DEVELOPMENT OF NATURAL SCIENCE INSTRUMENTS ON THE TOPICS OF GREEN PLANT ASSESSMENT

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Abstract

Evaluation instruments play an essential role in measuring the achievement of student knowledge in the learning process in classroom. Teachers can prepare evaluation instruments by making observations first to students during learning . This study aimed to develop an evaluation instrument with the help of Quizizz application for natural science subjects on green plant topics. The method used in this study is Research and development with a 4D model (Define, Design, Develop, Disseminate). Evaluation instruments developed from material validation tests obtained a value of 106. The validity of the class teacher's material is 93. And media expert validation of 90. The final score of evaluation instrument validation is 77.06% and is included in the high category based on the validation test of material experts and media experts; the evaluation instrument with Quizizz application is worthy and relevant of being used as an evaluation instrument to increase student interest in doing the questions.

Keywords: Elementary School; Evaluation Instrument; Natural Science; Quizizz

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How to Cite: Prastiawan, M. D. & Utaminingsih, E. S. (2024). DEVELOPMENT OF NATURAL SCIENCE INSTRUMENTS ON THE TOPICS OF GREEN PLANT ASSESSMENT. *Research and Development Journal of Education*, 10(2), 1208-1220

INTRODUCTION

Education is one of the parameters of the nation's progress. Education is the basis for creating and improving reliable human resources to be able to make a superior quality the nation (Paradise & Asmali, 2021). The quality of education in the country will reflect the country's progress (Ellianawati et al., 2020), and improving the quality of education will usher in the progress of a nation (Pratiwi & Fasha, 2015).

The Natural Science (Science) curriculum is arranged systematically so that learning takes place interactively, is fun (Utaminingsih, Raharjo, et al., 2023), motivates students to play an active role in learning and provides space for creativity and independence (Fatimah & Kartika, 2013). Science subjects contain a collection of systematic theories, born and developed through scientific methods such as observation and experimentation and demand scientific attitudes (Sarwi et al., 2019) such as curiosity, openness, and honesty (Ellianawati et al., 2021). Science is also seen as a process that leads to competencies that learners must possess (Saputra et al., 2021). Given the critical role of science learning that can guide students to have adequate competence, teachers must make various updates (Utaminingsih, Ellianawati, et al., 2023). Updates can be made through learning innovations, especially in science learning.

Research results by Nugroho and Mawardi (2021) show that the teacher needs to be more optimal in updating the learning process. Teachers only innovate in learning media rather than with evaluation instruments. The evaluation instruments used are limited to the

teacher manual used in schools (Utaminingsih, Ramadhani, et al., 2024). Innovations such as developing instruments that match the characteristics of students (Sarwi et al., 2021), for example, using many pictures to clarify questions or questions accompanied by quizzes has yet to be widely developed. According to Khotimah (2021), even though this is important so that the evaluation process feels good.

Referring to the description above, considering the critical role of science for the future provision of students, the competencies possessed must be determined by evaluating the competence of science students (Astuti et al., 2020). Given the absence of innovation related to the development of evaluation instruments (Utaminingsih, Sumartiningsih, et al., 2024), it is necessary to develop them in science learning. The development of this instrument can be carried out by assessing greenery in grade IV elementary school. Findings by Paradise & Asmali (2021), more research is needed to develop questions to evaluate the topic of green plant assessment in grade IV elementary school (SD).

Evaluation instruments play an essential role in measuring the achievement of student knowledge in the learning process (Utaminingsih, Intania, et al., 2024). Through evaluation instruments, teachers can find out the results of student achievement. Teachers prepare evaluation instruments by directly observing students in advance (Nugroho & Airlan, 2020). The development of evaluation instruments should be carried out systematically. The process starts from determining the topic of instrument review, preparing grids and questions, validating the results of problem development, and improving validation results to follow-up development results (Utaminingsih, Raharjo, et al., 2023). This is because the evaluation instrument is a means to provide information about students' mastery of green plant material in grade IV science subjects (Fitri et al., 2022). The use of evaluation instruments developed in this study is to develop valid evaluation instruments relevant to the topic raised by the characteristics of students, and they feel interested when working on questions (Zuliani et al., 2017). Based on the description above, this study aims to develop an evaluation instrument for assessing grade IV green plants in elementary schools.

