Development of Authentic Web Based Learning in Increasing Students' Motivation and Interest in Learning Natural Science

Abna Hidayati[1,*], Hendri Praherdiono[2], Afdhal Muttaqin[3], Andra Saputra[4], and Novra Arina[1]

[1]Curriculum and Educational Technology, Universitas Negeri Padang, Indonesia
[2]Educational Technology, Universitas Negeri Malang, Indonesia
[3]Physics, Universitas Andalas, Indonesia
[4]Craft Education, Institut Seni Indonesia Padangpanjang, Indonesia
Email: abnahidayati@fip.unp.ac.id (A.H.); henry.praherdhiono.fip@um.ac.id (H.P.); indonesiaallzputra@gmail.com (A.M.); andrasaputra@isi-padangpanjang.ac.id (A.S.); novra06@unp.ac.id (N.A.)
[*]Corresponding author

Manuscript received May 22, 2024; revised August 13, 2024; accepted September 11, 2024; published December 19, 2024

***Abstract*—This research aims to develop Authentic- Web based Learning in increasing students' motivation and interest in learning Natural Sciences. The research method used a quantitative survey method with respondents as many as 50 middle school students in the city of Padang, West Sumatra. Data collection uses: questionnaires, interviews, observation and documentation. The main instruments and data in this research are questionnaires on validity, practicality, motivation and student interest in learning. The research results show that the Web Learning used has been validated by experts for usability (92%), information quality (93%), service interaction (91%). The results are in the very valid category. Meanwhile, for practicality, information was obtained from users, namely ease of use, average score (91.8%), usability (91.7%), appearance (91.7% and presentation of material (90.1%). Meanwhile, the results of the motivation variable analysis The highest indicator is "MV10 (There are interesting activities in learning)" with an Outer Loadings value of 0.907, while for student interest in learning the highest indicator is "MT9 (Perseverance in learning)" with an Outer Loadings value of 0.958, meaning that this aspect of the indicator is dominant for students in applying Authentic Web Based Learning in Natural Sciences learning. Authentic Web Based Learning can be an alternative in increasing students' motivation and interest in learning science.**

***Keywords*—web learning, motivation, interest, natural science**

I. Introduction

Natural science is a phenomenon that occurs in nature or is produced by nature, especially the earth with a systematic method of observation [1, 2]. Natural science education is a multidimensional process of understanding science in order to get used to thinking critically about problems that arise in relation to natural developments [3–6]. Natural science education for a student is finding out about events that are and will occur in nature, especially in the surrounding environment [4, 5, 7]. The role of natural science education is very meaningful for the times to prepare for the future which is increasingly influenced by technological advances [1, 8]. Advances in science and technology in modern times are the basis for the emergence of an educational revolution [9]. The foundation of science education has the potential to have a strategic role in creating human resources capable of facing industrial challenges and globalization [10–12]. Science education is expected to be a means for students to learn about themselves and the environment, as well as prospects for further development in applying it in everyday life [13–15]. Students who have studied science are expected to have scientific skills and attitudes, be able to solve problems using scientific methods and be able to think critically and creatively. Science learning needs to be directed so that students are able to think critically and can foster student creativity in the learning process [16–20].

The phenomenon that the writer found in the process of learning natural science at a high school in Padang city, students are not interested in the lessons, they also don't like and tend to be afraid when the lessons begin. Finally, learning natural science in class becomes stiff, tense, scary, and it seems that the lesson is out of reach for students with lower-middle abilities. Some of the students even considered that natural science lessons were not important because they did not know what the benefits were for everyday life. Especially for students who are just in their first semester at junior high school, they are usually immediately surprised when they find natural science lessons full of formulas and calculations that make it difficult for students to do science questions, students also do not know what these formulas are used for in everyday life. This attitude affect students' motivation, making the learning become a burden for student, the inability of students to think critically, making students unable to be creative.

Based on the phenomena and problems that arise, it is necessary to increase students' motivation and interest in learning science in the process of learning science, because everything that starts with fun, willingness, and attention will produce something that is more optimal, as well as for learning science [21–24]. When students have great motivation and interest in natural science, the learning process will be fun, will make students think critically, creatively and will improve student learning outcomes [23–27].

Seeing the rapid development of science and technology can be a great opportunity to increase students' motivation and interest in learning natural science. The use of technology in the learning process in the current digitalization era will make it easier in the process of delivering science subject matter to students, one way to use this technology is by using Authentic Web learning in delivering science subject matter to students so that students' motivation and interest in learning in the science lessons will increase.

According to [28–30] Authentic Web learning, Authentic learning is learning designed to connect what students learn with everyday problems. Authentic learning includes

activities to assimilate new knowledge into the schemata structure of students' prior knowledge, concepts that are taught repeatedly and regularly and associated with new information, and concepts that are learned are always a larger part of "learning activities" that are directly related to students' minds with settings, activities, and social environment [12, 28, 31, 32]. The use of Authentic Web learning in the learning process can generate motivation and interest in student learning, and stimulate learning activities, as well as having a psychological influence on students. Authentic web-based learning leverages diverse online resources, provides scaffolded learning experiences, and uses real-time data and analytics to monitor and support student performance and integrates stronger contextual elements, such as adding real-world case studies, news articles, and videos that demonstrate practical applications of the scientific concepts being taught [32, 33]. These comprehensive elements make authentic web-based learning a holistic and effective educational approach, unlike other web learning. Authentic Web learning can also be useful for arousing learning enthusiasm, enabling students to study independently according to their interests and abilities, in Authentic web-based learning also provided asynchronous discussion platform and video conferencing. This will allow students to interact more effectively and develop better collaboration skills [33–35]. Authentic Web learning is a strategy or tool for conveying information through a set of images that are processed in such a way as to produce an interesting movement [32, 36].

Authentic Web learning is an innovative approach that is able to overcome various challenges in natural science education. Its uniqueness lies in its ability to integrate technology and real-world scenarios into the learning process, which is significantly different from traditional methods that tend to be passive. By linking learning materials to real-world phenomena, this approach helps students understand abstract concepts that are often difficult to apply in everyday life. In addition, authentic web-based learning can also increase student engagement and motivation, because it provides a relevant and challenging context, so that students become more interested and motivated to learn [34, 36].

The web technology used allows for more personalized learning, where students can learn at their own pace and style, making it more effective in helping students overcome learning difficulties, especially in understanding complex scientific concepts. Moreover, this approach supports the development of 21st century skills, such as critical thinking, collaboration, and digital literacy, which are very important in today's digital era, while preparing students to face future challenges better [32, 35].

II. Literature Review

In the context of authentic learning, constructivist theory finds particularly relevant and powerful application. Authentic learning seeks to create a learning environment rich in real-world contexts, encouraging students to construct knowledge through exploration, experimentation, and reflection on real-world problems. For example, in a science class, students might be asked to solve an environmental problem that exists around them, such as water pollution or climate change. Through these activities, students not only learn scientific concepts theoretically, but also apply them in relevant situations, deepening their understanding and making learning more meaningful [37, 38].

