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Development Of An AI-Driven Adaptive And Gamified Learning Model To Enhance Spiritual Literacy And Science Understanding In Elementary Education

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Abstract

This study aims to develop an AI and gamification-based adaptive learning model to improve spiritual literacy and understanding of science and natural sciences at SDIT Hafizul Ilmi. The research method used in this study is development with the ADDIE model approach developed by (Sugiyono 2020: 396). The ADDIE design model involves five stages of development procedures, namely Analysis, Design, Development, Implementation, and Evaluation. The population in this study were all fifth-grade students of SD IT Hafizul Ilmi. The sample in this study was 30 fifth-grade students. The results of the research obtained from data analysis were the average value of students before the action was 68 and the number of students who completed was 12 people with classical completeness of 40%. Meanwhile, the number of students who did not complete was 18 people with classical completeness of 60%. After implementing gamification in learning, the average posttest score was 94, with 28 students completing the class, with a 93% grade point average. This represents a 53% increase in class completion. The results of the development research indicate that an AI-based and gamification-based adaptive learning model can improve spiritual literacy and understanding of science and natural sciences. Based on the research findings, it is recommended that teachers implement an AI-based and gamification-based adaptive learning model to improve spiritual literacy and understanding of science and natural sciences.

Keywords: Adaptive Learning Model, AI and Gamification, Spiritual Literacy

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INTRODUCTION

Education in the digital era demands innovation that adapts to students' needs, particularly in integrating spiritual values with an understanding of science (IPAS). To achieve an effective learning process, creative learning models are needed that can increase students' enthusiasm and focus in paying attention to ongoing lessons. Therefore, one model that can be used is the adaptive learning model. Adaptive learning is a model designed based on the assumption of individual learning (Subhash & Cudney, 2018). Adaptive learning is also capable of displaying web pages according to individual characteristics, oriented to a wider user group, and providing navigation to limit the breadth of users in searching for information (Mehtälä, 2015). According to Kilpatrick, Swafford, and Findell, adaptive reasoning is the capacity to think logically, estimate answers, provide explanations of the concepts and procedures used in answering, and assess their accuracy. Along with the rapid development of technology, the integration of Artificial Intelligence (AI) in Social Studies (IPS) learning at the elementary school level presents great potential to improve the quality of students' learning experiences. The use of AI enables the creation of a more personalized and adaptive learning process, allowing students to learn at their own pace and learning style (Bovermann et al., 2018). For example, AI is capable of in-depth analysis of student learning data, providing real-time feedback, and tailoring learning materials based on individual needs (Feriyanto & Anjariyah, 2024). Thus, AI serves not only as a tool but also as a partner in the learning process, helping students understand complex concepts through a more interactive, engaging, and effective approach.

To achieve an effective learning process, a creative learning model is needed that can increase student enthusiasm and focus in paying attention to the ongoing lesson. Therefore, one model that can be used is the adaptive learning model. Adaptive learning is a model designed based on the assumption of individual learning. Adaptive learning is also capable of displaying web pages according to individual characteristics, orienting to a broader user group, and providing navigation to limit the breadth of users' information searches (Zainuddin et al., 2020).

However, preliminary observations at Hafizul Ilmi Islamic Elementary School revealed that only 45% of students achieved minimal mastery in spiritual literacy, while their understanding of social studies (IPAS) remained below the national standard, with an average score of 65 (Ghorbel et al., 2025). This indicates the need for a more personalized and engaging learning approach.

With the rapid advancement of technology, the integration of Artificial Intelligence (AI) in Social Studies (IPS) learning at the elementary school level offers significant potential for improving the quality of students' learning experiences. The use of AI enables a more personalized

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and adaptive learning process, allowing students to learn at their own pace and style. For example, AI can analyze student learning data in depth, provide real-time feedback, and adapt learning materials based on individual needs (Jogo et al., 2022). Furthermore, Generative AI also helps reduce the administrative burden on teachers, allowing them to focus on more important pedagogical aspects. Therefore, understanding the application of Generative AI in education is highly relevant to ensure this technology is optimally utilized to improve the quality of learning (Vorlíček et al., 2024).