METHODS

Research on developing evaluation instruments for green plant topics in class IV science subjects uses the type of Research and development (R&D) Research. The model used in this development research is a 4D model, namely Define, Design, Develop, and Disseminate. The design of the 4D development model in this instrument development research is presented in Figure 1.
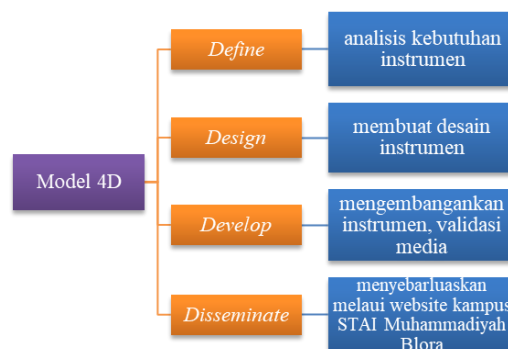

Figure 1.
Research Design for Science Evaluation Instrument Development

The first stage is Define, which examines information about problems that occur in students through teacher interviews. There is a problem: When students do class IV green plant topic questions, they get less than optimal learning results. This is not only caused by the teachers' teaching method, which is still conservative (lectures), but also by the instruments used by teachers, which are limited to books from school. Innovation is needed to develop valid, exciting, and feasible instruments for evaluating student learning outcomes. The next step is to analyze the problem and find a solution by collecting articles as a reference to find solutions. Overcoming these problems can be done by developing valid and feasible evaluation instruments.

The next stage is the stage Design (design). This stage plans the solution to the problems, namely designing the development of evaluation instruments in science subjects on the topic of green plants in class IV. This stage begins with collecting the most relevant references to develop science evaluation instruments on green plant topics, then collecting materials used to help solve problems, namely the software Quizizz. The next step involves creating assessment instruments, starting with making grids and developing questions using Quizizz.

The third step is Develop is to develop. Make questions with a total of 25 questions consisting of ten multiple-choice questions, five matchmaking questions, five short fill-in questions and five description questions according to the topic to be developed. This is continued by developing evaluation instruments and developed again using the application Quizizz. Evaluation instruments that have been designed and then tested for validation by validators. This validator consists of three lecturers and class IV teacher validation. The validators appointed to validate are education practitioners who are experts in their fields. The first lecturer validates the suitability of the question content to the topic. Validation of media experts or second lecturers validates the aspects of the media used. The teacher then validates the suitability of the language used for grade IV learners.

The results of expert validation will be used as a reference for revising instruments developed with the help of the Quizizz application. The validation results are qualitative and quantitative data. Qualitative data contains criticism and suggestions, while quantitative data contains scoring on the development of evaluation instruments (products) that have been developed. Guidelines for calculating scores from expert validation are presented in Table 2.

Table 2.
Validation result value categories

Value	Category
$80 < \times \geq 100$	Very High
$60 < \times \geq 80$	Tall
$50 < \times \geq 59$	Keep
$35 < \times \geq 50$	Low

Sumber: Juliyanti (2021)

The last stage of the study is dissemination. Based on the validation test results, the instrument was developed if declared feasible and appropriate. The evaluation instrument is disseminated through the Sekolah Tinggi Agama Islam Muhammadiyah Blora's ampus website. The dissemination process was also carried out through social media owned by researchers.

RESULTS & DISCUSSION

Results

The results of the grids that have been developed to make evaluation instruments can be seen in Table 3.

Table 3.
Evaluation Instrument-Making Grid.