Vygotsky added a social dimension to constructivist theory with the concept of the "Zone of Proximal Development" (ZPD), which refers to the distance between what students can achieve independently and what they can achieve with the help of others, such as teachers or classmates. In authentic learning, social interaction and collaboration play a critical role in helping students reach their full potential. Students work together to solve problems, share understanding, and construct new knowledge. This not only enriches individual understanding but also facilitates the development of social and communication skills [37–40].

The application of constructivist theory in authentic-based learning is also seen in a teaching approach that is more flexible and responsive to students' needs. Teachers in this model act as facilitators who support and guide students through their learning process, rather than simply conveying information. They create challenging yet supportive learning situations, where students are encouraged to think critically, solve problems, and reflect on their own learning process.

Motivation to learn is an encouragement that makes behavior or attitude in students to a success in learning [41, 42]. Meanwhile, according to [43, 44] motivation is a change in energy within a person which is marked by a change in feeling and is preceded by a response to a goal. Motivation is the driving force that has become active [45, 46]. Motivation is a change in energy within a person which is marked by the appearance of "feeling" and is preceded by response to goals [43, 44]. In essence, motivation is a psychological condition that encourages someone to do something. In learning activities, motivation is needed, because someone who does not have motivation in learning will not be able to carry out learning activities. Some indicators of motivations in learning are:

1) There is a desire to succeed

This motivation arises within the students themselves, so that students have a strong desire and desire to learn without coercion.

The theory that supports the indicator of learning motivation "There is self-confidence" is the Self-Efficacy Theory put forward by Albert Bandura in 1977 [47–49]. This theory states that individual belief in their own abilities influences their motivation, behavior and achievement. According to Self Theory, individuals who have a high level of self-efficacy tend to be more motivated to take action and try to achieve goals. In the context of learning motivation, students who have high self-confidence will believe that they have sufficient ability to face difficult learning tasks, overcome challenges, and achieve good results [42, 50].

2) There is a drive and need for learning

The existence of a need in learning makes students more active in learning because students realize the importance of learning to meet these needs.

The theory that supports the indicator of learning motivation "There is a conducive learning environment" is Environmental Theory which emphasizes the important role of the environment in shaping and influencing individual

motivation and behavior [51]. This environmental theory sees the environment as a significant factor in shaping learning motivation. In this context, the indicator of learning motivation "The presence of a conducive learning environment" can be supported by various theories that emphasize the importance of a comfortable, structured and supportive environment in increasing student motivation. Adequate environment, pleasant atmosphere, good facilities, and positive interactions between students and teachers can provide additional encouragement for students to be more motivated in learning and actively participating in the learning process [51].

3) There are hopes and aspirations for the future

A student who has hopes and aspirations in the future will be even more active in learning so he wants to become an achiever in class, to become class champion.

The theory that supports the indicator of learning motivation "There are hopes and aspirations for the future" is the Goal Theory [43]. This theory emphasizes the important role of specific, challenging, and meaningful goals in motivating individuals to try and achieve the desired results. In this context, the indicator of learning motivation "There are hopes and aspirations for the future" can be supported by theories that emphasize the importance of specific goals, goal orientation, identity, and expectations in motivating students to study diligently in order to achieve the desired achievements and future aspirations [43].

4) There is an appreciation for learning

Students who receive awards for their achievements will feel happy. Moreover, the award is in the form of praise and prizes so that the student will be happier and become enthusiastic in learning.

Theories that support the indicator of learning motivation "There is an appreciation in learning" are the Reinforcement Theory and the Extrinsic Motivation Theory. In this context, the indicator of motivation to learn "There is appreciation in learning" can be supported by theories that emphasize the importance of positive reinforcement and extrinsic motivation. Rewards in the form of praise, recognition, or prizes will increase students' motivation, provide additional encouragement to learn, and create positive feelings towards their efforts and achievements in learning [51].

5) There are interesting activities in learning

In the learning process, if learning activities are created in an interesting way, students will be more happy, interested and enthusiastic in participating in learning.

The theory that supports the indicator of learning motivation "There are interesting activities in learning" is Cognitive Theory [46]. This theory emphasizes the importance of learning experiences that are interesting, meaningful, and involve students actively in the learning process. In this context, the indicator of learning motivation "There are interesting activities in learning" can be supported by theories that emphasize the importance of student involvement, diversity of intelligence, constructivism, and experience flow in the learning process. Interesting learning activities can generate interest, enthusiasm, and motivation of students to be actively involved in learning [23, 50, 51].

In addition to motivation, students' interest in learning is also a special concern in the world of education, especially in secondary schools. Interest is an internal component within the individual that is very influential on his actions. An individual will feel the need to do something or even explore something if there is interest in him [52]. Likewise, interest is a feeling of preference and a feeling of being attracted to something without anyone asking. Interest is basically the acceptance of a relationship between oneself and something outside oneself. The stronger or closer the relationship the greater the interest [53].

Several ways that can be done to generate interest are by: (1) Connecting the subject matter being taught with the needs of students; (2) Adjusting the subject matter to the experiences and abilities of students; (3) Using various learning models and strategies [54, 55].

The elements contained in interest are (1) Interest is a psychological symptom; (2) There is concentration of attention, feelings, and thoughts from the subject because they are interested; (3) There is a feeling of pleasure towards the object being targeted; (4) There is a will or tendency in the subject to carry out activities to achieve goals [56–58]. Thus the interest in learning can be characterized by: (a) a sense of pleasure and liking for the lesson; (b) attention in the teaching and learning process; (c) curiosity towards mathematics more than other disciplines; (d) persistence in studying; and (e) willingness to be more involved in various activities [54], [59].

III. Materials and Methods

A. Research Methods

The initial stage was the development of valid and practical Web Based Learning, then the application of web learning was carried out to analyze students' interests and motivation in learning science. The method used in this study was a survey. The survey is carried out by giving questionnaires to respondents, namely the first high school students who had been randomly selected from several schools that were research partners in the city of Padang, West Sumatra. Survey research was conducted to obtain respondents' views, opinions and perceptions regarding the use of Authentic Web learning in learning. With an overview of the Outer model construction in Fig. 1:

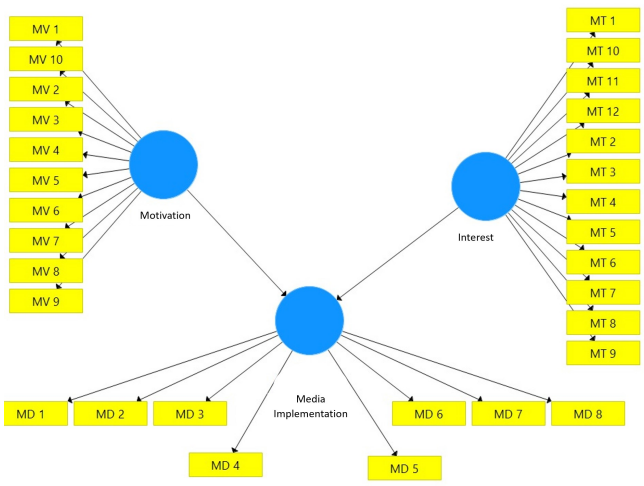

Fig. 1. The planned outer model construct.

