IJOEM

Indonesian Journal of Elearning and Multimedia
https://ejournal.1001tutorial.com/index.php/ijoem

OPEN ACCESS

Development of FAST (Fun and Smart Testing with Kahoot) Interactive Gamification Media to Improve Students' Understanding of Human Digestive System Materials in Grade V Elementary School

Deulis Ruswati[1*], Endin Mujahidin[2], Rudi Hartono[3]

[1,2,3]Universitas Ibn Khaldun Bogor
Jawa Barat, Indonesia
ruswati.deulis@gmail.com

Article Information:
Received April 16, 2025
Revised May 22, 2025
Accepted May 29, 2025

Keywords:
Gamification; IPAS; Learning Media; Student Understanding

Abstract

Background of study: Many elementary school students have difficulty understanding abstract science concepts, such as the human digestive system. Monotonous conventional learning methods are considered less able to attract students' attention.

Aims and scope of paper: This study aims to develop FAST (Fun and Smart Testing with Kahoot) interactive gamification media to improve students' understanding of the human digestive system material.

Methods: The research used the Borg & Gall development model synergized with the ADDIE model. The subjects of the study were 30 students in grade V of Ciherang State Elementary School, Sukabumi. Data collection techniques include observation, interviews, questionnaires, as well as pretest and posttest tests.

Results: The development and implementation of FAST interactive gamification media had a significant positive impact. Quantitatively, there was a substantial improvement in student learning outcomes; the average pre-test score of 47 rose to 91 in the post-test. An N-Gain analysis result of 0.82 indicated very high effectiveness in improving learning outcomes. The FAST media also underwent validation by learning design, media, and material experts, receiving very high feasibility scores: 94.4% (design experts), 96% (media experts), and 96.8% (material experts). Responses from both students and teachers were overwhelmingly positive. Students reported feeling more engaged, motivated, and enthusiastic. Teachers found the media helpful in explaining abstract concepts, facilitating direct learning evaluation, and creating a more lively classroom atmosphere, praising Kahoot! for its accessibility and flexibility.

Conclusion: FAST interactive gamification media is effective in increasing students' understanding and motivation to learn about human digestive system material.

A. Introduction

Education is a fundamental aspect in the development of a nation because through education, the next generation of the nation is formed to have a balanced intellectual, emotional, and spiritual intelligence (Agbedahin, 2019). Education not only aims to produce knowledgeable graduates, but also to be characterful and adaptive to the challenges of the 21st century (Arkanudin et al., 2025). In this dynamic

How to Cite : Ruswati, D., Mujahidin, E., & Hartono, R. (2025). Development of FAST (Fun and Smart Testing with Kahoot) Interactive Gamification Media to Improve Students' Understanding of Human Digestive System Materials in Grade V Elementary School. *IJOEM Indonesian Journal of E-Learning and Multimedia, 4*(2), 128–153. https://doi.org/10.58723/ijoem.v4i2.420
ISSN : 2830-2885
Published by : Asosiasi Profesi Multimedia Indonesia

digital era, the demand for improving the quality of learning is getting higher, especially at the basic education level (Alenezi et al., 2023). The Merdeka curriculum that is currently implemented requires learning that is differentiated, fun, and relevant to the needs and characteristics of students (Fauzan et al., 2023).

One of the main challenges in the learning process in elementary school is the lack of variety of learning methods and media used by teachers (Puspitarini & Hanif, 2019). Based on various studies and observations, learning is still dominated by conventional approaches, such as lectures and questions and answers, which tend to be one-way and boring (Amirova, 2025; Putri et al., 2025). This approach is not effective enough to build students' understanding in depth, especially in materials that are abstract and require visualization, such as the material of the human digestive system in the subject of IPAS (Natural and Social Sciences) (Resti et al., 2024). This material is often difficult for students to understand because it deals with internal biological concepts that cannot be directly observed by elementary school students (Selviari et al., 2025).

Data from observations conducted at SD Negeri Ciherang in Sukabumi Regency show that more than 70% of grade V students have not reached the Minimum Completeness Criteria (KKM) in the material of the human digestive system. The average score of students is below the specified graduation threshold, which is 62. In detail, out of the 30 students studied, 21 students or 70% obtained scores below the standard, while only 9 students (30%) achieved or exceeded the KKM. This phenomenon shows that there is a gap between the ideal expectations of fun and meaningful science learning and the reality in the field that shows low student learning outcomes and motivation.

This problem certainly cannot be allowed to drag on. Innovation is needed in learning strategies that are able to increase student involvement actively and deeply. One of the approaches that is currently widely studied and applied in the world of education is gamification (Oliveira et al., 2023; Osatuyi et al., 2018). Gamification is the application of game elements such as points, levels, challenges, and rewards into non-game contexts, including in the teaching and learning process (Luo, 2022; Saleem et al., 2022). This approach has been proven to be able to increase student motivation, engagement, and even understanding because it provides a fun, challenging, and interactive learning atmosphere (Alsawaier, 2017; Chans & Castro, 2021).

Several studies have underlined the effectiveness of gamification in learning (Uz Bilgin & Gul, 2020). Fauzi et al. (2022) in his research revealed that the use of game-based educational media can increase students' interest and understanding in science learning. Akbar et al. (2024) also proves that multimedia-based interactive learning media on human digestive system materials can improve student learning outcomes. However, these studies generally still focus on aspects of interest and motivation for learning, and have not comprehensively tested the effectiveness of media in improving understanding through a strong quantitative evaluative approach.

