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Artificial Intelligence-Based Snakes and Ladders Game Media to Improve the Learning Outcome of Elementary School Students

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ABSTRAK

Kurangnya pengamalan nilai-nilai pancasila pada siswa sekolah dasar berdampak pada kompetensi dan karakter siswa yang rendah. Penelitian ini bertujuan untuk mengembangkan media permainan ular tangga berbasis AI untuk meningkatkan hasil belajar siswa pada materi meneladani perilaku Pancasila mata pelajaran Pendidikan Pancasila. Jenis penelitian ini yaitu penelitian pengembangan (R&D). Model yang digunakan dalam mengembangkan media yaitu ADDIE. Subjek penelitian yaitu ahli media dan ahli materi pelajaran. Uji coba produk dilakukan pada kelompok kecil dengan diambil sampel sebanyak 28 siswa. Pada tahapan uji pemakaian dilaksankan oleh seluruh siswa kelas V SD Metode yang digunakan dalam mengumpulkan data yaitu observasi, wawancara, studi pustaka, dan tes. Instrumen pengumpulan data berupa lembar kuesioner dan soal tes. Teknik ynag digunakan untuk menganalisis data yaitu analisis deskriptif kualitatif, kuantitatif, dan statistik inferensial. Hasil penelitian yaitu hasil uji kelayakan produk didasarkan pada hasil validasi ahli media 87,5% dan ahli materi sebesar 85%. Uji kepraktisan produk didasarkan pada penilaian Angket respon guru sebesar 87,5% dan respon siswa sebesar 84%. Uji keefetifan didasarkan pada hasil uji T-test menunjukan adanya pengaruh media permainan berbasis ular tangga.hasil uji N-gain menunjukan terjadi peningkatkan hasil belajar. Disimpulkan bahwa media permainan ular tangga berbasis AI dapat meningkatkan hasil belajar siswa sekolah dasar.

ABSTRACT

The lack of practice of Pancasila values among elementary school students impacts students' low competency and character. This research aims to develop an AI-based snakes and ladders game media to improve student learning outcomes in material that emulates Pancasila behavior in Pancasila Education subjects. This type of research is development research (R&D). The model used in developing media is ADDIE. The research subjects are media experts and subject matter experts. Product trials were conducted in small groups with a sample of 28 students. At the usage test stage, it was carried out by all fifth-grade elementary school students. The methods used to collect data were observation, interviews, literature studies, and tests. The data collection instruments are questionnaires and test questions. The techniques used to analyze data are qualitative descriptive analysis and quantitative and inferential statistics. The research results, namely the product feasibility test results, are based on the validation results of media experts at 87.5% and material experts at 85%. The product practicality test was based on the teacher response questionnaire assessment of 87.5% and student response of 84%. The effectiveness test is based on the T-test results showing the influence of snakes and ladders-based game media. The results of the N-gain test show an increase in learning outcomes. It was concluded that the AI-based Snakes and Ladders game media can improve the learning outcomes of elementary school students.

1. INTRODUCTION

Education is essential because it is one way of fulfilling human needs. Through education, humans can hone intellectual and spiritual qualities and contribute to the nation's and state's sustainable development (Septian et al., 2020; Verawati et al., 2020). Education is one way a person can develop all his potential through learning activities obtained during education (Dewa et al., 2020; Mustoip et al., 2023).

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Education is a bridge to developing human potential through learning (Nahdi & Jatisunda, 2020; Putera et al., 2024). It is hoped that the potential of each student can develop well by the norms that apply in society and are expected to be beneficial for the country. Therefore, humans must obtain education throughout their lives; without education, a person cannot develop and keep up with the times well (Khairunnisa & Apoko, 2023; Sukmanasa et al., 2023). The curriculum is one of the most critical components of education. Educational developments influence the curriculum. The curriculum is the basic framework for implementing learning in educational units (Andari, 2022; Febriyanti & Sulistyawati, 2024). The curriculum covers various aspects, including subjects, learning systems, and techniques for implementing student assessments (Febriyanti & Sulistyawati, 2024; Mahmudah et al., 2023).