B. Research Participants

Research participants were junior high school students who were taken from research partner schools in terms of accreditation or school ratings in the good category in the city of Padang, West Sumatra. Participants were selected from students who had received learning by using Authentic Web based learning in their learning process.

C. Research Instruments

The research instrument was a questionnaire consisting of two main variables, namely students' motivation and interest in learning. These two variables were obtained from the literature review which most dominantly influenced the use of the learning media used. The research variables consist of the following grids in Table 1 and Table 2:

Table 1. Learning motivation lattice

Indicator	Number of Items
There is a desire to succeed	2
There is a need for encouragement in learning	2
There is hope for the future	2
There is an appreciation in learning	2
There are interesting activities in learning	2

Table 2. Learning interest grid

Indicator	Number of Items
Enjoyment and love of learning	3
Attention in the teaching and learning process	2
Curiosity towards learning science	3
Perseverance in learning	2
Willingness to be more involved in various activities	2

D. Research Stages

The research was conducted in two stages, they are; 1) the preparation and 2) the implementation stages. The preparatory stage is carried out by coordinating with participants and developing research instruments. Instrument development is started by developing questions from a predetermined grid. Furthermore, the implementation stage was carried out by distributing questionnaires and making direct observations on students of the Junior High School in the city of Padang, West Sumatra to obtain supporting data. Questionnaires were distributed to be filled out by predetermined participants.

E. Data Analysis

The data were analyzed using SPSS and SmartPLS applications. The initial stage is to test the validity of the questionnaire to experts in their field. The validity results can be described as follows: Based on the results of testing the validity of the instrument, the results obtained for the validity of the student learning motivation instrument were 96% in the very valid category, then the results of the validity of the instrument for student learning interest were 95% in the very valid category. Furthermore, after being declared valid, the questionnaire that has been filled in by the participants will be processed with SPSS and SmartPLS to determine the factors that have the most influence on the specified variables.

IV. Result and Discussion

A. Result

1) Application of web based learning

Utilization of web based learning in learning has been implemented in natural science learning. Before conducting the survey, the researcher had observed the use of the learning web on the selected respondents. Authentic web-based learning, consists of various technological tools used to support the teaching and learning process effectively and interactively. Web-based learning, for example, is used as the main learning platform, allowing teachers to upload materials, assign assignments, and provide additional resources that students can access at any time. In addition, students use Google Forms or Microsoft Excel to collect and analyze data in their research projects, such as temperature change surveys or plant growth measurements, which are then presented using Microsoft PowerPoint. The integration of these technological tools not only enriches the student learning experience but also ensures that the learning process takes place dynamically, collaboratively, and is relevant to the real-world context.

Authentic web based learning is developed according to the flow of online learning as follows in Fig. 2.

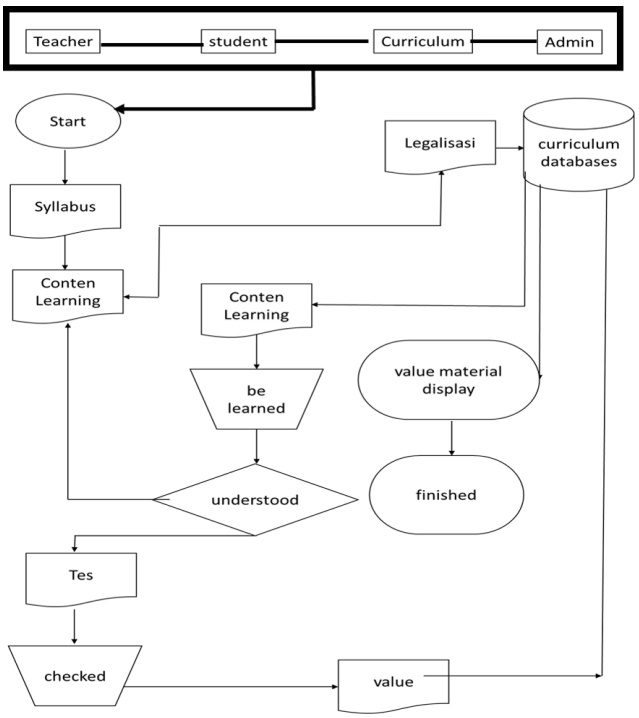

Fig. 2. Web development process of learning.

Based on the picture above, it can be seen that the learning web flow is developed on the website. This learning web user is intended for teachers and students, curriculum developers and learning admins. The essence of web-based learning is that there is a learning process with two approaches, namely independently and with the guidance of students.

The Web Learning used has been validated by experts for usability (92%), information quality (93%), service interaction (91%). The results are in the very valid category. As for practicality, information was obtained from users, namely the ease of use of the average score (91.8%), usefulness (91.7%), appearance (91.7% and presentation of material (90.1%). This means that the practicality test results are in the very practical category. The initial appearance of web learning that is used to analyze student motivation and interest in learning science can be seen in the Fig. 3–7:

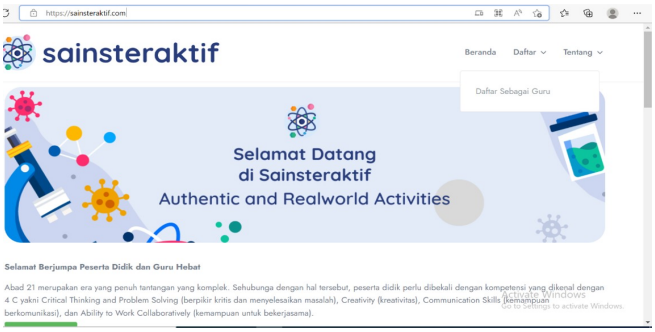

Fig. 3. Initial web learning appearance.

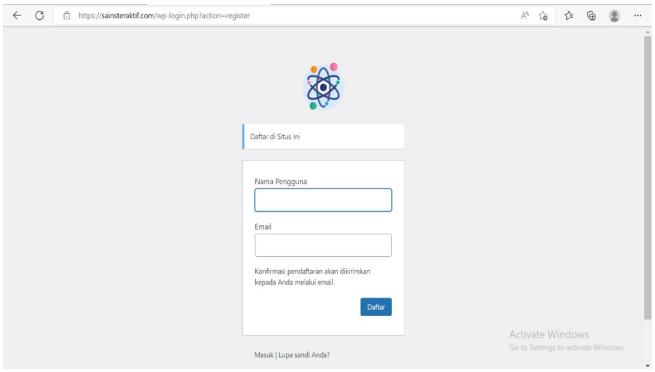

Fig. 4. User identity.

