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Development of Gamification-Based HTML5 Interactive Learning Media for Human Digestive System in Elementary Education

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Abstract: This study aims to develop interactive learning media based on HTML5 with a gamification approach to improve students' understanding, activeness, and learning motivation. This research used a Research and Development (R&D) method with the ADDIE model, consisting of five main stages: analysis, design, development, implementation, and evaluation. The validation process was carried out by three experts using a feasibility assessment instrument, followed by a limited trial with fifth-grade students at SD Negeri Inpres Malompo Elementary School. Data analysis was conducted quantitatively through validation questionnaires and student responses. The findings indicated that the media was considered "very feasible" in terms of content, visual appearance, and technical aspects, and was highly effective in helping students understand the concept of digestive organs interactively. This media offers an innovative alternative in science learning in elementary schools and has the potential for further development in other materials, contributing to the development of gamification-based digital media in elementary education.

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Introduction

Natural Science (IPA) learning in elementary schools currently still faces various challenges, such as low interest, motivation, and student learning outcomes. According to Mujiyono in Prabawa (2022), science learning outcomes in Indonesia are relatively low due to many factors, one of which is the learning environment created by teachers that forms an understanding of science that has abstract material by memorizing. Trisnawaty & Slameto, (2017) also stated that the factor causing low student understanding is the learning method used is oriented towards the teacher, and students as listeners. Another challenge is to arouse student learning motivation. Today's students, known as Alpha, tend to have unique characteristics. They are more interested in visual, interactive, and technology-based learning. Therefore, the presentation of complex material requires a concrete and interactive approach to suit the characteristics of their cognitive development. Other studies show that most students have difficulty understanding abstract concepts in science topics, such as the digestive system, if not assisted by supporting visual learning media (Pratama & Rachmadtullah, 2020).

In this context, the development and application of interactive learning media is a very potential solution. Interactive learning media that combines audio, visual, animation, and direct interaction elements can create a more enjoyable learning atmosphere, attract students' attention, and clarify the delivery of material so that it is easier for students to understand science concepts. In line with the views of Karo-karo and Rohani (2018) in

Vol. 12 No. 4 : October 2025
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pp. 1215-1225

conveying that when media that is in accordance with student characteristics is utilized properly, it will optimize the learning process. According to Zamani & Heru (2016) The use of computer technology to create learning media has many advantages, one of which is that learning becomes more innovative and interactive because it can combine text, images, audio, animation/video into one unit that supports each other. The use of computer-assisted learning media has been shown to have a positive effect on student motivation and learning outcomes. One of the advantages of using computer technology to develop learning media is that it is more innovative and interactive. This is what causes animated media to motivate students and increase students' positive attitudes. According to Sugiyono (2022), learning media serves to clarify the presentation of messages, overcome space and time limitations, and enable direct interaction between students and learning resources

Research by Astuti, D., Wijayanti, A., & Purnamasari, V. (2025) also emphasized that interactive learning media is very relevant and effective for use in learning because it can make it easier for teachers to deliver material in an innovative and interesting way, while also allowing students to be actively involved in the learning process so that it supports exploratory and collaborative learning in accordance with the characteristics of the Independent Curriculum

According to Heriyanto (2021), gamification in learning can increase students' learning motivation by presenting game elements such as challenges, points, and awards that stimulate active involvement and interaction between students and teachers, thus creating a more interesting and effective learning atmosphere. Research by Zainuddin, Z., & Perera, CJ (2020) shows that the application of gamification in science learning at the elementary school level is still limited, especially in the form of technology-based learning media that are in accordance with the curriculum and characteristics of elementary school students. The development of HTML5-based learning media with a gamification approach is a potential solution to face this challenge. Ariyani and Ganing (2022) emphasize that the use of HTML5 technology in creating learning media makes it easier to present materials interactively and responsively, in accordance with the characteristics of modern learning. This approach is also supported by research findings showing that game elements in learning can increase student engagement by up to 40% (Yildirim & Demir, 2014).

