b. Predictors: (Constant), self-regulated learning

Table 8. Analysis of variance summary of correlation between self-regulated learning and cognitive learning outcomes

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	83.216	1.445		57.603	.000
	Self-regulated learning	.064	.019	.276	3.298	.001

a. Dependent Variable: Learning Outcomes

Table 9. Regression coefficient of correlation between self-regulated learning and cognitive learning outcomes

Table 9 shows that the R square is strong (0.714), indicating that it is related to self-regulated learning. The contribution of self-regulated learning to student cognitive learning outcomes is 71.42%. Cognitive learning outcomes are also influenced by other factors that are not detected as much as 28.58%.

Table 10 shows that the results of the analysis of variance are highly statistically significant (0.000), which indicates that the correlation between self-regulated learning, digital literacy, and students' perception to the learning media, and cognitive learning outcomes is very strong. The B values of the three variables (self-regulated learning, digital literacy, and students' perception to the learning media) are presented in Table 11, and the constant is 63.489. It can be seen that the multiple regression equation is $y = 0.080X_1 + 0.221X_2 + 0.050X_3$.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.827 ^a	.714	.716	.65304

a. Predictors: (Constant), self-regulated learning

Table 10. Regression summary of the relationship between self-regulated learning and cognitive learning outcomes

ANOVA ^a						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	26.656	3	8.885	33.700	.000 ^b
	Residual	34.276	130	.264		
	Total	60.933	133			

a. Dependent Variable: Learning Outcomes

b. Predictors: (Constant), Students' Perception, Digital Literacy, Self-regulated Learning

Table 11. Analysis of variance summary of correlation between students' perception to the learning media, digital literacy, and self-regulated learning on cognitive learning outcomes

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	63.489	2.521		25.183	.000
	Students' perception	.080	.052	.194	1.535	.127
	Digital literacy	.221	.065	.430	3.411	.001
	Self-regulated learning	.050	.015	.216	3.275	.001

a. Dependent Variable: Cognitive Learning Outcomes

Table 12. Regression coefficient of correlation between students' perception to learning media, digital literacy, and self-regulated learning on cognitive learning outcomes

Table 12 shows that R square is very strong (0.864), indicating that related to the contribution of students' perception to the learning media, digital literacy, and self-regulated learning to student cognitive learning

outcomes by 86.41%. While other factors that affect cognitive learning outcomes that are not detected are 13.59%. Table 13 shows that students' perception to the learning media provides an effective contribution of 5.63%, digital literacy provides the highest effective contribution of 9.36%, while the self-regulated learning variable provides an effective contribution of 71.42% to student cognitive learning outcomes. Simultaneously, the effective contribution of the three variables was 86.41% to students' cognitive learning outcomes.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.913a	.864	.824	.51348

a. Predictors: (Constant), Self-regulated Learning, Digital Literacy, Students' Perception

Table 13. Summary of regression of the relationship between students' perception to the learning media, digital literacy, and self-regulated learning on cognitive learning outcomes

Variable	RC (%)	EC (%)
X1 (Students' Perception) – Y (Learning Outcomes)	1.41	5.63
X2 (Digital Literacy) – Y (Learning Outcomes)	3.43	9.36
X3 (Self-regulated Learning) – Y (Learning Outcomes)	95.17	71.42
X1 (Students' Perception) & X2 (Digital Literacy) & X3 (Self-regulated Learning) – Y (Learning Outcomes)	100	86.41

Table 14. Effective contribution of students' perception to the learning media, digital literacy, and self-regulated learning to cognitive learning outcomes

3.2. Discussion

Based on the results of the study, it is known that the highest contribution is influenced by self-regulated learning, then digital literacy, and students' perception to the learning media on cognitive learning outcomes which are 71.42%, 9.36%, and 5.63% respectively. This is in accordance with and supported by several previous studies conducted by Çetin, (2021), List, Eva and Klee (2020), Radovanović, Holst, Belur, Srivastava, Hounghonon, Le Quentrec et al. (2020), which states that digital literacy is needed to realize sustainable development and is a relevant factor to bridge this digital divide so that digital literacy skills as one of the pillars of digital inclusion, especially in the learning process. This is also supported by states that digital literacy is an important capacity for student learning in a rapidly changing technological world as a conceptual framework refers to many complex skills so that teachers must have digital competence, especially in using resources and visualizing them in digital information sources.