Learning Outcomes	Question Indicator	Realm	No Problem	Question Form
Learners identify parts and functions of the plant body	Students can determine the parts of plants that function to absorb water.	C3	1	Multiple Choice
	Students can name parts of plants.	C4	2	Choice Double
	Students can put forward various rods.	C3	3	Multiple choice
	Students can choose plants that have fibrous roots.	C6	4	Multiple choice
	Learners can name plants based on leaf type.	C1	5	Multiple choice
	Learners can choose plant parts that do not play a role in growing.	C6	6	Multiple choice
Students can understand the needs of plants for photosynthesis and the results.	Students complete the explanation of the process of photosynthesis.	C1	7	Multiple choice
	Learners can choose which results from the photosynthesis process.	C2	8	Multiple choice
	Mentions the need for the process of photosynthesis.	C5	9	Multiple choice
	Students complete the explanation of the process of photosynthesis.	C4	10	Double selection
	Learners can explain the function of roots.	C1	11	Short fill
Learners identify the parts and functions of each part of the plant body	Students complete the explanation of the process of photosynthesis.	C2	12	Short fill
Students can understand the needs of plants to carry out		C2	13	Short fill

Learning Outcomes	Question Indicator	Realm	No Problem	Question Form
photosynthesis and the results				
Learners identify the parts and functions of each part of the plant body	Learners name body parts of plants.	C1	14	Short fill
Students can understand about plant breeding	Students can describe how flowering plants breed.	C2	15	Short fill
Students understand the place of food reserves in plants			16	
			17	
	Students match statements that agree with correct answers.	C1	18	Matchmaking
			19	
			20	
Learners identify the parts and functions of each part of the plant body	Learners explain the body parts of plants.	C2	21	description
	Learners can name plant parts.	C1	22	description
	Learners explain the body parts of plants	C2	23	description
	Describe how. Breeding of flowering plants.	C1	24	description
Learners can understand the difference between perfect flowers and imperfect flowers	Learners can explain the difference between perfect and imperfect flowers.	C2	25	description

Expert validation results

The results of expert validation, which include material expert validation and media expert validation, are presented in Tables 4, 5, and 6.

Table 4.
Results of Validation of Lecturer Material Content

Point	V value	Classification
1	4	Relevant
2	4	Relevant
3	5	Relevant
4	4	Relevant

5	5	Very Relevant
6	4	Relevant
7	4	Relevant
8	4	Relevant
9	4	Relevant
10	4	Relevant
11	5	Very Relevant
12	4	Relevant
13	4	Relevant
14	4	Relevant
15	5	Very Relevant
16	4	Relevant
17	4	Relevant
18	4	Relevant
19	4	Relevant
20	4	Relevant
21	4	Relevant
22	5	Very Relevant
23	4	Relevant
24	5	Very Relevant
25	4	Relevant
Sum	106	Relevant

The following validation is the content validator. The results of content validation with grade IV teacher validation are presented in Table 5.

Table 5.
Results of Validation of Class IV Teacher Material Content

Point	V value	Information
1	4	Relevant
2	4	Relevant
3	3	Quite relevant
4	3	Quite relevant
5	4	Relevant
6	3	Quite relevant
7	3	Quite relevant
8	4	Relevant
9	4	Relevant
10	4	Relevant
11	3	Quite relevant
12	4	Relevant
13	4	Relevant
14	4	Relevant
15	3	Quite relevant
16	3	Quite relevant
17	4	Relevant
18	4	Relevant
19	4	Relevant
20	4	Relevant
21	4	Relevant

Point	V value	Information
22	4	Relevant
23	4	Relevant
24	4	Relevant
25	4	Relevant
Sum	93	Relevant

The third validator is media expert validation. The results of validation by media experts are presented in Table 6.

Table 6.
Media Expert Validation Results

Point	Value	Classification
1	10	Quite relevant
2	20	Pull
3	15	Relevant
4	10	Quite relevant
5	15	Relevant
6	20	Pull
Sum	90	Worthy

The validity value is determined based on the results of the analysis test of material expert validation and media expert validation. The overall results of the validation are presented in Table 7.