Although challenges in implementing media development remain, HTML5-based interactive learning media allows for more interesting and dynamic presentation of materials, so that it can maximize the learning experience of elementary school students. With a gamification approach, this media encourages active involvement of students in the learning process, which is very important to increase motivation and interest in learning in today's digital era. This research presents a novel integration of HTML5 technology with gamification approaches specifically designed for human digestive system learning at the elementary school level. Unlike previous studies that predominantly focused on singular aspects—either technological implementation or gamification strategies—this research synthesizes both elements within a comprehensive learning platform, thereby addressing the gap in holistic educational media development for primary science education.

Research Method

The research used the development research method with the ADDIE Model, which consists of five phases: analyze, design, develop, implement, and evaluation (Branch, 2009). Each stage ensures that the product developed is in accordance with students' needs and is effective in improving their understanding of the learning material. By applying this model,

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Vol. 12 No. 4 : October 2025
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pp. 1215-1225

researchers can identify needs, design interesting interactive media, and produce its success systematically.

The research began with an analysis of students' learning needs, learning outcomes, student characteristics, and the school environment. Continued at the design stage to ensure that the learning media developed is not only relevant to the needs of students and teachers, but also innovative and effective in supporting learning materials on human digestive organs. At the development stage, the learning media is designed by utilizing the Ariculate Storyline 3 application and HTML5 hosting, using interactive and responsive animation elements. After the media is ready, the media will be tested for validity by expert validation tests of design, media and materials.

Subsequently, the study employed user testing methodology with fifth-grade elementary students as research participants to evaluate media effectiveness and usability, with 3 stages, namely individuals as 3 students, small groups of 10 students, and large groups of 30 students. Data collection was carried out through several methods, including observation, interviews and questionnaires to collect students' and teachers' opinions about learning media. At the evaluation stage validation questionnaires of material experts, media experts, design experts and student response questionnaires as a reference to determine the level of feasibility, practicality, and usefulness of the media. The types of data used are quantitative data and qualitative data with a scale to measure the feasibility of the media.

Table 1. Interval-based score interpretation criteria Likert-type scale

No	Achievement Level	Achievement
1	0% - 19,99%	Totally unworthy
2	20% - 39,99%	Not feasible
3	40% - 59,99%	Less worthy
4	60% - 79,99%	Worth it
5	80% - 100%	Very worthy

Results and Discussion

Media Expert Validation Test

Based on the results of the percentage score from the media expert questionnaire and compared with table 1.1, the score interpretation criteria based on intervals, so that researchers can conclude from each aspect, the cover design and layout aspects received a score of 80%, which is very feasible, the text aspect received a score of 66% which is feasible but with improvements to the type and color of the letters (*font*), the image and button feature aspects obtained 100% very feasible results, the language aspect 93% very feasible, the usage aspect 96% very feasible, and the interactive media aspect 100% very feasible, so that if totaled it becomes 91.6% the product feasibility according to media experts is very feasible or very valid to be continued.

Table 2. Media Expert Validation Score Percentage

Assessment Aspects	Score	Category
A. Cover Design and Layout Aspects	12/15 x 100% = 80%	Very Worth It
B. Text Aspects	10/15 x 100% = 66%	Worth it
C. Image Aspects and Button Features	25/25 x 100% = 100%	Very Worth It
D. Language Aspects	14/15 x 100% = 93%	Very Worth It
E. Usage Aspects	24/25 x 100% = 96%	Very Worth It
F. Interactive Media Aspects	25/25 x 100% = 100%	Very Worth It
Average Score Sum	4.58 out of 5	

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Email:paedagogy@undikma.ac.id

Vol. 12 No. 4 : October 2025
E-ISSN: 2722-4627
pp. 1215-1225

Eligibility Percentage	91,6%
Media Design Validation Category	Very Worth It

Design Expert Validation Test

Based on the results of the percentage score from the design expert questionnaire and compared with table 1.1, the score interpretation criteria based on intervals, so that researchers can conclude from each aspect, the cover design and layout aspects get a score of 80%, which is very feasible, the text aspect gets a score of 60% which is feasible but with improvements to the type and color of the letters (*font*), the image and button feature aspects obtained a result of 76% very feasible, the language aspect 80% very feasible, the usage aspect 80% very feasible, and the interactive media aspect 80% very feasible, so that if totaled it becomes 76.6% of the product's feasibility according to design experts is feasible with improvements, so researchers need to make improvements/revisions and carry out stage 2 validation.