Several researchers have demonstrated that adaptive learning can increase student engagement in the classroom (Syahr et al., 2025). Key active learning experiences in the context of adaptive learning include the stages of engage, explore, explain, elaborate, and evaluate.

Teaching materials are tools that can assist students in the learning process and improve student learning outcomes if the materials used are appropriate to the needs and the current curriculum. Teaching materials can also reduce the teacher-centered paradigm to a student-centered one, resulting in more active students (Montiel-Ruiz et al., 2023). The use of science and natural sciences teaching materials that cover cultural diversity is expected to develop students' critical thinking skills. A pre-analysis of the teaching material needs in grade 4 of SD-IT Hafizul Ilmi revealed that the teaching materials used, particularly science and natural sciences, are government-provided materials, namely student textbooks and teacher textbooks (Maharani et al., 2022). This teaching material is the only teaching material used by teachers in the learning process.

METHODS

This research method uses Research and Development (R&D). Research and Development (R&D) is a research method used to develop products. Research and development is a strategy or research method that is quite effective in improving practices. The R&D method is a systematic approach used to design and develop learning programs and products that meet internal criteria (Fuadah, 2021).

This research uses the ADDIE model, which provides opportunities for evaluating development activities at each stage, positively impacting the quality of the developed product (Mayasari, 2023). The ADDIE model consists of five stages: analysis, design, development, implementation, and evaluation (Sugiyono 2020: 396).

The advantage of the ADDIE model is that, as we know, it consists of five interrelated and systematically structured components. This means that the first to the fifth stages must be applied

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systematically and cannot be ordered randomly, or we can choose which ones we prefer to prioritize. Because these five stages/steps are very simple compared to other design models, their simplicity, structure, and systematic nature make them easy for educators to learn (Yuniati et al., 2022).

Based on the learning model developed, namely an AI-based adaptive learning model and gamification, the five stages are (Sari, 2023):



Figure 1. ADDIE development stages

This research was conducted in fifth-grade students at SDIT Hafizul Ilmi, located in Blang Krueng, Baitussalam District, Aceh Besar Regency, Aceh Province. The research took place during the odd semester of the 2025/2026 academic year, from November to October 2025. The subjects were fifth-grade students at SDIT Hafizul Ilmi (Rafifa et al., 2019).

Data collection techniques were used to obtain data at an early stage, with the aim of analyzing student needs in the science and science learning process (Sa'adah et al., 2022). The techniques used included observation, interviews, and questionnaires.

Data analysis techniques were used to obtain a quality product that met the criteria for validity, practicality, and effectiveness (Firtsanianta & Khofifah, 2022). The steps in analyzing the quality criteria for the developed product are as follows: the collected data were analyzed qualitatively and quantitatively. After the data was collected, it was analyzed qualitatively by describing the responses obtained from respondents and then summarizing them in clear, easy-to-understand sentences.

Qualitative Data Analysis

Qualitative data analysis is the analysis of data obtained from suggestions, input,

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comments, and constructive feedback from validators. These responses and comments are used to develop an AI- and gamification-based adaptive learning model to improve spiritual literacy and science understanding at SDIT Hafizul Ilmi (Mudjid et al., 2022).

Quantitative Data Analysis

Quantitative data analysis was conducted by researchers to process data derived from validation questionnaires conducted by subject matter experts, media experts, and practitioners. Furthermore, quantitative data analysis was used to analyze pre-test and post-test learning outcome data, which was used to determine the effectiveness of the developed teaching media (Brezovszky et al., 2019).