Table 7.
Overall Validation Results

Validators	Value
1	106
2	93
3	90
Total	289
Average	77.06
Criterion	High

The findings of this study indicated that the development of an evaluation instrument supported by the Quizizz application for the green plants topic in fourth-grade elementary science was deemed appropriate, with a high validation score. The instrument was designed using the 4D development model (Define, Design, Develop, Disseminate), involving validation by subject matter experts, media experts, and classroom teachers. With a total validation score of 77.06%, the instrument fell within the high category, indicating its relevance for increasing students' interest and motivation in completing assessment tasks. These results supported the previous findings of Bahri et al. (2021), who concluded that evaluation instruments developed through technology-based applications like Quizizz can enhance student engagement.

This study also aligned with the research by Utaminingsih, Sumartiningsih, et al., 2024), who emphasized the importance of innovation in developing evaluation instruments, particularly in the context of science education. They highlighted that teachers often prioritize innovation in teaching media over evaluation instruments. The use of the Quizizz application in this study represented a relevant innovation. It provided evaluation questions

tailored to students' characteristics and utilized technology to make the evaluation process more engaging and interactive. This finding is consistent with Pomalato et al. (2021) assertion that science literacy-based evaluation instruments can help students achieve better learning outcomes.

Furthermore, this research reinforced the findings of Jiananda (2017), who reported that using Quizizz in science learning assessments significantly enhanced the effectiveness of the evaluation process. They found that Quizizz presented questions visually engaging and interactively, which ultimately helped students grasp concepts more quickly and motivated them to complete the assessments (Juliyanti et al., 2021). In this study, using Quizizz facilitated the development of the evaluation instrument and provided a more dynamic and enjoyable learning experience for students. This is particularly important as (Utaminingsih, Intania, et al., 2024) noted that using technology-based assessment tools fosters critical thinking skills and deepens students' conceptual understanding.

Evaluation Instruments Before and After Revision

The evaluation instruments before and after revision by material expert validators are presented in Table 8 and Table 9.

Table 8.
Evaluation Instruments Before Revision Material Expert

Num.	Question Form	Question	Key
4	Multiple Choice	Which plant has fibrous roots... a. corn b. Guava c. spinach d. orange	C
5	Multiple Choice	Any plant that has parallel leaves... a. guava b. sugar cane c. mango d. spinach	B
6	Multiple Choice	Which part of the plant **does not** play a role in growing... a. leaf b. trunk c. root d. fruit	D
7		Mustard plants store food reserves at what ... **a. rod**	E
8		Mango trees store food reserves on what... **b. fruit**	B
9	Matchmaking	Plants that store food on leaves are ... **c. cassava**	D
10		Plants that store food reserves on tubers are... **d. spinach**	C
11		The sugarcane plant stores food crops on what... **e., leaves**	A

Table 9.
Evaluation Instruments After Revision Material Expert Validation

Num.	Problem form	Question		
4	Multiple Choice	Below are the types of plants that have parallel roots. a. corn b. Guava c. Spinach d. orange		
5	Multiple Choice	Below are the types of plants that have parallel leaves. a. guava b. sugar cane c. mango d. spinach		
6	Multiple Choice	The part of the plant that **does not** play a role in growing is... a. leaf b. trunk c. root d. fruit		
7	Matchmaking	Mustard plants store food reserves at what ...	a.	stem
		Mango trees store food reserves on what...	b.	fruit
8		Plants that store food on leaves are ...	c.	cassava
9		Plants that store food reserves on tubers are	d.	spinach
10		...	e.	leaf
		The sugarcane plant stores food crops on...		

Based on Table 7, the validation results of science evaluation instruments on the topic of green plants. Developed with the help of Quizizz, it is within the high criteria, so it is worth using. Research supports this by Juliyanti (2021) that the science development instrument developed using Quizizz was declared valid and interesting, so it is suitable for evaluation.

The evaluation instrument developed will be run on an Android Smartphone. The instrument containing class IV green plant material questions is intended to increase students' interest in doing evaluation questions. The images on Quizizz are expected to attract interest and motivate students to do further questions to get maximum learning results. An initial view of the evaluation instrument being developed using the Quizizz application is presented in Figure 2.