Despite the fact that it was found that students in rural areas have digital literacy that is in the low category. This is caused by several factors, the main factor being the limited access to digital resources and infrastructure in rural areas, especially in the use of the learning media (Dube, 2020; Ntaila & Mbaraka, 2023; Soekamto et al., 2022). Educational institutions in rural areas also experience limited technology and digital applications needed as learning media, which can hinder the integration of digital literacy into the biology curriculum. This is also in accordance with the results of research conducted by Chen, Li and Chen (2022), Khaled, Hazaymeh and Montierre (2022) which states that teachers do not have digital literacy skills, hindering their ability to effectively teach digital literacy to students. Therefore, it is imperative to provide teacher training programs to improve their digital literacy before integrating digital resources in rural areas.

Another factor contributing to low digital literacy in rural areas is the limited availability of internet services and connectivity (Price, Deville & Ashmore, 2022). Rural areas often have poor digital connectivity, making it difficult for learners of biology subjects to access online resources, research articles, and educational platforms essential to their studies. This hinders students' ability to engage in

online learning, collaborate with peers and keep up with the latest developments in biology digitally (Khan, 2021; Meng, Dong, Roehrs & Luan, 2023).

Digitalization of the biology learning process is very important to provide a meaningful learning process for students, but based on the results of the study found that the perception of students in rural areas is very low. One of the main causes is the lack of local potential-based references that are directly related to students lives. (Lillo, 2023; Maisyura, Ajizah & Amintarti, 2021). Many students have difficulty understanding biological concepts, lacking access to learning materials that are relevant to their environment. The lack of relevant learning media hinders their ability to understand and apply biology concepts effectively (Cowie, Townsend & Salemink, 2020). So it is necessary to develop creative and locally relevant learning media in biology subjects. The learning media used optimizes the learning process. For teachers, learning media helps realize concepts or ideas concretely and motivates students to be active (Bawaneh, 2020; Chamdani, Salimi & Fajari, 2022; Falloon, 2020; Uyun, Bahriah, Zuhijra, Ningsih & Fitriani, 2023; Widyaningrum, Maryani & Vehachart, 2022).

This is supported by research that has been conducted Buditjahjanto and Irfansyah, (2023) stated that learning media has a significant effect on cognitive learning outcomes. Technological advances and their rapid development always create new and interesting things to engage students in learning and meet the increasing needs of education (Kalogiannakis, Papadakis & Zourmpakis, 2021). Innovating by utilizing technology has made students develop well and improved the quality of education (Willans & Fernández, 2022). Learning media can also develop a learning environment that arouses students' enthusiasm and activeness (Prahani, Nisa, Nurdiana, Krisnaningsih, Amiruddin & Sya'roni, 2023).

Students activeness in the learning process will lead them to be self-regulated learner. However, based on the results of the study, it was found that students' self-regulated learning was still low. There are several factors that cause low student self-regulated learning in biology subjects, especially in rural areas. One of the factors is the limited access to resources and infrastructure. Underdeveloped areas often lack adequate educational facilities, including well-equipped biology laboratories and libraries (McFayden, Breaux, Bertollo, Cummings & Ollendick, 2021). Lack of resources hinders students ability to engage in hands-on experiments, access relevant textbooks and scientific literature, and undertake self-regulated learning in biology subjects. all with the aim of making the learning process more effective. The globalization of technology and its disruptive impact has led to an increased interest in technology for student life (Alaleeli & Alnajjar, 2020).