Curriculum transitions impact changes in the order and concept of learning. One example of the changes is that the PPKN or Citizenship Education subject has changed to Pancasila Education (Apriliani et al., 2021; Selfi et al., 2021). Pancasila education aims to direct students' moral attention, hoping that Pancasila's morals can be realized in everyday life. The expected behavior of Pancasila in learning activities is to radiate devotion to God Almighty, who consists of various religious, cultural, and diverse interest groups (Fildza et al., 2023; Nurmalisa, 2018). Second, behavior that supports democracy prioritizes collective interests above individual and group interests to realize social justice for all Indonesian people (Lubis & Najicha, 2022; Rahayuningsih, 2021). This behavior is the primary reference in implementing Pancasila education learning as a form of implementing Pancasila principles in schools (Basri et al., 2021; Utari & Afendi, 2022).

However, the current problem is the lack of practice of Pancasila values among elementary school students. This is supported by previous research findings, which state that many students still have poor character (Apriliani et al., 2021; Hidayah & Suyitno, 2021). Other findings also reveal that many students still have difficulty learning PPKn because students feel bored while studying (Filivani & Agung, 2021; Supraweti, 2021). The results of observations and interviews conducted in class V of SD Negeri Ngaliyan 05 Semarang City showed results related to the lack of students paying attention to learning specific material that was considered difficult to understand, for example, on the material on Practicing the Principles of Pancasila. This is due to a lack of teacher creativity in providing and utilizing learning media. Teachers still use classical learning media, such as objects in the school environment and pictures in students' books, so teachers are expected to be more creative, considering that in 21st-century learning, teachers must utilize existing technology. These problems affect student learning outcomes in Pancasila education subjects. Several class V students at SD Ngaliyan 05 Semarang City have not yet reached the Learning Goal Achievement Criteria (KKTP) in the cognitive aspect.

The solution to overcome this problem is to develop innovative learning media that can improve student learning outcomes. Providing creative and innovative learning media is needed as a trigger to form the characteristics of students who want to learn and play simultaneously (Albana & Sujarwo, 2021; Antariani et al., 2021). Media can help teachers convey material so students can get a concrete picture (Arisandy et al., 2021; Mutmainnah et al., 2021). Innovation in education is an essential reference in the learning process. This innovation positively affects the student learning process (Munandar et al., 2021; Nafriadi & Hastuti, 2020). One learning innovation that educators can use is game-assisted learning media innovation. Games are an example of a learning tool that can stimulate thoughts, feelings, attention, and learning abilities or skills to encourage the learning process used to achieve learning goals (Harjanta & Herlambang, 2018; Okra, 2023).

Previous research findings state that game-based media can increase students' interest and motivation in learning (Murti & Handayani, 2022; Nabilah & Warmi, 2023; Salsabila et al., 2023). Other findings also confirm that game media such as Snakes and Ladders can improve student learning outcomes (Afandi, 2015; Sukmawati et al., 2022; Zuhriyah, 2020). However, there has been no study regarding the snake and ladder game media based on artificial intelligence to improve elementary school students' learning outcomes. The advantage of the media developed is that in the Snakes and Ladders game, students do not play individually but in groups accompanied by LKPD (Student Worksheets) so that in the learning process, they are assisted by the Snakes and Ladders learning media, which provides direct feedback in the hope of making the learning process more effective and fun. Based on this, this research aims to develop artificial intelligence-based snakes and ladders game media to improve elementary school students' learning outcomes.

2. METHODS

This type of research is development research (R&D). In this development research, the product will be in the form of an articulate storyline-based learning media for the Snakes and Ladders game to test the feasibility of the product and also the effectiveness of the Snakes and Ladders game product as a learning

medium for Pancasila Education subjects on material that emulates Pancasila behavior. The model used in developing media is ADDIE,, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (Maxnun et al., 2024). At the analysis stage, the core activity is analyzing the need to develop learning media. This activity aims to identify problems that occur and determine the necessary needs. The design stage includes product design activities based on the analysis carried out in the first stage. This stage begins with making a prototype or storyboard as a development plan. The development stage includes activities to realize the product design created in the previous stage. The implementation stage is the stage for implementing the learning media design that has been developed and has received the title valid and suitable for use, in real situations in the classroom involving students. The evaluation stage, namely activities at this stage, includes a revision process for developing learning media by the suggestions, comments, and input that have been obtained.