Figure 2.
Initial View of Evaluation Instruments

Media expert validation, in addition to assessment, also provides suggestions and input to improve the evaluation instinct with the help of Quizizz to make it better. The improvements to Quizizz are presented in Figures 3 and 4.
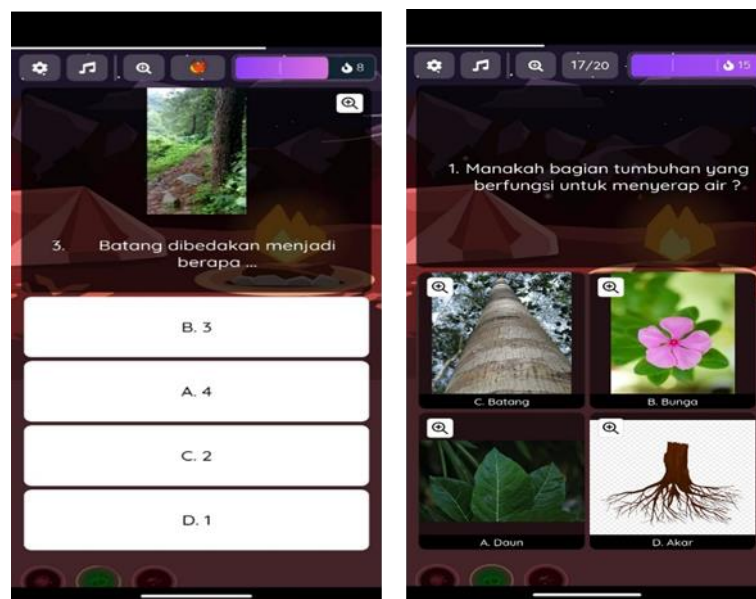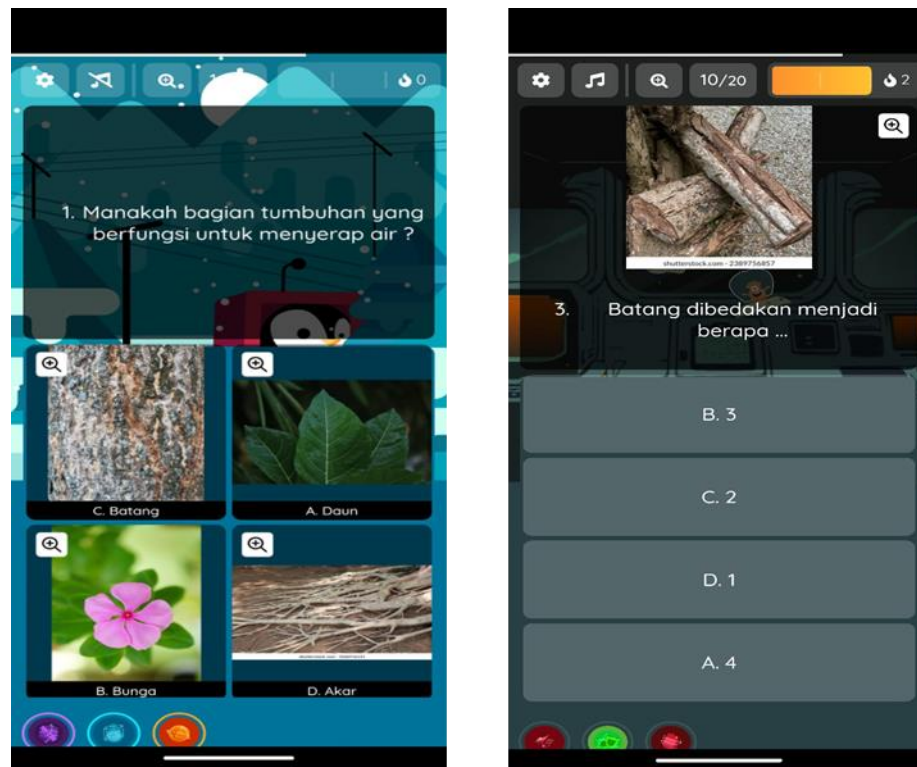