Product Feasibility Analysis from Expert Validation

Data analysis techniques, which are data processing processes to obtain comprehensive knowledge and important information that can be used for decision-making, are known as research data analysis procedures (Sofia et al., 2020). Data on the validity and effectiveness of teaching materials and the use of learning media were collected through validation by media and subject matter experts, as well as teacher responses (Purnomo, 2023). The research instrument for validators and individual, small group, and limited field group testing was created on a Likert scale, divided into scores of 4, 3, 2, and 1, with response categories: Very Good, Good, Poor, and Very Poor. This was done to ensure the feasibility of the teaching module. Therefore, the calculation was performed using the following formula (Feriyanto & Anjariyah, 2024):

$$\text{score} = \frac{number\ of\ indicators\ per\ category}{\text{total number of category indicators}} x100\%$$

After the students' pre-test and post-test results are known, N-gain is used to determine the quality of improvement. The following is the N-gain formula and categories according to Hada et al. (2021):

$$\frac{Posttest\ score\ -Pretest\ scoreSkor}{Maximum\ score - Pretest\ score}$$

Table 1. N-gain Categories

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Score	Category
$G \geq 0.7$	Tall
$0.3 \leq X < 0.7$	Currently
$G < 0.3$	Low

RESULTS AND DISCUSSION

This research is a research and development (R&D) project aimed at developing an AI- and gamification-based adaptive learning model to improve spiritual literacy and social science understanding at Hafizul Ilmi Elementary School. The ADDIE development model used consists of five stages:

1) Analysis,
2) Design (planning),
3) Development,
4) Implementation, and
5) Evaluation

Each stage is implemented systematically to produce valid, practical, and effective teaching media according to the learning needs of students. This research was conducted on fifth-grade students, beginning with a pre-test on the topic of the Indonesian people's struggle against colonialism (Tangkui & Keong, 2021). The pre-test results showed that most students had not yet achieved the minimum completion criteria. This condition became the basis for researchers to develop an AI-based and gamification-based adaptive learning model to improve spiritual literacy and understanding of science at SDIT Hafizul Ilmi. After the module was used in the learning process, students' post-test scores increased, as evidenced by the post-test results of all fifth-grade students (Jääskä & Aaltonen, 2022).

Analysis Stage

The initial step undertaken by the researchers was a needs analysis. This analysis was conducted to gauge students' needs for an AI- and gamification-based adaptive learning model to improve spiritual literacy and understanding of science at Hafizul Ilmi Islamic Elementary School (Rosydiana et al., 2023).

The needs analysis was conducted with fifth-grade teachers at Hafizul Ilmi Islamic

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Elementary School, preparing several questions (Destriani, 2021). The analysis revealed a lack of teacher skills in integrating this technology into learning, and the limited availability of learning media specifically incorporating wordwall applications (Lei et al., 2022).

Pre-Test

The pre-test was conducted to obtain initial student learning outcomes, aimed at proving whether the AI-based and gamification-based adaptive learning model can improve student learning outcomes (Ali et al., 2024). Pre-test data was obtained by analyzing the answers to pre-test questions from fifth-grade students at SDIT Hafizul Ilmi. Based on the pre-test results, the students obtained the following scores :

Table 2. Summary of Pre-Test Results

1.	AB	65	100	Not Completed
2.	ARM	59	100	Not Completed
3.	AW	75	100	Completed
4.	AW	59	100	Not Completed
5.	AS	58	100	Not Completed
6.	AZR	75	100	Completed
7.	AST	75	100	Completed
8.	CAS	68	100	Not Completed
9.	CFA	70	100	Not Completed
10.	FN	75	100	Completed
11.	HSA	77	100	Completed
12.	HKL	70	100	Not Completed
13	IRD	66	100	Not Completed
14	IA	60	100	Not Completed
15	KAF	61	100	Not Completed
16	MA	61	100	Not Completed
17	MQ	65	100	Not Completed
18	MJ	65	100	Not Completed
19	MAK	75	100	Completed
20	MH	66	100	Not Completed

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21	MRH	55	100	Not Completed	
22	MSH	65	100	Not Completed	
23	NA	63	100	Not Completed	
24	NJ	67	100	Not Completed	
25	MHS	75	100	Completed	
26	MHS	75	100	Completed	
27	SA	78	100	Completed	
28	TMF	75	100	Completed	
29	ZN	75	100	Completed	
30	MJ	77	100	Completed	
Amount		2.050	3000	Completed	12
Average		68		Not Completed	18
Presentation		68 %			

Based on the results of the student pre-test above, there were 12 students who got a passing grade above the KKM (75) and 18 students who got a passing grade below the KKM (75), with a passing percentage of 40% and a non-passing grade below the KKM of 60%.