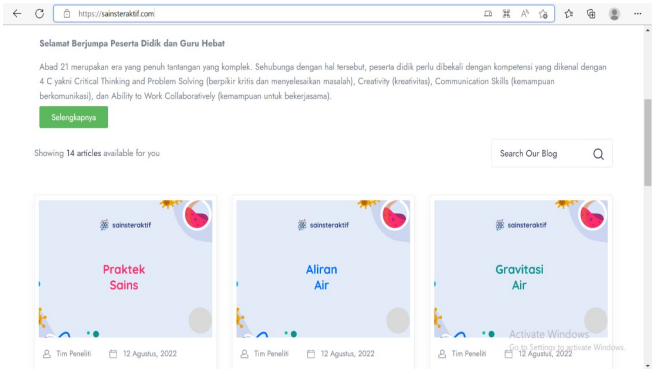

Fig. 5. Choice of learning activities.

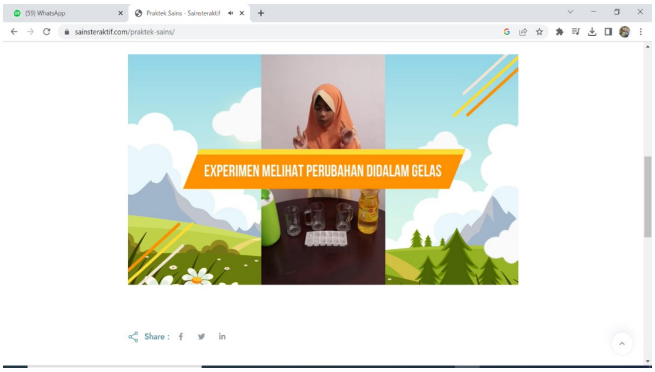

Fig. 6. Learning video.

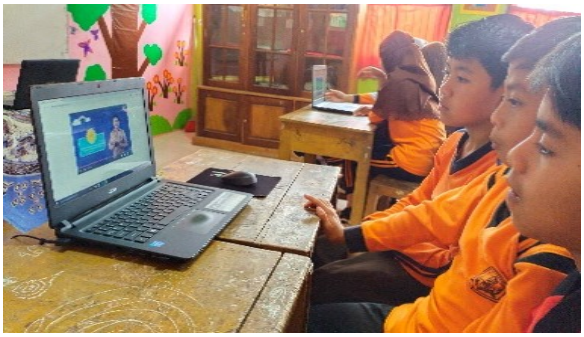

Fig. 7. Use of web learning by students.

2) Analysis of motivation and interest

After processing the data using SmartPLS, the initial Outer model results were obtained from the research in looking at the outer loadings of the item blocks that measure the model construct, the data is presented in Fig. 8.

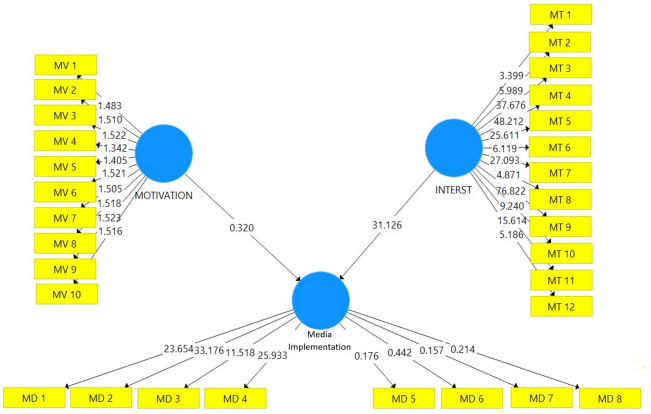

Fig. 8. Initial outer model results.

Based on Fig. 8, it is known that in Outer Loadings there are several items that are invalid because they have Outer Loadings below 0.5. Based on the picture above, it can be seen that the invalid items are MD 5, MD 6, MD 7, MD 8, so these items must be removed from the model. The results of the Outer Loadings of each variable can be seen in the following Table 3:

Table 3. Motivation

Variable	Items	Respondents	Outer Loadings	Results
Motivation	MV 1	50	0.805	Valid
	MV 2	50	0.887	Valid
	MV 3	50	0.865	Valid
	MV 4	50	0.783	Valid
	MV 5	50	0.860	Valid
	MV 6	50	0.838	Valid
	MV 7	50	0.792	Valid
	MV 8	50	0.730	Valid
	MV 9	50	0.795	Valid
	MV 10	50	0.907	Valid

The results of data processing on the motivational variable with SmartPLS are shown in Table 3. All items on the motivational variable are greater than 0.5 and are said to be quite high. These results indicate that the use of each of these items is stated to be able to measure motivation variables appropriately, the highest Outer Loading value is in the item (MV10 value 0.907) and the lowest is in the item (MV8 value 0.730).

The results of data processing on the motivation variable with SmartPLS are shown in Table 4. All items in the interest variable are greater than 0.5 and are said to be quite high. These results indicate that the use of each of these items is stated to be able to measure the interest variable appropriately, the highest Outer Loading value is in the item (MT9 value 0.958) and the lowest is in the item (MT1 value 0.505).

Table 4. Interest

Variable	Items	Respondents	Outer Loadings	Results
Interest	MT 1	50	0.505	Valid
	MT 2	50	0.680	Valid
	MT 3	50	0.943	Valid
	MT 4	50	0.944	Valid
	MT 5	50	0.918	Valid
	MT 6	50	0.737	Valid
	MT 7	50	0.921	Valid
	MT 8	50	0.603	Valid
	MT 9	50	0.958	Valid
	MT 10	50	0.747	Valid
	MT 11	50	0.809	Valid
	MT 12	50	0.631	Valid

The results of data processing on the variable Implementation of Authentic Web learning Media with SmartPLS are shown in Table 5, that not all items in the variable are valid, the highest Outer Loading value is in the item (MD2 value 0.906) and the lowest is in the item (MD8 value -0.045), invalid item values will be excluded from variable measurement. The results of the model measurement path from this study after several items from invalid variables were removed, the results were as shown in Fig. 9.