Figure 3.
Before Repair

Figure 4.
After Repairs to Root and Stem Drawings

Evaluation instruments with the help of Quizizz are declared valid with high scores based on material expert validation and media expert validation. Furthermore, the evaluation instrument was disseminated through the website owned by the STAI Muhammadiyah Blora campus, which can be accessed at the IP address: https://www.staimuhblora.ac.id/2023/12/30/pengembangan-instrumen-evaluasi-dengan-bantuan-quizizz/ and disseminated through social media accounts owned by researchers can be accessed on the Instagram account @prastiawan_52.

CONCLUSION

Development of green plant topic evaluation instruments with Quizizz building from material content validation tests of 106, material content validation of 93 and media expert validation of 90. The final score of instrument validation obtained a score of 289 with an average of 77.06 and is included in the high category, so the instrument for evaluating green plant topics with the help of Quizizz is feasible to use. This instrument will be run on an Android smartphone so that students feel happy when working on problems. The evaluation instrument, with the help of Quizizz, is expected to attract interest and motivate students to do the questions. Thus, students get maximum learning results.

REFERENCES

Astuti, A. T., Supahar, Mundilarto, & Istiyono, E. (2020). Development of assessment

instruments to measure problem solving skills in senior high school. *Journal of Physics: Conference Series*, *1440*(1). https://doi.org/10.1088/1742-6596/1440/1/012063

Bahri, S., Simbolon, M., & Alhad, K. (2021). Development of Assessment Instrument of Scientific Literacy Ability for Students at Musamus University. *Advances in Social Science, Education and Humanities Research Proceedings of the International Joined Conference on Social Science (ICSS 2021)*, *603*(Icss), 395–398.

Ellianawati, E., Mufiatunnikmah, S., Setyaningsih, N. E., & Subali, B. (2020). Asesmen Multi Representasi Berbasis Keterampilan Abad Ke-21 pada Materi Gerak Lurus. *Physics Education Research Journal*, *2*(1), 19. https://doi.org/10.21580/perj.2020.2.1.5038

Ellianawati, E., Subali, B., Khotimah, S. N., Cholila, M., & Darmahastuti, H. (2021). Face-to-face mode vs. Online mode: A discrepancy in analogy-based learning during covid-19 pandemic. *Jurnal Pendidikan IPA Indonesia*, *10*(3), 368–377. https://doi.org/10.15294/JPII.V10I3.30037

Fatimah, S., & Kartika, K. (2013). Pembelajaran IPA Sekolah Dasar Berbasis Pendidikan Karakter. *Jurnal Al-Bidayah*, *5*(2), 281–297.

Firdaus, M., & Asmali, A. (2021). Pengembangan instrumen penilaian berbasis literasi sains. *Kemendikbudristek*, *10*(2), 55.

Fitri, L., Mahzum, E., & Hamid, A. (2022). Effectiveness Of Using The Quizzz Application In The Evaluation Of Learning Physics On Students. *Jurnal Pendidikan Fisika*, *11*(2), 111–115. https://doi.org/10.24114/jpf.v11i2.38115

Jiananda, A. (2017). Pengembangan Instrumen Penilaian Proyek Mind Mapping untuk Mengukur Penguasaan Konsep Fisika dan Keterampilan Berpikir Kreatif Development of Mind Mapping Project Assessment Instruments to Measure Mastery of Physics Concepts and Creative Thinking Skills.

Juliyanti, N. U. E., Indah, C. H. R., & Hadiwijaya, M. (2021). Pengembangan Media Pembelajaran menggunakan aplikasi Quizizz pada Implementasi Ulangan Harian Siswa. *Jurnal Budi Utomo Malang*, *10*(2), 145–151.

Khotimah, S. K. S. H. (2021). Pemanfaatan Media Pembelajaran, Inovasi di Masa Pandemi Covid-19. *Edukatif: Jurnal Ilmu Pendidikan*, *3*(4), 2149-2158.