Design Stage

In this design stage, researchers designed an AI-based and gamified adaptive learning model according to the desired development (Anantrasirichai & Bull, 2022). The AI-based and gamified adaptive learning model was designed with an attractive interface and easy-to-understand language. It included material and practice questions in the social sciences (IPAS) related to verses from the Quran or Hadith (Tejawiani et al., 2023). The gamification was designed to motivate students. Materials were collected to serve as references in developing a framework for teaching materials on the Indonesian nation's struggle against colonialism.

In the process of creating gamification in learning, the initial stage is gathering materials. The steps for creating gamified learning media are as follows:

1. Open the Wordwall website and log in by creating an account.
2. Once logged in, click the "Create Activity" button on the main page.
3. Various interactive activity templates will appear.
4. Find and click "Open the box" (the gift-shaped icon).

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5. This template is suitable for mystery-style questions and quizzes, where students open boxes one by one to answer the questions inside.
6. At the top of the page, write the activity title, for example, "Opening the Box - Spiritual Literacy and Science Questions."
7. Next, write the question in the "question" column and the answer in the "answer" column.
8. Then, click "Done" to save.
9. Then, click "Start" to try the game.

The results of the development of gamification media in learning, namely by using a wordwall application to design the specified gamification learning media.

Development Stage

The development stage is the core of several stages implemented. At this stage, the developed product aligns with the planning model structure, including materials, supporting images, design, and other aspects. The stages include validation by med (Nikitas et al., 2020) .ia experts, content experts, and teachers to ensure alignment with Islamic values and pedagogical standards.

Table 3 Validation Results Data from Media Expert Lecturers

No.	Aspects	Indicator	∑x	∑xi	P (100%)
1.	Display Design	Suitability of layout, color, and typography.	5	5	100%
2.	Navigation Clarity	Easy to access buttons/menus	4	5	80%
3.	Graphic Quality	The images/animations are clear, engaging, and appropriate.	4	5	80%
4.	Access Speed	Media runs smoothly without errors	5	5	100%

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No.	Aspects	Indicator	∑x	∑xi	P (100%)
5.	AI and Gamification Integration	Adaptive features and gamification work as intended.	4	5	80%
6.	Compatibility	Can be accessed on various devices (laptop/cellphone)	5	5	100%
7.	Alignment with Learning Objectives	Material according to science and spiritual literacy competencies	5	5	100%
8.	User engagement	Encourage interactivity and learning motivation.	5	5	100%
9.	Media appeal	Fun and not boring media	5	5	100%
10.	User effectiveness	Helping students understand science material	4	5	80%
11.	Suitability to elementary school student characteristics	Child-friendly, simple, communicative media.	4	5	80%
12.	Development potential	Media can be further developed	5	5	100%
	Amount		**55**	**60**	**91%**

The validation results obtained are explained in the table above from the media validator expert using the following formula:

$P = \frac{\sum X}{\sum Xi}$ x 100%

$P = \frac{55}{60}$ x 100% = 91%

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Based on the results of the media expert validation assessment on gamification-based science teaching media from the validator, it received a score of 91% with the results of the criteria being feasible to be implemented by fifth grade students of SDIT Hafizul Ilmi in science lessons (Anggraeni & Meilina, 2024).