The research location is SD Negeri Ngaliyan 05. The research subjects are media experts and subject matter experts. Each expert provides an assessment or validation using a feasibility assessment validation instrument for the Artificial Intelligence (AI) based snakes and ladders game media design. Product trials are carried out in small groups. The trial was carried out on the class V population of SD Negeri Ngaliyan 05 with a sample of 28 students. The usage test stage was carried out by all class V students of SD Negeri Ngaliyan 05 in a large-scale test. At this stage, students are given media that has been developed and asked to operate it in learning Pancasila education, as well as material on the practice of Pancasila principles. The methods used to collect data are observation, interviews, literature study, and tests. Observation activities are carried out by direct field observation regarding the learning flow of related research topics. Next, the interview process was carried out with the fifth-grade teacher at SD Negeri Ngaliyan 05, Semarang City. The final stage is a literature study carried out by reviewing and collecting data from other references that help prepare the research report. The test method is an evaluation activity at the end of learning activities to determine the level of student's knowledge of the material being taught. The data collection instruments are questionnaires and test questions. The instrument grid is presented in Table 1 and Table 2.

Table 1. Assessment Instrument Grid for Learning Media Experts

Indicator	Descriptor
Media is in accordance with the curriculum, learning outcomes and learning objectives	1. Show the intended learning outcomes. 2. Convey the learning objectives to be achieved. 3. The material presented is in accordance with the curriculum reference used. 4. Images or illustrations in the snake and ladder game media based on artificial intelligence are in accordance with the discussion of the material.
According to the student's level of development	1. Material is presented coherently according to learning objectives 2. The image looks clear and logical 3. The text looks clear and logical 4. The overall appearance of the media is attractive
Media is easy to use by students and teachers	1. The snake and ladder game media based on artificial intelligence is easy to use and increases students' interest in learning 2. Instructions for using the media are clear 3. The use of the snakes and ladders game media based on artificial intelligence is suitable for use in class V Pancasila education learning. 4. Snakes and Ladders game media based on artificial intelligence is appropriate to the student's level of development.
Attractive visual design	1. The display design of the snakes and ladders game media based on artificial intelligence attracts students' learning interest. 2. The use of features in the snake and ladder game based on artificial intelligence is interesting and not boring. 3. The color combination of images and text is attractive. 4. The preparation of the snakes and ladders game media based on artificial intelligence meets the standards of good learning media.

Table 2. Assessment Instrument Grid for Learning Material Experts

Indicator	Deskriptor
Relevant to learning outcomes and learning objectives	1. The material is appropriate to learning outcomes. 2. The material presented is in accordance with the learning objectives. 3. The material presented is not out of context or topic discussed. 4. The material on the practice of Pancasila principles has been covered in its entirety in the snake and ladder game media based on artificial intelligence.
The material is appropriate to the level of thinking	1. The material is appropriate to students' intellectual development. 2. The material is appropriate to students' emotional development. 3. The material is related to everyday life. 4. Material according to the level of difficulty.
Suitability of the material to the questions in the media	1. Material in the media can increase students' knowledge. 2. Material in the media can increase students' interest in learning. 3. Material in the media can increase students' thinking intelligence. 4. Questions in the media can motivate students to solve problems.
Suitability of learning activities to the material	1. Presentation takes precedence by including learning outcomes and learning objectives that are appropriate to the material. 2. The material begins with trigger questions and observing activities. 3. The material is presented systematically and in accordance with the material discussed based on the problems posed as student learning resources. 4. There are questions and quizzes that can be solved by students in groups

The techniques used to analyze data are qualitative descriptive analysis and quantitative and inferential statistics. Qualitative descriptive analysis manages data in the form of input provided by experts regarding artificial intelligence-based learning media in Pancasila education subjects. Quantitative descriptive analysis manages data in the form of expert scores regarding artificial intelligence-based learning media in Pancasila education subjects. Inferential statistical analysis tests the effectiveness of artificial intelligence-based learning media in improving student learning outcomes in Pancasila education subjects.