Table 5. Outer loadings media implementation

Variable	Items	Respondents	Outer Loadings	Results
Implementation Media	MD 1	50	0.884	Valid
	MD 2	50	0.906	Valid
	MD 3	50	0.830	Valid
	MD 4	50	0.895	Valid
	MD 5	50	0.040	Not Valid
	MD 6	50	0.093	Not Valid
	MD 7	50	0.035	Not Valid
	MD 8	50	-0.045	Not Valid

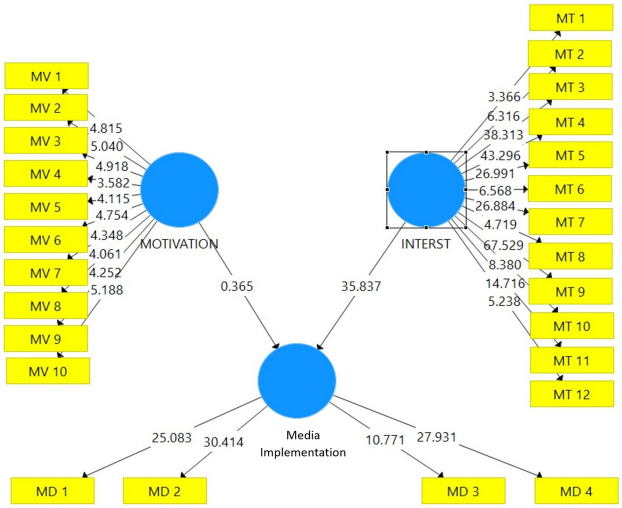

Fig. 9. Outer research model results.

All indicators have a positive relationship to each latent variable and the loading factor for each item is greater than 0.5 and is said to be quite high. These results indicate that the use of each of these items is stated to be able to measure latent variables appropriately. The recommended minimum AVE value measurement is 0.50, the results of the calculation of the AVE output obtained can be seen in the Table 6:

Table 6. Path coefficients

Variable	Cronbach's Alpha	Rho_A	Composite Reliability	Average Variance Extrad (AVE)
Interest	0.943	0.958	0.953	0.635
Media Implementation	0.903	0.912	0.932	0.774
motivation	0.952	0.994	0.956	0.686

Visually, the AVE value can be seen from the histogram graphic:

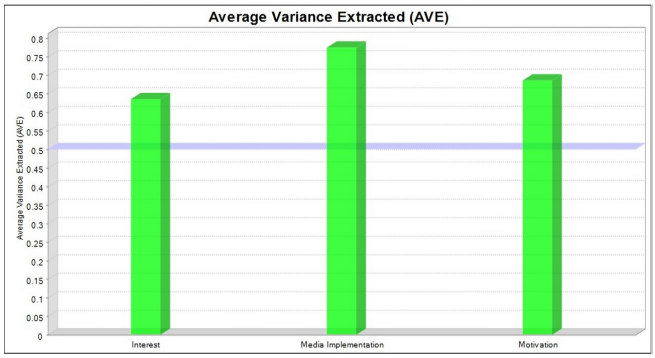

Fig. 10. AVE outputs.

From Table 6 and Fig. 10 above it can be seen that the AVE output obtained by each latent variable is greater than 0.5, which indicates that each latent variable is said to be valid.

Furthermore, data processing from Path Coefficients is carried out using SmartPLS, the following results are obtained:

Table 7. Path coefficients

Variabel	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values
Interest –> Media	0,953	0.956	0.027	35.733	0.000
Motivation –> Media	0.019	0.017	0.053	0.362	0.718

Based on the data presented in Table 7, it can be concluded that in the application of Authentic Web learning in the science learning process for high school students, that the interest variable has a significant effect on the application of Authentic Web learning, while motivation does not have a significant effect on the application of Authentic Web learning.

B. Discussion Result

Authentic Web learning is a learning method by utilizing electronic devices online or online. Authentic Web learning allows the teaching and learning process to be carried out by anyone, anytime and anywhere [56, 57]. Like the principles of other online activities, distance and time are no longer a barrier to carrying out activities, including learning in this case. Authentic Web learning itself is now widely used by almost all schools and colleges. Apart from changing times to become completely digital, it also makes it easier to understand material. One of the main advantages of Authentic Web learning is the visualization of objects that appear more real and can be said to be closer to their original form [60–62].

Another advantage of Authentic Web learning is its ability

to create and visualize difficult scenes such as the effects of collapsed buildings, earthquakes, landslides, and others [63]. The use of Authentic Web learning in the learning process is very helpful for teachers when conveying subject matter that requires direct visual objects. Authentic Web learning can be implemented for children to learn because during their development period children have a tendency to imitate and observe, making it easier for children to receive material [9], [64, 65]. In addition, children are also interested in cartoons or animations that display colorful images and sounds that can add to the atmosphere of the animation [66].

As for the results of the research that has been done in the application of Authentic Web learning in natural science learning, it is found that there is an influence from students' interest and learning motivation in the application of Authentic Web learning in science learning, with details of the research results that aspects of student learning motivation t-count 0.362 > *t* - table 0.019 means that the application of Authentic Web learning has an effect on students' learning motivation in natural science learning because the value is higher, while for student learning interest t - count 35,733 > t - table 0.953 means that the application of Authentic Web learning has a significant effect on student learning interest. In line with the previous research, it is found that Authentic Web learning, which is developed in a valid and practical manner, make it easier for students to understand the delivered subject matter. In the same way, Authentic Web learning facilitate the learning process which displays detailed visual objects for teachers [53]. Authentic Web learning can be used as an alternative to problems in the field of education, either as an addition, complement or substitute for existing learning activities [67].

As for the items in the student learning motivation variable, the highest score is in item (M10 with an Outer Loadings value of 0.907) item M10 comes from the indicator. There are interesting activities in learning, meaning that this indicator aspect becomes dominant for students in implementing Authentic Web learning in science learning. Whereas the lowest item is item (M8 with an Outer Loadings value of 0.730) item M8 comes from the indicator means that there is appreciation in learning, meaning that this aspect of the indicator does not really affect the variable of student learning motivation compared to other indicators. In line with the previous research results by [25, 68] Learning will be successful if the motivation given by the teacher is given exactly according to what students need. Student learning motivation will increase when the teacher is able to provide fun activities in the learning process, a fun learning process will attract students' attention, so students will study seriously. The existence of interesting activities in the learning process will bring out the motivation of student learning itself and can improve student learning outcomes [27, 69].

As for the items in the student learning interest variable, the highest score is in the item (MT9 with an Outer Loadings value of 0.958). The MT9 item comes from the Perseverance indicator in learning, meaning that this aspect of the indicator becomes dominant for students in applying Authentic Web learning to science learning. Whereas the lowest item is item (MT1 with an Outer Loadings value of 0.505) item M1 comes from the indicator means that there is appreciation in learning, this aspect of the indicator has no significant effect on the variable of student interest in applying Authentic Web learning to science learning. Study persistence is a serious attitude in learning to achieve an understanding of the material being studied [10, 70]. This learning persistence will later affect student interest and learning outcomes. Perseverance in learning is one of the important things because with persistence students are able to generate motivation in themselves to strive to achieve the goals they want [45, 71]. Based on the existing discussion, the effectiveness of students' motivation and interest in learning can be increased by using authentic web-based learning in the learning process.