Another factor is the lack of biology teachers with appropriate competencies in rural areas. Many schools in rural areas struggle to attract and retain highly qualified teachers in rural areas (Li, Shi & Xue, 2020; Plessis & Mestry, 2019; Sutchter, Darling-Hammond & Carver-Thomas, 2019). The lack of experienced and knowledgeable teachers may hinder students ability to receive quality biology teaching and guidance, ultimately affecting their self-regulated learning (Hernanda, Absori, Azhari, Wardiono & Arlinwibowo, 2023; Machado & Nahar, 2023; William, 2021).

Based on this, it is necessary to conduct a professional development program to improve digital literacy skills by using digital technology effectively, especially in the field of education (Gündüzalp, 2021; Liu, Tretyakova, Fedorov & Kharakhordina, 2020; Maphosa & Bhebhe, 2019; Radovanović et al., 2020; Timotheou, Miliou, Dimitriadis, Sobrino, Giannoutsou, Cachia et al., 2023). Learning processes are needed to explore how the integration of technology resources in the classroom evolves along with the transformation of educational materials (Sanz, Melgarejo & López-Iñesta, 2023), So this will also affect the students' perception to the learning media. These programs should involve teacher training, curriculum development that incorporates digital literacy and the use of digital technology in learning. In addition, it is important to raise awareness of the importance of digital literacy and critical perception of media involving the use of technology.

The use of technology and digital resources to search for information, communicate, collaborate and access learning content independently. This shows that digital literacy can affect to the self-regulated learning. With

good digital literacy skills, students can access and utilize learning resources independently, increase learning motivation, and develop better self-learning skills (Anthonysamy et al., 2020; Liza & Andriyanti, 2020; Maimun & Bahtiar, 2023; Maru, Pikirang, Setiawan, Oroh & Pelenkahu, 2021; Tohara & Al, 2021). Strengthening digital literacy in education, it is expected that students can be ready to face the changing times and prepare themselves for the future towards the era of digitalization. Improving the teaching-learning process through the right way of applying new technology for virtual learning is still an important point to achieve digital inclusion (Miras, Ruiz-Bañuls, Gómez-Trigueros & Mateo-Guillén, 2023).

This is also supported by research conducted by Coiro, (2021), Kozanoglu and Abedin, (2020), Sary, Dudija and Moslem (2023), stated that good digital literacy can make a positive contribution to student self-regulated learning. Students who have good digital literacy will be better able to access and utilize digital resources to support their learning process. The resources that support this are by utilizing learning media. The students' perception to the learning media should be developed based on the findings of the situation and students potential needs (Capilla, Molins, Pérez, Bakit & Pizarro, 2022; Basir, Lian, Salmizi & Shaharin, 2019). Learning by example, teachers teach students in a way that aligns with their future roles while training them to be self-reliant in empowering the competencies needed (Mohbey, 2023).

Self-regulated learning is another important factor found to correlate with student learning outcomes. Students who were independent tend to achieve better academic performance compared to students who are not independent (Martzoukou, 2020; Sari, Priatna & Juandi, 2022). There is a relationship between learning media and self-regulated learning on learning outcomes. The combination of learning media and self-regulated learning makes learning more interesting and enjoyable for students so as to produce better results (Skulmowski & Xu, 2022; Sudarmo, Arifin, Pattiasina, Wirawan & Aslan, 2021). Overall, students' perception to the learning media, digital literacy skills and self-regulated learning are important factors contributing to student learning outcomes in rural areas. Improving digital literacy skills and encouraging self-regulated learning can have a positive impact on improving student and teacher competencies (Gürsoy, 2021; Jannah, Prasojo & Jerusalem, 2020; Karataş & Arpacı, 2021; Kim, 2019).

This is also supported by Herguedas and Asencio (2023) stated that other competencies that specifically lead to the empowerment of future competencies must be integrated in their empowerment. Students must be able to integrate their prior knowledge with newly acquired knowledge, so that the new knowledge or learning is meaningful and can help develop new skills (Ferrer & Pizarro, 2022). Therefore, technology should be utilized as an important and potential supporting medium for the purpose of learning reform (Rizal, Rusdiana, Setiawan & Siahaan, 2022). Effective and efficient learning starts with improving teacher competence.