3. RESULT AND DISCUSSION

Results

The results of the development of artificial intelligence-based learning media products in the Pancasila education subjects of grade V elementary school students at SDN Ngaliyan 05 Semarang were developed using *the Genially* www.genially,com platform based *on artificial intelligence* used as a learning process with achievement criteria on (1) the results of the design of the development of the snake and ladder game media based on *artificial intelligence* (2) the feasibility results of artificial intelligence-based snakes and ladders game media, (3) the results of the effectiveness of artificial intelligence-based snakes and ladders game media. Students together with teachers can access the artificial intelligence-based snake and ladder game media on a link provided by researchers. The teacher accesses the media and displays it on the projector screen after which students and teachers can carry out learning assisted by artificial intelligence-based snake and ladder game media to find out the learning outcomes of grade V students in Pancasila education subjects.

This research was conducted with a *Research and Development* (R&D) approach to the ADDIE development model which consists of five stages, namely *Analysis, Design, Development, Implementation, and Evaluation*. Therefore, researchers will describe the results of learning media development by the stages of ADDIE. The first stage is the analysis stage. The analysis carried out related to the learning process of Pancasila education, student character, and supporting facilities and infrastructure was carried out through observation and interviews. The use of learning media, especially Pancasila education subjects, is still minimal and focuses on print media in the form of package books and LKS that have been provided, and in delivering material to students relying on blackboards and the use of learning media only uses learning video models and PPT which are less interactive, teachers are less creative in presenting learning with the help of 21st-century technology as a result learning activities take place monotonously Making students bored and less challenged to learn the material presented by teachers through less interactive media.

The second stage is the design stage. The design stage is the planning stage of making media and is based on the analysis stage carried out previously. In this stage, an outline of the contents of the media contains the main material and components to be outlined in the media to be developed. Furthermore, researchers are looking for references to examples of Snakes and Ladders games that are suitable for development in making learning media. The result of this stage is a rough description of the learning that will be developed, which is adapting from the paper snake and ladder game in general but modified in digital form assisted by a genially platform by utilizing artificial intelligence technology. At this stage, researchers also designed material content to exemplify Pancasila behavior which underlies the purpose of playing snakes and ladders games based on artificial intelligence. The results of the design will be developed according to the components of the media.

The third stage is the development. a product development process is carried out according to the design stage which is developed into an AI-based snakes and ladders game learning media product assisted on a platform from genially. After the product is successfully developed, the next step is to conduct media feasibility tests using product validation. The components of the AI-based snakes and ladders game media are initial view of ai-based snakes and ladders game media, material, and based snakes and ladders game. The results of the development of the AI-based Snakes and Ladders Game media are presented in Figure 1.

Figure 1. AI-Based Snakes and Ladders Game Media

Figure 1 shows the appearance of the artificial intelligence-based snakes and ladders game media. After the AI-based snakes and ladders game was developed, then the media was validated by 2 validators to determine the feasibility of the AI-based snakes and ladders game. Validators consist of 2 lecturers who are experts in their fields. The validation results showed in Table 3.

Table 3. Media Validation Results

No	Aspect	Total	Score (%)
1	Media Validation	70	87.5%
2	Material Validation	68	85%

The results of media expert validation, with sixteen validation indicators related to conformity to learning outcomes and objectives, media effectiveness, and suitability of design display showed a figure of 87.5% with very feasible and valid criteria, which can be used with revisions suggested by media experts. The results of the material expert validation, with sixteen indicators. Validation indicators are related to the accuracy of learning objectives and learning outcomes of the material presented. In the assessment process on the validation sheet, validators also provide comments and suggestions on shortcomings and errors that

must be corrected in the AI-based snakes and ladders game. There are suggestions for improvement on the main page to add the university logo and the identity of the media maker. The revised results are presented in Figure 2.