Table 4. Validation Results Data from Subject Matter Expert Lecturers

No.	Aspects	Indicator	∑x	∑xi	P (100%)
1.	Competency-Based	The material is in accordance with CP/JD IPAS and spiritual literacy objectives	4	5	80%
2.	Conceptual Accuracy	The science material is correct, up to date, and does not give rise to misconceptions.	5	5	100%
3.	Depth of Material	The material is quite in-depth and appropriate for elementary school level.	5	5	100%
4.	Breadth of Material	The scope of material is in accordance with the scope of elementary school science	4	5	80%
5.	Contextuality	The material is linked to students' daily lives	5	5	100%

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No.	Aspects	Indicator	∑x	∑xi	P (100%)
6.	Integration of Spiritual Values	Spiritual values are conveyed clearly and meaningfully.	4	5	80%
7.	Relevance to Elementary School Student Character	Simple, communicative language, and appropriate to developmental level	4	5	80%
8.	Systematization	The material is structured in a coherent, logical and easy to understand manner.	5	5	100%
9.	Language Clarity	The language is easy to understand, communicative, and appropriate to the developmental level.	4	5	80%
10.	Presentation Attractiveness	The material is interesting, motivating, and provokes curiosity.	4	5	80%
11.	Supporting Spiritual Literacy	Encourage students' awareness of spiritual values.	5	5	100%
12.	Improving Understanding of Science	Help students understand science concepts better.	5	5	100%

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No.	Aspects	Indicator	∑x	∑xi	P (100%)
13.	Potential for Sustainability	The material can be used/adapted for other learning.	4	5	80%
	Amount		**58**	**65**	**89%**

The validation results obtained data are explained in the table above from the material validator expert using the following formula (Owan et al., 2023):

$$P = \frac{\sum X}{\sum Xi} \times 100\%$$

$$P = \frac{58}{65} \times 100\% = 89\%$$

Based on the results of the assessment of AI-based learning activities and Gamification with Science material in grade V from the material expert validator, the average number was 89% with the results meeting the criteria for being suitable for use in learning (Rainy & Chowdhury, 2022).

Table 5 Validation Results Data from Practitioner Expert Teachers

No.	Indicator	∑x	∑xi	P (100%)
1.	This AI-based and gamification-based adaptive learning model is suited to learning needs in the digital era.	5	5	100%
2.	The components in the model are arranged systematically and are easy to understand.	4	5	80%
3.	The model design is in accordance with the characteristics of elementary school students.	5	5	100%

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No.	Indicator	∑x	∑xi	P (100%)
4.	The media and features used in this model are easy to operate by teachers and students.	4	5	80%
5.	This model helps improve students' spiritual literacy.	5	5	100%
6.	The use of gamification makes students more motivated in learning.	5	5	100%
7.	This model can be easily implemented in school environments.	4	5	80%
8.	Teachers can adapt quickly to the use of this model.	4	5	80%
9.	This model is relevant to the science and science curriculum that applies in schools.	4	5	80%
10.	This model can be used sustainably for the development of technology-based learning.	5	5	100%
	Amount	**45**	**50**	**90%**

Based on the results of the assessment of AI-based learning activities and Gamification with Science material in grade V from the teacher response validator, the average number was 90% with the results meeting the criteria for being suitable for use in learning (Doyan et al., 2025).

The average validation percentage from the three validators was 90%. This result indicates that the AI- and gamification-based adaptive learning model is highly valid without revision. The validation results by the three experts are presented in the table and diagram below (Munasiah et al., 2020).