Nugroho, A. N., & Airlan, G. S. (2020). Pengembangan Instrumen Penilaian Keterampilan Berpikir Kritis Pembelajaran IPA Kelas 4 SD. *Jurnal Ilmiah Pendidikan Profesi Guru*, *3*(September), 400–407. https://doi.org/http://dx.doi.org/10.23887/jippg.v3i3

Nugroho, A. S., & Mawardi, M. (2021). Pengembangan Instrumen Penilaian Sikap Tanggungjawab dalam Pembelajaran Tematik di Sekolah Dasar. *Jurnal Basicedu*, *5*(2), 808–817. https://doi.org/10.31004/basicedu.v5i2.825

Pomalato, S. W. D., Ismail, R., Amin Otoni Harefa, Imawan, O. R., Ningsi, B. A., & Wulandar, D. (2021). Instrument test development of mathematics skill on elementary school. *Mathematics and Statistics*, *9*(2), 106–111. https://doi.org/10.13189/ms.2021.090204

Pratiwi, U., & Fasha, E. F. (2015). Pengembangan Instrumen Penilaian Hots Berbasis Kurikulum 2013 Terhadap Sikap Disiplin. *Jurnal Penelitian Dan Pembelajaran IPA*, *1*(1), 123. https://doi.org/10.30870/jppi.v1i1.330

Saputra, A., Jampel, I. N., & Suwatra, I. I. W. (2021). Pengembangan Instrumen Penilaian Kompetensi Pengetahuan Ipa Siswa Sd Kelas V. *Journal for Lesson and Learning Studies*, *4*(1), 13–19. https://doi.org/10.23887/jlls.v4i1.29794

Sarwi, S., Baihaqi, M. A., & Ellianawati, E. (2021). Implementation of Project Based Learning Based on STEM Approach to Improve Students' Problems Solving Abilities. *Journal of Physics: Conference Series*, *1918*(5), 1–5.

https://doi.org/10.1088/1742-6596/1918/5/052049

Sarwi, S., Ellianawati, E., & Suliyanah. (2019). Grounding Physics and Its Learning for Building Global Wisdom in the 21st Century. *Journal of Physics: Conference Series*, *1171*(1). https://doi.org/10.1088/1742-6596/1171/1/012001

Utaminingsih, E. S., Ellianawati, E., Widiarti, N., Sumartiningsih, S., & Puspita, M. A. (2023). A Systematic Review : Digital Literacy for Strenghthening Character in Facing the Era of Society 5.0. *Research and Development Journal Of Education*, *9*(2), 638–647.

Utaminingsih, E. S., Intania, B. Y., Aida, H., Salama, M. S., & Sukma, I. M. (2024). Designing an Innovative Educational Framework for " How We Live and Grow " Using the 4D Model. *Journal of Educational Development 12*, *12*(1), 42–52.

Utaminingsih, E. S., Raharjo, T. J., & Ellianawati. (2023). Development of an E-module Based on STEAM on the Topic of Human Blood Circulation. *Jurnal Penelitian Pendidikan IPA*, *9*(7), 5333–5340. https://doi.org/10.29303/jppipa.v9i7.3719

Utaminingsih, E. S., Ramadhani, M. H., & Puspita, M. A. (2024). Fostering Superior Characters : Development of Innovative Instruments for Critical Reasoning and Independent Character in the Realm of Science Topic. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 4650–4661. https://doi.org/10.29303/jppipa.v10i8.7053

Utaminingsih, E. S., Sumartiningsih, S., & Wuriningsih, F. R. (2024). Development of science literacy competency evaluation instruments on human circulatory topic. *Thabiea : Journal of Natural Science Teaching*, *7*(1), 56–78.

Zuliani, D., Florentinus, T. S., & Ridlo, S. (2017). Pengembangan Instrumen Penilaian Karakter pada Siswa Kelas IV Sekolah Dasar. *Journal of Research and Educational Research Evaluation*, *6*(1), 46–54.