Improving teacher competence through a smart teaching approach is supported by several previous studies conducted by Akour and Alenezi, (2022), Bahri, Arifin, Jamaluddin, Muharni and Hidayat, (2023), Stepanyuk, Mironets, Olendr, Tsidylo and Stoliar, (2020) Smart teaching refers to the use of technology and smart learning strategies to improve teaching effectiveness supported by technology that is solutive and innovative with the help of technology. Technology-enabled learning media can engage students through innovative, interactive lessons, simulations and virtual experiments. This hands-on approach can improve students' understanding and retention of digital literacy concepts as well as students' independence by using learning media (Eveline, Jumadi, Wilujeng & Kuswanto, 2019; Mukhasheva, Ybyraimzhanov, Naubaeva, Mamekova & Almukhambetova, 2023; Pötzsch, 2019; Silamut & Petsangsri, 2020; Soltovets, Chigisheva & Dmitrova, 2020).

4. Conclusions

Based on the findings and discussion, it can be concluded that students' perception to the learning media, digital literacy, and self-regulated learning have a contribution simultaneously have a moderate relationship to cognitive learning outcomes. The results found are (1) The students' perception to the learning media directly and significantly affects students' cognitive learning outcomes. The

contribution of students' perception to the learning media to cognitive learning outcomes is 5.63%, (2) Digital literacy has a direct and significant effect on cognitive learning outcomes, both individually and simultaneously the contribution of digital literacy to student cognitive learning outcomes is 9.36%. (3) There is a direct and indirect effect between self-regulated learning of 71.42% on student cognitive learning outcomes. (4) The effective contribution of students' perception to learning media, digital literacy, and self-regulated learning is 86.41% to students' cognitive learning outcomes. In addition, it was identified that the contribution of digital literacy to students' cognitive learning outcomes was higher than the contribution of students' perception to the learning media and self-regulated learning.

The implication of this research is the need for more students' perception to the learning media to empower digital literacy so as to increase their self-regulated learning. The learning process should accommodate the learning of information technology skills with the help of innovative learning media that can meet all the needs of students inclusively to improve digital literacy. When learning, students are exposed to the latest technology that facilitates and assists their learning so as to minimize the gap in the quality of education between urban and rural areas. The learning process is more meaningful and directs learners to have 21st century competencies. This is also supported by the relationship between students' perception to the learning media, digital literacy skills, and self-regulated learning together on student learning outcomes in remote areas has a positive relationship. This indicates the importance of equalizing education in an inclusive manner that is oriented towards 21st century competencies.

5. Limitations and Future Research

The limitation of this research is that the number of school institutions is limited to one rural area of Jenepono district where there are regional characteristics and types of learning technology internet network conditions so that further research is needed in several rural areas with different characteristics.

Future research is needed on students' perception to the learning media, digital literacy, and self-regulated learning on students' cognitive learning outcomes in other rural areas, and Empowering students' digital literacy with the help of innovative learning media such as the latest ones that begin with a meaningful approach so as to increase self-regulated learning and student cognitive learning outcomes inclusively so as to minimize the gap in the quality of education, especially in remote areas.

Declaration of Conflicting Interests

The authors declare no potential conflicts of interest in connection with the research, authorship, and/or publication of this article.

Funding

This research is funded by the Directorate of Research, Technology and Community Service of the Directorate General of Higher Education, Research and Technology, Ministry of Education, Culture, Research and Technology in accordance with the contract for the implementation of the Fundamental-Regular Research Program for Fiscal Year 2023 Contract Number: 139/E5/PG.02.00/PL/2023; 2773/UN36.11/LP2M/2023.

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Journal of Technology and Science Education, 2024 (www.jotse.org)



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