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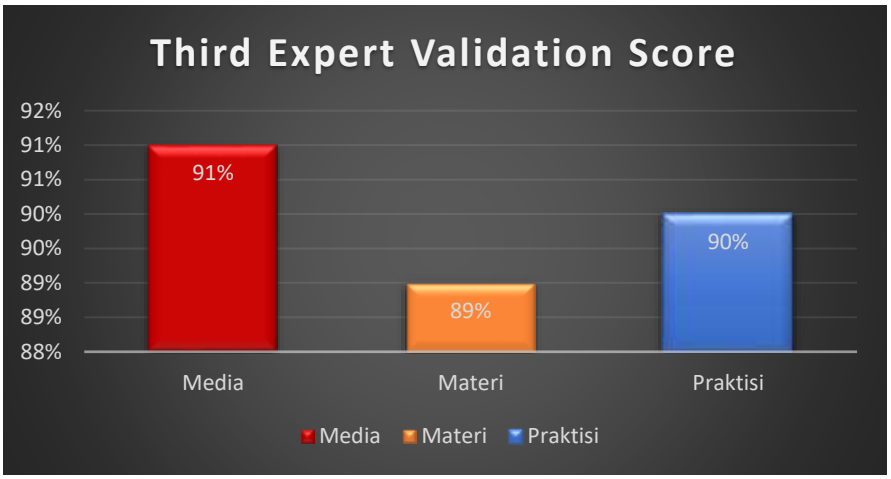


Figure 2. Third Expert Validation Score

Implementation

The implementation phase is the activity of applying and delivering learning using an AI-based and gamification-based adaptive learning model. After being declared highly feasible by the validator, the AI-based and gamification-based learning media can be implemented with fifth-grade students according to the material taught by the teacher. The learning implementation was delivered to 30 fifth-grade students at SDIT Hafizul Ilmi. The following are the learning and implementation stages in this study (Noviyanti, 2020).

Table 6. Implementation Stages

Implementation Of Learning Using An Adaptive Learning Model Based On Ai And Gamification To Improve Spiritual Literacy And Understanding Of Science At Hafizul Ilmi Sdit	
Activity Description	**Documentation**
1) The Teacher Greets The Students And They Respond. 2) The Teacher And Students Pray Together.	

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Implementation Of Learning Using An Adaptive Learning Model Based On Ai And Gamification To Improve Spiritual Literacy And Understanding Of Science At Hafizul Ilmi Sdit	
Activity Description	**Documentation**
3) Beginning Of Learning The Teacher Delivers Apperception And Past Material	
4) The Teacher Explains The Material According To The Students' Level Of Thinking Ability.	
5) The Teacher Provides A Gamification Link In The Wordwall Application To Students. Https://Wordwall.Net/Play/96437/596/132	
6) Students Work On The Questions In The Link.	
7) Teachers Provide New Knowledge And Integrate It With Things That Students Will Experience In Everyday Life.	

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Evaluation

After the implementation phase, the next stage is the evaluation of the learning media. Product effectiveness is assessed based on student scores after implementation. Evaluation is used to determine the effectiveness of the product. Evaluation scores are obtained through a post-test, which is used to determine improvements in student learning outcomes using AI-based adaptive learning and gamification models (Alainati et al., 2023).

Post-Test

Post-test scores were obtained by collecting data from students' scores on 10 choice questions, each with a 100% score. At this stage, the researcher explained the social studies (IPAS) lesson on the Indonesian nation's struggle against colonial rule using an AI-based and gamified adaptive learning model. Then, they distributed evaluation sheets to students regarding the IPAS material.

Table 7. Summary of Post-test Results

No.	Student	∑x	∑xi	Completeness
1.	AB	96	100	Completed
2.	ARM	85	100	Completed
3.	AW	100	100	Completed
4.	AW	88	100	Completed
5.	AS	73	100	Not Completed
6.	AZR	90	100	Completed
7.	AST	100	100	Completed
8.	CAS	92	100	Completed
9.	CFA	100	100	Completed
10.	FN	95	100	Completed
11.	HSA	100	100	Completed
12.	HKL	93	100	Completed
13	IRD	100	100	Completed
14	IA	74	100	Not Completed
15	KAF	93	100	Completed
16	MA	100	100	Completed
17	MQ	100	100	Completed

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No.	Student	∑x	∑xi	Completeness	
18	MJ	95	100	Completed	
19	MAK	100	100	Completed	
20	MH	91	100	Completed	
21	MRH	100	100	Completed	
22	MSH	89	100	Completed	
23	NA	93	100	Completed	
24	NJ	100	100	Completed	
25	MHS	100	100	Completed	
26	MHS	92	100	Completed	
27	SA	100	100	Completed	
28	TMF	97	100	Completed	
29	ZN	95	100	Completed	
30	MJ	100	100	Completed	
	Amount	2831	3000	Completed	28
	Average	94		Not Completed	2
	Presentation	94 %			

Based on Table 4.4, the average score was 94 and the completion rate was 94%. Based on this, the development of the adaptive learning model based on gamification was very effective.