V. Conclusion

Based on the results and discussion it can be concluded that: 1) there is a significant influence from the application of Authentic Web learning in natural science learning on students' learning interest with the indicator "Persistence in the learning process" which becomes dominant in the variable of student learning interest, and 2) for the learning motivation variable students in the application of Authentic Web learning in natural science learning the dominant indicator on the student motivation variable is the indicator "There are interesting activities in learning". Furthermore, several key elements in learning science in secondary schools, including using videos, images and graphics, choosing real and familiar material, which can support the learning process. It is suggested to teachers or learning designers to optimize and utilize authentic web-based learning in learning, especially in science learning, as well as utilizing online materials that can be accessed, and learning applications on the internet, as supporting factors for learning effectiveness. As for future researchers, I hope the results of this research can be a source of reference or reference material in developing learning media.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

A.H. designed and developed the main idea of the study, developed the conceptual framework, and conducted the main data analysis. H.P. contributed to the collection of field data, validation of research instruments, and was involved in the interpretation of results and editing of draft articles. A..) managed the literature review and ensured the appropriateness of the theories used in the study, and compiled the references and bibliography. A.S. was responsible for the research methodology and statistical analysis, and provided significant input in the preparation of the methods and results sections. N.A. conducted a critical review of the entire article, provided suggestions for improvement, and was responsible for coordination with the journal in the submission and revision process. All authors had approved the final version.

Acknowledgment

The authors are grateful to the Institute for Research and

Community Service (LP2M), Universitas Negeri Padang, for funding this research under contract number 1681/UN35.13/LT/2022.

REFERENCES

[1] M. Siponen and T. Klaavuniemi, "On natural science beliefs in IS: Short comments to commentators," *J. Inf. Technol.*, vol. 36, no. 1, pp. 90–92, 2021. doi: 10.1177/0268396220948252

[2] L. Weise and G. Wilz, "Immediate effects of individualized music listening on behavioral and psychological symptoms of dementia: A randomized controlled trial," *Int. J. Geriatr. Psychiatry*, no. June 2022, pp. 1–9, 2023. doi: 10.1002/gps.5893

[3] S. Sinyanyuri, E. Utomo, M. S. Sumantri, and V. Iasha, "Literasi Sains dan Asesmen Kompetensi Minimum (AKM): Integrasi Bahasa dalam Pendidikan Sains," *J. Basicedu*, vol. 6, no. 1, pp. 1331–1340, 2022. doi: 10.31004/basicedu.v6i1.2286

[4] M. Sari, "Usaha Mengatasi Problematika Pendidikan Sains Di Sekolah Dan Perguruan Tinggi," *Al-Ta lim J.*, vol. 19, no. 1, pp. 74–86, 2012. doi: 10.15548/jt.v19i1.9

[5] Faisal and S. N. Martin, "Science education in Indonesia: Past, present, and future," *Asia-Pacific Sci. Educ.*, vol. 5, no. 1, pp. 1–29, 2019. doi: 10.1186/s41029-019-0032-0

[6] Y. Cho, "Designing immersive virtual reality simulation for environmental science education," *Electronics*, vol. 12, no. 3, 2023.

[7] G. Nugroho, "Analisis motivasi belajar siswa pada pembelajaran IPA di SDN 16/ii Sepunggur," *Integr. Sci. Educ. J.*, vol. 1, no. 2, pp. 67–71, 2020. doi: 10.37251/isej.v1i2.67

[8] M. Maison, D. A. Kurniawan, and N. I. S. Pratiwi, "Pendidikan sains di sekolah menengah pertama perkotaan: Bagaimana sikap dan keaktifan belajar siswa terhadap sains?" *J. Inov. Pendidik. IPA*, vol. 6, no. 2, pp. 135–145, 2020. doi: 10.21831/jipi.v6i2.32425

[9] V. Thi *et al.*, "The current state of virtual reality and augmented reality adoption in Vietnamese education : A teacher's perspective on teaching natural sciences," *Int. J. Inf. Educ. Technol.*, vol. 14, no. 3, 2024. doi: 10.18178/ijiet.2024.14.3.2068

[10] B. Situmorang and M. L. Dalimunthe, "Analysis of the influence of human resources competence, motivation, work environment and the role of leadership on the performance of asset steward in the organization of regional devices serdang bedagai regency," *Int. J. Public Budgeting, Account. Financ.*, vol. 2, no. 1, pp. 1–12, 2015.

[11] C. Polekar and G. U. Karadkar, "Development of learning resource for prevention of iron deficiency anaemia for women employees from selected institutions of navi mumbai," *J. Pharm. Negat. Results*, vol. 13, no. 9, pp. 5384–5391, 2022. doi: 10.47750/pnr.2022.13.S09.658

[12] L. Yuliati, "Authentic learning berbasis inquiry dalam program stem terhadap literasi saintifik siswa berdasarkan tingkatan kemampuan pemecahan masalah siswa," *J. Pendidik. Teor. Penelitian, dan Pengemb.*, vol. 4, no. 3, pp. 1024–1029, 2019.

[13] R. R. Ahya, "The caring attitudes for environment of lanting householders as a learning resource on social studies," *Innov. Soc. Stud. J.*, vol. 2, no. 3, pp. 66–74, 2020.

[14] M. Karpudewan and C. K. Meng, "The effects of classroom learning environment and laboratory learning environment on the attitude towards learning science in the 21st-century science lessons," *Malaysian J. Learn. Instr.*, vol. 272, no. Specialissue, pp. 25–45, 2017. doi: 10.32890/mjli.2017.7795

[15] R. M. Tan, R. T. Yangco, and E. N. Que, "Students' conceptual understanding and science process skills in an inquiry-based flipped classroom environment," *Malaysian J. Learn. Instr.*, vol. 17, no. 1, pp. 159–184, 2020. doi: 10.32890/mjli2020.17.1.7

[16] G. C. Das, "Pedagogical knowledge in mathematics : A challenge of mathematics teachers in secondary schools," *Int. J. Inf. Educ. Technol.*, vol. 5, no. 10, pp. 789–793, 2015. doi: 10.7763/IJIET.2015.V5.612

[17] N. Ishartono, S. Hajar, and A. Razak, "Instruments for measuring pre-service mathematics teachers TPACK skill in integrating technology : A systematic literature review," *Int. J. Inf. Educ. Technol.*, vol. 13, no. 8, pp. 1177–1191, 2023. doi: 10.18178/ijiet.2023.13.8.1919

[18] H. Herwin, R. Nurhayati, and S. C. Dahalan, "Mobile assessment to improve learning motivation of elementary school students in online learning," *Int. J. Inf. Educ. Technol.*, vol. 12, no. 5, pp. 436–442, 2022. doi: 10.18178/ijiet.2022.12.5.1638

[19] Z. Sharlovych, L. Vilchynska, S. Danylyuk, B. Huba, and H. Zadilska, "Digital technologies as a means of improving the efficiency of higher education," *Int. J. Inf. Educ. Technol.*, vol. 13, no. 8, pp. 1214–1221, 2023. doi: 10.18178/ijiet.2023.13.8.1923

[20] Y. E. Chieng and C. K. Tan, "A sequential explanatory investigation of TPACK : Malaysian science teachers "survey and perspective," *Int. J. Inf. Educ. Technol.*, vol. 11, no. 5, pp. 235–241, 2021. doi: 10.18178/ijiet.2021.11.5.1517

[21] F. Camelia and P. A. Islam, "Analisis landasan ilmu pengetahuan dan teknologi," *Susunan Artik. Pendidik.*, vol. 5, no. 1, 2020.