Table 3. Design Expert Validation Score Percentage

Assessment Aspects	Score	Category
A. Cover Design and Layout Aspects	12/15 x 100% = 80%	Very Worth It
B. Text Aspects	9/15 x 100% = 60%	Worth it
C. Image Aspects and Button Features	19/25 x 100% = 76%	Worth it
D. Language Aspects	12/15 x 100% = 80%	Very Worth It
E. Usage Aspects	20/25 x 100% = 80%	Very Worth It
F. Interactive Media Aspects	20/25 x 100% = 80%	Very Worth It
Average Score Sum	3.83 out of 5	
Eligibility Percentage	76,6%	
Media Design Validation Category	Worth it	

After revising the product related to changes and additions of features and media elements, there was a visible increase in validation results. Here is the difference in validation results after revision.

Table 4. Improvement of design expert validation results after revision

Assessment Aspects	Score		Category
	Before	After	
A. Cover Design and Layout Aspects	80%	93%	Very Worth It
B. Text Aspects	60%	100%	Very Worth It
C. Image Aspects and Button Features	76%	96%	Very Worth It
D. Language Aspects	80%	100%	Very Worth It
E. Usage Aspects	80%	96%	Very Worth It
F. Interactive Media Aspects	80%	100%	Very Worth It
Average Score After Revision	4,875 out of 5		
Eligibility Percentage	97,5%		
Media Design Validation Category	Very Worth It		

Material Expert Validation Test

Based on the percentage score results from the material expert questionnaire and compared with table 1.1 score interpretation criteria based on intervals, so that researchers

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Jurnal Penelitian dan Pengembangan Pendidikan
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Email:paedagogy@undikma.ac.id

Vol. 12 No. 4 : October 2025
E-ISSN: 2722-4627
pp. 1215-1225

can conclude from each aspect, the Content Feasibility aspect (Digestive Organ Content) is 100% which is very feasible, the linguistic aspect is 93% very feasible, the material presentation aspect gets a result of 95% very feasible, the game aspect is 100% very feasible, so that if totaled it becomes 97.5% the product feasibility according to the material expert is very feasible to continue.

Table 5. Percentage of Expert Validation Score

Assessment Aspects	Score	Category
A. Content Suitability Aspect (Digestive Organ Content)	20/20 x 100% = 100%	Very Worth It
B. Linguistic Aspects	14/15 x 100% = 93%	Very Worth It
C. Aspects of Material Presentation	19/20 x 100% = 95%	Very Worth It
D. Game Aspects (*Game*)	25/25 x 100% = 100%	Very Worth It
Average Score Sum	4,875 out of 5	
Eligibility Percentage	97,5%	
Media Design Validation Category	Very Worth It	

Individual user trials

There are 3 aspects that students assess regarding media, material, and games (*game*). The following is a table of respondent results:

Table 6. Individual Student Trial Results

Respondent	Aspect										Total Scale	Total Percentage
	Media							Material		Game (*game*)		
Student 1	5	5	5	4	4	5	5	4	5	5	47	94%
Student 2	5	5	5	4	5	5	5	5	4	5	48	96%
Student 3	5	5	5	5	5	5	5	5	5	5	50	100%
Total Overall Scale											145	96,6%

Based on the results of small group tests conducted by 3 students, the results in table 1.6 show that the overall average score reaches 96.6%. The score shows that the media is very feasible to continue.

Small Group User Trial

For small group trials, sThe selected students from the pretest results, namely 3 students with high scores above 80, 4 students with medium scores 61-79, and 3 students with low scores below 60. The following are the results of the small group trial.

Table 7. Small Group Student Trial Results

Respondent	Aspect										Total Scale	Total Percentage
	Media							Material		Game (*game*)		
Student 1	5	5	5	5	4	4	5	5	5	5	48	96%
Student 2	5	5	5	5	5	5	5	5	5	5	50	100%
Student 3	5	5	5	5	4	4	5	5	5	5	48	96%
Student 4	5	5	5	4	5	4	5	4	5	5	47	94%
Student 5	5	5	5	5	5	5	5	4	5	5	49	98%
Student 6	5	5	4	4	5	5	5	5	5	5	48	96%
Student 7	5	5	5	5	5	5	5	4	5	5	49	98%
Student 8	5	5	5	5	5	5	5	5	5	5	50	100%
Student 9	5	5	5	5	5	4	4	5	5	5	48	96%