Figure 2. AI-Based Snakes and Ladders Game Media Revision

AI-based Snakes and Ladders game media after revision is presented in the image where the gam2e page has added a university logo and educational logo according to the provisions of the validator and has also added the identity of the media maker by the provisions and suggestions of the validator. The stage after the media feasibility study is the implementation stage. AI-based snakes and ladders game media that has been developed and revised by the provisions of validators will be tested in real situations, namely in classroom learning. Trials were conducted to see the level of effectiveness of the media. The learning media for the artificial intelligence-based snakes and ladders game was tested on 6 students and 22 students in grade V of SD Negeri Ngaliyan 05 Semarang with the division of two groups, namely small-scale groups and large-scale groups. The last stage in the ADDIE research model is the evaluation stage. The evaluation stage was carried out to determine the effectiveness of the AI-based snakes and ladders game media that had been developed by researchers. The effectiveness test of the media is measured based on pretest and posttest values. \With testing on small groups of 6 students and large groups of 22 students. Furthermore, the value is tested statistically with paired sample t-test and Ngain.

Table 4. Small-Scale Normality Test Results

Group	Statistic	df	sig
Pretest	0.940	6	0.6660
Posttest	0.982	6	0.961

The normality test results in the small-scale group get a sig value of 0.660 for the pretest and 0.961 for the posttest, which means that the second value of the sig is >0.05, so the data is normal. The T-Test test results get a sig value of 0.001, which means that the sig value is 0.001 < 0.05, so there are differences in learning outcomes before and after using AI-based snake and ladder game media. Small Scale N-Gain Test Results showed in Table 5.

Table 5. Small Scale N-Gain Test Results

	N	Minimum	Maximum	Mean	Sid.deviation
N-gain score	6	0.50	0.80	0.6213	0.11284
N-gain percent	6	50.00	80.000	62.1338	11.28360
Valid N	6				

Based on the results of the N-gain Test above, it can be seen that the use of AI-based snakes and ladders game media in small-scale groups has increased by 0.6213 with a moderate increase category. It can be concluded that the use of AI-based snakes and ladders game media is effectively used for learning in small groups. The next stage is to test the effectiveness of the media against large-scale groups with a total of 22 student. Based on the large-scale group normality test through SPSS software, the results are that the sig value is 0.225 for the pretest value and the sig is 0.089 for the posttest value, which means that the second value of the sig is > 0.05, then the data of the value is normally distributed. The results from the paired sample t-test test through SPSS software getting a sig value of 0.001<0.05, so it can be interpreted that learning assisted by AI-based snake and ladder game media influences on increasing student learning

outcomes in exemplifying Pancasila behavior. Furthermore, to determine the improvement of learning outcomes before and after using the media, an N-Gain test was carried out. The N-Gain test table showed in Table 6.

Table 6. Large-Scale N-Gain Test Results

	N	Minimum	Maximum	Mean	Sid.deviation
N-gain score	22	57	1.00	0.8005	0.10445
N-gain percent	22	57.14	100.00	80.0525	10.44539
Valid N	22				

Based on the results of the N-Gain test in the large-scale group above, it is known that grade V students of SDN Ngaliyan 05 Semarang have increased after carrying out learning assisted by *artificial intelligence-based snake and ladder game media* on material exemplifying Pancasila behavior of 0.8005 with a high increase category. It is said to be a high category because it ≥ 0.7 so it is concluded that the snake and ladder game media based on artificial intelligence is effectively used as a learning medium. Furthermore, the assessment of the teacher and student response questionnaire was carried out and analyzed to see the practicality of the artificial intelligence-based snakes and ladders game media. The results of the AI-based snake and ladder game media practicality assessment from the teacher assessment obtained a percentage of 87.5% with very practical criteria and in Table 12 the results of the AI-based snake and ladder game media practicality assessment from the assessment of 28 students obtained an average combined percentage of 84% with very practical criteria.

Discussion

The results of data analysis show that the learning media for the AI-based snakes and ladders game is feasible with validity, practicality, and effectiveness, so it is suitable for use in learning. The AI-based Snakes and Ladders game learning media is suitable for learning due to the following factors. First, the AI-based Snakes and Ladders game learning media is suitable for use in learning because it improves student learning outcomes. The snake and ladder game learning media has high effectiveness in improving student learning outcomes. The Snakes and Ladders game is a type of game that has gone global (Prameswari, 2018; Wulandari & Pravesti, 2021). The Snakes and Ladders game is simple: a rectangular piece of paper with a row of numbers 1 to 100 inserted with images of snakes and ladders across at several points on specific numbers. Using a digital-based snakes and ladders game has advantages, including the material studied having benefits that can be felt directly by students, increasing insight into students' digital literacy skills, improving students' skills in operating digital tools, and stimulating students' brain Intelligence (Anggraeni et al., 2023; Rajab et al., 2023). This snakes and ladders game can also be an exciting and fun learning object for students; they tend to pay attention and are enthusiastic about learning (Andriani & Wahyudi, 2023; Anggraeni et al., 2023)**.**