N Gain Test

The increase in student learning outcomes in understanding is indicated by the Gain value. Gain is the difference between the posttest and pretest scores, indicating an increase in student abilities after the learning process. The normalized N-Gain test was conducted to show the extent of student cognitive improvement after participating in AI-based and gamified science learning. The N-Gain calculation is the difference between the posttest and pretest scores divided by the difference between the highest score and the pretest score. The following are the N-Gain score results:

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Table 8. N-Gain score results

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
NGain_Score	30	.35	1.00	.8373	.18622
NGain_Persen	30	35.00	100.00	83.7349	18.62221
Valid N (listwise)	30				

It can be seen that the N-Gain score results have a mean value of 0.837349, this value is greater than 0.7 (0.83>0.7) so the category obtained is high/high effectiveness. N-Gain percent mean value of 83.7349, then it is interpreted as effective. So it can be concluded that the adaptive learning model based on AI and gamification to improve spiritual literacy and understanding of science at SDIT Hafizul Ilmi can improve student learning outcomes and is proven to be effective.

Based on the results of the N-Gain test, which has proven that the use of an AI-based and gamification-based adaptive learning model can improve spiritual literacy and understanding of science at SDIT Hafizul Ilmi (Ma et al., 2025). The basis for decision-making is that the hypothesis is accepted if the mean value is greater than 0.3. The following hypotheses are used (Haristiani, 2019):

Ho : student learning evaluation results score >83

Ha : student learning evaluation results score <83

So based on the conclusion of the hypothesis, it is stated that ho is rejected and ha is accepted.

CONCLUSION

Based on the entire research process, including analysis, design, development, validation, and initial implementation with fifth-grade students at Hafizul Ilmi Islamic Elementary School (SDIT), several conclusions were drawn. The AI-based and gamification-based adaptive learning model for improving spiritual literacy and understanding of science and natural sciences (IPAS) was successfully developed systematically through the ADDIE model.

The analysis revealed that the average student score before the intervention was 68, with 12 students completing the course, with a classical completion rate of 40%. Meanwhile, 18 students failed to complete the course, with a classical completion rate of 60%. After implementing gamification in the learning process, the average posttest score was 94, with 28 students completing the course, with a classical completion rate of 93%. This resulted in a 53%

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increase in classical completion. The results of the development research indicate that the AI-based and gamification-based adaptive learning model for improving spiritual literacy and understanding of science and natural sciences at Hafizul Ilmi Elementary School is as follows:

1. The developed AI-based and gamification-based adaptive learning model is valid, as evidenced by validation results from media experts (91%, categorized as very valid), material experts (89%, categorized as very valid), and practitioners (90%, categorized as very valid). Overall, the validity of the AI-based and gamification-based adaptive learning model is 90%, categorized as very valid.
2. The AI-based and gamification-based adaptive learning model is effective in improving students' spiritual literacy, as evidenced by the effectiveness results of the N-Gain test, which obtained an average value of 83.7349 with a category > 0.7, thus categorizing as highly effective. The N-Gain percentage obtained from the table is 83.7349, and this value is greater than 80% (83% > 80%), thus indicating that the AI-based and gamification-based adaptive learning model is effective for implementation and can improve the spiritual literacy of fifth-grade students at SDIT Hafizul Ilmi.

Thus, the adaptive learning model based on AI and Gamification has been proven to be able to improve students' spiritual literacy by developing gamification in the learning process which is very valid, practical and effective.

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