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Jurnal Penelitian dan Pengembangan Pendidikan
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Email:paedagogy@undikma.ac.id

Vol. 12 No. 4 : October 2025
E-ISSN: 2722-4627
pp. 1215-1225

Respondent	Aspect										Total Scale	Total Percentage
	Media							Material		Game (*game*)		
Student 10	5	5	5	5	5	5	5	5	5	5	50	100%
Total Overall Scale											487	97,4%

Based on the results of small group tests conducted by 10 students, the results in table 1.7 show that the overall average score reaches 97.4%. The score shows that the media is very feasible to continue. Here are some student comments on the media:

Large Group User Trial

After getting good results in small group trials, the researcher continued with large group trials to see better progress and the impact of media in large-scale use. In this case, there were 30 students who participated in the media trial. The following are the results of the large group trial.

Table 8. Large Group Trial Results

Respondent	Aspect										Total Scale	Total Percentage
	Media							Material		Game (*game*)		
Student 1	5	5	5	5	5	5	5	5	5	5	50	100%
Student 2	5	5	5	5	4	5	5	5	5	5	49	98%
Student 3	5	5	5	5	5	5	5	5	5	5	50	100%
Student 4	5	5	5	5	5	5	5	5	5	5	50	100%
Student 5	5	5	5	5	5	5	5	5	5	5	50	100%
Student 6	5	5	5	5	5	5	5	5	5	5	50	100%
Student 7	5	5	5	5	5	5	5	4	5	5	49	96%
Student 8	5	5	5	5	5	5	5	5	5	5	50	100%
Student 9	5	5	5	5	5	5	5	5	5	5	50	100%
Student 10	5	5	5	5	5	5	5	5	5	5	50	100%
Student 11	5	5	4	4	5	5	5	5	5	5	48	96%
Student 12	5	5	5	5	5	5	5	5	5	5	50	100%
Student 13	5	5	5	5	5	5	5	5	5	5	50	100%
Student 14	5	5	5	5	5	5	5	5	5	5	50	100%
Student 15	5	5	5	5	5	5	4	4	5	5	48	96%
Student 16	5	5	5	5	5	5	5	5	5	5	50	100%
Student 17	5	5	5	5	5	5	5	5	5	5	50	100%
Student 18	5	5	5	5	5	4	5	5	5	5	49	98%
Student 19	5	5	5	5	5	5	5	5	5	5	50	100%
Student 20	5	5	5	5	5	5	5	5	5	5	50	100%
Student 21	5	5	5	5	5	5	5	5	5	5	50	100%
Student 22	5	5	5	5	5	5	5	5	5	5	50	100%
Student 23	5	5	4	5	5	5	5	5	5	5	49	98%
Student 24	5	5	5	5	5	5	5	5	5	5	50	100%
Student 25	5	5	4	5	5	5	5	5	5	5	49	98%
Student 26	5	5	5	5	5	5	5	5	5	5	50	100%
Student 27	5	5	5	5	5	5	5	5	5	5	50	100%
Student 28	5	5	5	5	5	5	5	5	5	5	50	100%
Student 29	5	5	4	4	4	5	5	5	5	5	47	94%
Student 30	5	5	5	5	5	5	5	5	5	5	50	100%
Total Overall Scale											1.488	99,2%

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Email:paedagogy@undikma.ac.id

Vol. 12 No. 4 : October 2025
E-ISSN: 2722-4627
pp. 1215-1225

The total results of the questionnaire from 30 students from table 1.8 amounted to 99.2% indicating students' liking for the media. In addition to using written questionnaires, researchers also asked directly as an open assessment for all students, about their feelings when using the media, what made them like the media, and suggestions for researchers regarding the media. Students were very enthusiastic and hoped that there would be media for other subjects.