Second, the AI-based Snakes and Ladders game learning media is suitable for learning because it makes learning more accessible for students. Snakes and Ladders media is a tool for implementing learning (Andrianto et al., 2021; Ariessanti et al., 2020). The benefits of using learning media based on the snakes and ladders game that is carried out effectively in the teaching and learning process results in the development of students' intellectual intelligence (Anggraeni et al., 2023; Oktafia, 2024; Rajab et al., 2023). The Snakes and Ladders game is played by two or more people, using dice to control the course of the game, and has boxes containing numbers depicting ladders and snakes (Wati, 2021; Zulfana et al., 2020). In this game, students are directed to demonstrate the game media to find the results they want to achieve to realize media activity in implementing learning (Chabib et al., 2017; Rajab et al., 2023). In line with previous research, using the Snakes and Ladders Game learning media can make learning more accessible for students. This shows that the snakes and ladders learning media influence students' understanding (Darmawan & Wahyudi, 2023; Kusuma Ardi & Desstya, 2023; Siregar & Ananda, 2023).

Third, the AI-based Snakes and Ladders game learning media is suitable for learning because it is convenient. The learning media for the AI-based Snakes and Ladders game is efficient for students to use anywhere and anytime. This is because developing learning media for the Snakes and Ladders game uses advanced technology. The latest technology has been integrated into education, especially in learning media (Anghelescu & Nicolaescu, 2019; Shahroom & Hussin, 2018). Learning media in this century are starting to collaborate with Artificial Intelligence technology. Artificial Intelligence, abbreviated as AI, is the latest technology 21, which utilizes artificial Intelligence (Anghelescu & Nicolaescu, 2019; Muhammad Yahya et al., 2023). In the information-rich digital era, teachers face increasingly complex tasks in managing student data (Mambu et al., 2023; Siahaan et al., 2020). AI can help teachers filter and group data from various

sources, provide deep insight into individual students' development needs and help teachers make more informed decisions (Ottenbreit-Leftwich et al., 2023; Rathore et al., 2023). Artificial intelligence (AI) technology has great potential to improve the quality of teacher teaching.

Previous research findings also state that artificial intelligence technology can guide and recommend teachers to improve their learning strategies and achieve more optimal learning outcomes (Cichocki & Kuleshov, 2021; Rusmiyanto et al., 2023). Other research also states that the Snakes and Ladders game can help improve student learning outcomes and motivation (Andrianto et al., 2021; Anggraini et al., 2018; Lestari & Hermawati, 2023). Based on this, it can be concluded that the AI-based Snakes and Ladders game learning media is suitable for learning because it makes learning more accessible for students. The limitation of the research is that the AI-based snake and ladder game learning media developed is only intended for elementary school students, especially on Pancasila education material. This research implies that the media developed can be used to facilitate student learning. Apart from that, this media can trigger students' interest in participating in learning to improve student learning outcomes on exemplary Pancasila behavior material. The resulting learning media adopts HOTS (Higher Order Thing and Skill) learning as a learning demand in the 21st century. The application of the artificial intelligence-based snakes and ladders game in the material is not limited to the game itself. On the other hand, the media also contains icons equipped with a collection of random questions or challenges related to material about exemplary Pancasila behavior.

4. CONCLUSION

The results of data analysis show that the AI-based learning media for the Snakes and Ladders game has received very good qualifications from experts, teachers, and students, so it is suitable for use in learning. The t-test results also show an influence of snakes and ladders-based game media. The results of the N-Gain test show that class V students at SDN Ngaliyan 05 Semarang experienced an increase in learning outcomes after using the snake and ladder game media based on Artificial Intelligence. It was concluded that the AI-based Snakes and Ladders game media can improve student learning outcomes. The AI-based Snakes and Ladders game learning media makes it easier for students to learn and increases student motivation, so it impacts increased learning outcomes.

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