[22] M. Rezky and N. Handy, "The utilization of environment on kambang island as a learning resource on social studies : A literature study," *Kalimantan Soc. Stud. J.*, vol. 5, no. October, pp. 85–92, 2023.

[23] Y. D. Puspitarini and M. Hanif, "Using Learning media to increase learning motivation in elementary school," *Anatol. J. Educ.*, vol. 4, no. 2, pp. 53–60, 2019.

[24] V. I. Febriani, A. Kasim, and I. N. Kundera, "Development of weblog as learning resource of coordination system for student in senior high school," *J. Ris. Pendidik. MIPA*, vol. 6, no. December, pp. 109–115, 2022. doi: 10.22487/j25490192.2022.v6.i2.pp.109-115

[25] A. S. Purnama, "Influence of interest and motivation to learn about student learning outcomes at STAB Dharma Widya in Tangerang city," *J. Dhammavicaya*, vol. 5, no. 1, pp. 30–45, 2021.

[26] O. Amtu, K. Makulua, J. Matital, and C. M. Pattiruhu, "Improving student learning outcomes through school culture, work motivation and teacher performance," *Int. J. Instr.*, vol. 13, no. 4, pp. 885–902, 2020. doi: 10.29333/iji.2020.13454a

[27] S. Kliachko, "Research papers the significance of digital pedagogy: Teachers' perceptions and the factors influencing their," *I-Manager's J. Educ. Technol.*, vol. 11, no. 3, pp. 22–33, 2014.

[28] J. Herrington, "Authentic learning on the web: Guidelines for course design," *Research Online Is the Open Access Institutional Repository for the University of Wollongong. For Further Information Contact Manager*, 2014. doi: 10.4018/978-1-59904-325-8.ch003

[29] Ambiyar, R. Efendi, Y. Irawati, Waskito, and Suryadimal, "Effectiveness e-authentic assessment in computer network course," *J. Phys. Conf. Ser.*, vol. 1481, no. 1, 2020. doi: 10.1088/1742-6596/1481/1/012131

[30] A. Bentri and A. Hidayati, "Improving digital pedagogy competence through in- service training for elementary school teacher," in *Proc. International Conference on Research and Learning of Physics*, 2023, pp. 1–8. doi: 10.1088/1742-6596/2582/1/012064

[31] M. N. A. Rashid, F. M. Hamzah, M. N. A. Rahman, and M. S. Rasul, "Model authentic learning bagi program kejuruteraan politeknik malaysia: Aplikasi interpretive structural modelling," *Malaysian J. Learn. Instr.*, vol. 13, no. 2, pp. 227–251, 2016. doi: 10.32890/mjli2016.13.2.9

[32] A. Hidayati, A. Bentri, and Eldarni, "Supporting factors for the implementation of mobile learning for elementary school students using an authentic approach and real-world activities," *Int. J. Interact. Mob. Technol.*, vol. 16, no. 5, pp. 107–120, 2022. doi: 10.3991/ijim.v16i05.26551

[33] X. Diao, Q. Zeng, H. Duan, Z. Song, and C. Zhou, "Personalized learning resource recommendation based on course ontology and cognitive ability," *J. Comput.*, vol. 32, no. 2, pp. 149–163, 2021. doi: 10.3966/199115992021043202013

[34] A. D. Astiti, R. C. Murti, and M. Hakiki, "Development of web-based digital libraries as learning resource facilities in elementary schools Pengembangan perpustakaan digital berbasis website sebagai fasilitas sumber belajar di sekolah dasar," *J. Kaji. Inf. Perpust.*, vol. 11, no. 1, pp. 147–160, 2023.

[35] T. L. S. Kim, "Science epistemological beliefs of form four students and their science achievement using web-based learning," *Malaysian J. Learn. Instr.*, vol. 3, pp. 33–52, 2006. doi: 10.32890/mjli.3.2006.7582

[36] A. Saputra, N. Gistituati, A. Bentri, I. Aziz, and A. Hidayati, "Analysis of teacher barriers in the implementation of Niversitas Negeri Padang, Sumatra Barat , Indonesia," *DE_JOURNAL (Dharmas Educ. Journal)*, vol. 5, no. 1, pp. 50–57, 2024.

[37] H. Huang and S. Liaw, "An analysis of learners' intentions toward virtual reality learning based on constructivist and technology acceptance approaches," *Int. Rev. Res. Open Distrib. Learn.*, vol. 19, no. 1, 2018.

[38] M. C. Johnson-glenberg, L. Birchfield, David A Tolentino, and T. Koziupa, "Collaborative embodied learning in mixed reality motion-capture environments: Two science studies," *J. Educ. Psychol.*, vol. 106, no. 1, pp. 86–104, 2014. doi: 10.1037/a0034008

[39] C. Dunleavy and M. Dede, "Augmented reality teaching and learning," *Handbook of Research on Educational Communications and Technology*, 2014, pp. 735–745. doi: 10.1007/978-1-4614-3185-5_59

[40] A. Marougkas, C. Troussas, A. Krouska, and C. Sgouropoulou, *Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade*, 2023.