Discussion

From the comprehensive validation and trial results obtained, findings were systematically reviewed to achieve a holistic evaluation of the interactive media's validity, effectiveness, and attractiveness. In accordance with Sugiyono's (2017) validation methodology, expert evaluations were processed through mean calculations to establish total percentage outcomes that represent the media's validity. This methodological approach is consistent with Akbar's (2013) educational product evaluation framework and Borg & Gall's (2003) research and development validation principles, thereby ensuring systematic and reliable assessment of the developed learning media. The media validity calculation results are presented as follows:

Table 9. Total Results of Interactive Learning Media Validity

Expert Validator	Score Obtained	Score Maximum	Eligibility Percentage
Members of the Media	110	120	91,6%
Design Expert	117	120	97,5%
Subject Matter Expert	78	80	97,5%
Total Media Validity	305	320	95,31%

According to the analysis recorded in Table 1.9, the experts gave a value of 305 from a maximum score of 320, thus giving a percentage result of the validity of this interactive learning media of 95.31%. This result is included in the very valid category, which means that this interactive learning media is very worthy of use because it has been tested both in terms of media, design, and materials used.

In addition to expert opinions, this interactive learning media has been used directly by fifth grade students of SD Negeri Inpres Malompo, Nabire Regency, Central Papua. Students were given the opportunity to directly use interactive learning media that can be accessed with a link in the form of HTML5 using gadgets and internet networks. The following are the results of product trials on users.

Table 10. Total Results of the Effectiveness of Interactive Learning Media

User Validator	Score Obtained	Score Maximum	Eligibility Percentage
Individual	145	150	96,6%
Small Group	487	500	97,4%
Large Group	1.488	1.500	99,2%
Total Media Validity	2.120	2.150	98,6%

The measurement of the effectiveness of this interactive learning media is intended to measure how well the media can attract students' interest in learning and help students understand the concept of human digestive organ material. The results of the analysis obtained are recorded in table 1.10. The students gave a score of 2,120, thus providing a percentage result of media effectiveness of 98.6%. This result is included in the Very Eligible

category, thus indicating that students get benefits and pleasure in using the interactive learning media that has been created.

With this, the results of the research on the questionnaire are in line with research which states that the gamification approach is able to increase students' learning motivation through game elements, such as providing challenges and rewards, as well.*Game* as a learning medium has the potential to create a fun and interactive learning experience (Ayuardini, 2023).

Based on the results of the research and development that has been done, it can be concluded that interactive learning media based on HTML5 with a gamification approach on the material of digestive organs for elementary school students is classified as very feasible and interesting to use as a learning medium. It can be seen from the results of expert validation with a total validation percentage of 95.31% and the total results of the product trial percentage on individual users of 96.6%, small groups of 97.4% and large groups of 99.2%. The results of validation by material experts, learning design experts, and media experts show that this media meets the eligibility criteria in terms of content, visual appearance, technical, and presentation strategy. The trial showed a positive response, where most students felt motivated, interested, and helped in understanding the concept of digestive organs through embedded gamification features, such as challenges, levels, and direct feedback.

Conclusion

The results showed that the interactive learning media based on HTML5 with a gamification approach was considered "very feasible" in terms of content, visual appearance, and technical aspects, and was effective in helping students understand the concept of digestive organs interactively. This media offers an innovative alternative in science learning in elementary schools and has the potential for further development in other materials. This study contributes to the development of gamification-based digital media in elementary education and becomes the basis for further research on the effectiveness and long-term impact of its use.

Recommendation

Based on the results obtained, several recommendations can be put forward as follows:

1. For Teachers and Education Practitioners, it is suggested that this media be used as an alternative interactive and fun learning, especially in science learning on the theme of the human body. The use of media should be accompanied by time management and guidance, so that the student's learning experience is more focused.
2. For Further Developers, this media can be further developed to cover other materials in science subjects or other subjects, so that it becomes part of a more comprehensive thematic learning media series. Integration with LMS platforms and adaptation to various types of devices are also important steps to reach more students effectively.
3. For further researchers, it is recommended to conduct trials on a wider scale and over a longer period of time in order to see the impact of media use on student learning outcomes on an ongoing basis, as well as assess its effectiveness in diverse learning contexts.
4. For Schools and Policy Stakeholders, it is important to provide digital infrastructure support, such as adequate internet access and learning devices that can be used by

Vol. 12 No. 4 : October 2025
E-ISSN: 2722-4627
pp. 1215-1225

students, so that digital-based learning media like this can be implemented evenly and do not create access gaps among students.

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