[41] P. G. Altbach and J. Knight, "The internationalization of higher education: Motivations and realities," *J. Stud. Int. Educ.*, vol. 11, no. 3–4, pp. 290–305, 2007. doi: 10.1177/1028315307303542
[42] I. Ismail, R. M. Idrus, and T. Gunasegaran, "Motivation, psychology and language effect on mobile learning in Universiti Sains Malaysia," *Int. J. Interact. Mob. Technol.*, vol. 4, no. 4, pp. 31–36, 2010. doi: 10.3991/ijim.v4i4.1408
[43] P. Reilly, "The development of student motivation to learn english at a university in Mexico," *Int. J. Instr.*, vol. 13, no. 3, pp. 401–416, 2020. doi: 10.29333/iji.2020.13328a
[44] R. Efendi, A. Putra, G. Hasibuan, and P. S. Siregar, "Canva application-based learning media on motivation and learning outcomes," *Int. J. Elem. Educ.*, vol. 7, no. 2, pp. 342–352, 2023.
[45] F. Hardiansyah, M. Misbahudholam, and A. Rasia, "Enhancing students' learning motivation through changing seats in primary school," *ejournal.upi.edu*, vol. 9, no. 1, pp. 253–268, 2022. doi: 10.53400/mimbar-sd.v9i1.43002
[46] N. Obiosa, "Effects of students' motivation and engagement on students' satisfaction in a lecture: Empirical analysis," *Int. J. Instr.*, vol. 13, no. 3, pp. 861–876, 2020. doi: 10.29333/iji.2020.13357a
[47] I. G. Budasi, N. M. Ratminingsih, K. Agustini, and M. Y. Risadi, "Power point game, motivation, achievement: The impact and students' perception," *Int. J. Instr.*, vol. 13, no. 4, pp. 509–522, 2020. doi: 10.29333/iji.2020.13432a
[48] J. A. Colquitt, J. A. Lepine, and R. A. Noe, "Toward an integrative theory of training motivation: A meta-analytic path analysis of 20 years of research," vol. 85, no. 5, pp. 678–707, 2000. doi: 10.1037//0021-9010.g5.5.678
[49] D. Fortus and I. Touitou, "Changes to students' motivation to learn science," *Discip. Interdiscip. Sci. Educ. Res.*, vol. 3, no. 1, pp. 1–14, 2021. doi: 10.1186/s43031-020-00029-0
[50] R. Niswaty, S. Rusbiati, R. Salam, U. N. Makassar, J. A. P. Pettarani, and K. Unm, "The influence of teacher's reinforcement for students motivation," in *Proc. the 1st International Conference on Education, Science, Art and Technology*, 2017, pp. 148–153.
[51] C. C. Tsai, "The effects of augmented reality to motivation and performance in EFL vocabulary learning," *Int. J. Instr.*, vol. 13, no. 4, pp. 987–1000, 2020. doi: 10.29333/iji.2020.13460a
[52] R. Thahir, N. Magfirah, and A. Anisa, "Hubungan antara high order thinking skills dan kemampuan literasi sains mahasiswa pendidikan biologi," *Biodik*, vol. 7, no. 3, pp. 105–113, 2021. doi: 10.22437/bio.v7i3.14386
[53] A. Febliza, Z. Afdal, and J. Copriady, "Improving students' critical thinking skills: is interactive video and interactive web module beneficial?" *Int. J. Interact. Mob. Technol.*, vol. 17, no. 3, pp. 70–86, 2023. doi: 10.3991/ijim.v17i03.34699
[54] N. Balta, "Education sciences STEM career interest of kazakhstani middle and high school students," *Educ. Sci.*, vol. 12, no. 397, pp. 1–17, 2022. doi: https:// doi.org/10.3390/educsci12060397
[55] S. Høgheim, E. S. Jenssen, and R. A. Federici, "Do lectures matter? Exploring students' situational interest in two learning arenas in teacher education," *Scand. J. Educ. Res.*, pp. 1–14, 2022. doi: 10.1080/00313831.2022.2115131
[56] I. P. M. Dewantara, I. N. Suandi, I. W. Rasna, and I. B. Putrayasa, "Cultivating students' interest and positive attitudes towards Indonesian language through phenomenon-text-based information literacy learning," *Int. J. Instr.*, vol. 12, no. 2, pp. 147–162, 2019. doi: 10.29333/iji.2019.12210a
[57] I. G. Smarandache *et al.*, "Students' approach to learning: Evidence regarding the importance of the interest-to-effort ratio," *High. Educ. Res. Dev.*, vol. 41, no. 2, pp. 546–561, 2022. doi: 10.1080/07294360.2020.1865283
[58] S. Tatiana, J. Hanna, M. Kristiina, and P. Jouni, "The changes in lower secondary school students' interest during collaborative learning the changes in lower secondary school students' interest during collaborative learning," *Scand. J. Educ. Res.*, 2022. doi: 10.1080/00313831.2021.1958377
[59] A. Bentri and A. Hidayati, "Factors supporting digital pedagogical competence of primary education teachers in Indonesia," *Front. Educ.*, no. November, pp. 1–9, 2022. doi: 10.3389/feduc.2022.929191
[60] R. M. R. Hussain and K. K. Al Saadi, "Students as designers of e-book for authentic assessment," *Malaysian J. Learn. Instr.*, vol. 16, no. 1, pp. 23–48, 2019. doi: 10.32890/mjli2019.16.1.2
[61] P. Cannon, L. Lumsden, V. Wass, and P. Cannon, "An innovative and authentic way of learning how to consult remotely in response to the COVID-19 pandemic," *Educ. Prim. Care*, vol. 33, no. 1, pp. 53–58, 2022. doi: 10.1080/14739879.2021.1920476
[62] F. Chen, Y. Leng, J. Ge, D. Wang, C. Li, and B. Chen, "Effectiveness of virtual reality in nursing education: Corresponding author ," *J. Med. INTERNET Res.*, vol. 22, no. 4, pp. 1–13, 2020. doi: 10.2196/18290
[63] A. Hidayati, A. Bentri, and N. Arina, "Improving science learning competence through advance organizer model innovation based on authentic and real worlds activities for elementary school student Improving science learning competence through advance organizer model innovation based on authenti," in *Proc. International Conference on Research and Learning of Physics*, 2022, pp. 1–5. doi: 10.1088/1742-6596/2582/1/012049
[64] L. Hsu and Y. Chen, "Teachers' knowledge and competence in the digital age : Descriptive research within the TPACK framework," *Int. J. Inf. Educ. Technol.*, vol. 8, no. 6, pp. 6–9, 2018. doi: 10.18178/ijiet.2018.8.6.1081
[65] S. Dangprasert, "The development of a learning activity model for promoting digital technology and digital content development skills," *Int. J. Inf. Educ. Technol.*, vol. 13, no. 8, pp. 1242–1250, 2023. doi: 10.18178/ijiet.2023.13.8.1926
[66] R. Ghnemat, A. Shaout, and A. M. Al-sowi, "Higher education transformation for artificial intelligence revolution: Transformation framework," *Int. J. Emerg. Technol. Learn.*, vol. 1, no. 19, pp. 224–241, 2022.
[67] K. Kummen and B. D. Hodgins, *Learning Collectives With / In Sites of Practice : Beyond Training and Professional Development*, vol. 44, no. 1, pp. 111–122, 2019.
[68] T. Mayasari, "Integrasi budaya Indonesia dengan pendidikan sains," *Semin. Nas. Pendidik. Fis.*, no. 2010, pp. 12–13, 2017.
[69] R. B. Nicoleta Sămărescu, "Artificial intelligence in education: Next-gen teacher perspectives," *Amfiteatru Econ. J.*, vol. 26, no. 65, pp. 145–161, 2024.
[70] A. M. J. Sojanah, Suwatno, and Kodri, "Factors affecting teachers' technological pedagogical and content knowledge (a survey on economics teacher knowledge)," *Cakrawala Pendidik.*, vol. 40, no. 1, pp. 1–16, 2021. doi: 10.21831/cp.v40i1.31035
[71] S. Sutarto, D. P. Sari, and I. Fathurrochman, "Teacher strategies in online learning to increase students ' in terest in learning during COVID-19 pandemic," *Indones. Inst. Couns. Educ. Ther.*, vol. 8, no. 3, pp. 129–137, 2020.