In addition, it is still rare to find research that specifically develops learning media by integrating systematic instructional designs such as ADDIE and Borg & Gall models with popular gamification platforms such as Kahoot!. In fact, this combination of approaches is very promising in designing media that is not only visually and interactive, but also pedagogically strong and can be adapted to learning objectives. Wow! As one of the online quiz platforms that are based on games has great potential in increasing student engagement. These platforms have proven effective in various educational contexts to build a competitive, fun, and learning environment that improves material retention (Hasram et al., 2021; Mazelin et al., 2022; Pitoyo et al., 2020).

The gap found from literature studies and realities in the field shows that there is still a lack of development of gamification-based learning media that is systematically and structured for science learning at the elementary school level, especially in the material of the human digestive system. This research is here to answer this gap, by developing an interactive gamification media FAST (Fun and Smart Testing with Kahoot) which aims to improve students' understanding of the material of the human digestive system. FAST is designed with a scalable instructional design approach and engaging gameplay elements, such as scores, leaderboards, awards, and time limits.

The development of this media refers to the synergy of the ADDIE (Analysis, Design, Development, Implementation, Evaluation) and Borg & Gall development models, to ensure that the resulting media is not only visually appealing, but also has a clear, gradual structure and learning process that is in accordance with the characteristics of grade V elementary school students. The development process starts from needs

analysis, media design and development, validation by experts, limited and extensive trials, to evaluation of media effectiveness using pretest-posttest design and N-Gain analysis.

This research not only seeks to answer technical challenges in science learning, but also strengthens technology-based learning approaches that support the achievement of 21st century competencies, namely critical thinking, communication, collaboration, and creativity. With this medium, students not only learn passively, but also actively build their understanding through hands-on interaction in a fun and competitive learning environment.

The purpose of this study is to develop and test the effectiveness of Kahoot-based FAST interactive gamification media! in improving students' understanding of the material of the human digestive system. This research is expected to make a real contribution to technology-based learning media innovation, encourage digital transformation in basic education, and become a reference for the development of similar media at the level and other learning materials.

B. Research Methods

The research used the Borg & Gall development model synergized with the ADDIE model. The selection of Borg & Gall and ADDIE models in the development of FAST interactive gamification media is based on the consideration of the advantages of each model in supporting the structured and effective educational product development process.

The Borg & Gall model was chosen because it offers a comprehensive product development stage, from needs analysis, design, initial development, expert validation, limited and extensive trials, to product revision. This model is particularly suitable for research and development (R&D) aimed at producing valid, practical, and effective learning products based on input from experts and users.

Meanwhile, the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model is used as a systematic and learning process-oriented instructional design framework. ADDIE helps design a structured learning experience, according to the characteristics of the learners, learning objectives, and gamification approach used.

By combining these two models, the FAST media development process becomes more directed, tested, and based on strong learning theories, so that the resulting media is not only visually appealing, but also pedagogically and functionally qualified in the context of IPAS learning in elementary schools. This study integrates the Borg & Gall and ADDIE models in which there are several integrated research stages, namely:

Table 1. Stages of Combining Borg & Gall and ADDIE Model Steps

ADDIE Stage	Borg & Gall Stage	Explanation
Analysis	1. Informing Collection 2. Planning	Identify the needs of students and teachers, conduct literature studies and collect preliminary data to determine the specification of the media to be developed.
Design	3. Early Product Development	Designing interactive gamification media concepts, arranging learning flows, display designs, and evaluation instruments to be used.
Development	4. Preliminary Trial 5. Product Revision 6. Initial Trial 7. Product Revision	Develop media prototypes, conduct expert validation (materials, media, design), and revise products based on validation results.
Implementation	8. Field Trials	Apply media to students through small and large scale trials, as well as analyse user responses to the media developed.
Evaluation	9. Product Enhancement 10. Dissemination & Implementation	Improving the media based on the results of the trials, as well as disseminating the results of the research so that it can be implemented in wider learning

The subjects of the study were 30 students in grade V of Ciherang State Elementary School, Sukabumi. Data collection techniques include observation, interviews, questionnaires, as well as pretest and posttest tests.

C. Results and Discussion

1. Result

Prior to the development and implementation of the FAST interactive gamification media, the researcher conducted initial observations on the learning outcomes of grade V students of SD Negeri Ciherang on the material of the human digestive system. Based on the data obtained, it is known that the majority of students have not reached the Minimum Completeness Criteria (KKM) set by the school, which is 62.

Of the total 30 students observed, 21 students (70%) obtained a score below the KKM, while only 9 students (30%) managed to achieve or exceed the completeness score. This condition shows that as many as two-thirds of students have difficulty in understanding the material, which shows the need for improvement in the learning process.

Table 2. The Results of Initial Observations of the Learning Outcomes of Fifth Grade Students of SD Negeri Ciherang on the Material of the Human Digestive System

No.	Number of Pupils	Low Score < 62		High Score ≥ 62		Total
		f	%	f	%	%
1	30	21	70	9	30	100

Based on the following table, it clearly illustrates that most of the students of grade V have not understood the material of the human digestive system well. With 70% of students below the threshold of completeness, it can be concluded that the learning approach currently used is not yet effective. This can be caused by several factors, such as: (1) Learning methods that are still conventional, teacher-centered, and minimal interaction; (2) The absence of visual or interactive media that can help explain abstract biological concepts; (3) Lack of student motivation to learn, because the learning process feels monotonous and uninteresting.

These initial conditions show that there is a significant difference between learning expectations and the reality in the field, which is the main and urgent reason for developing more innovative and effective learning media. Thus, this observational data becomes a strong foundation in designing FAST interactive gamification media designed to increase student engagement and understanding through technology-based and game-based approaches.

A. Analysis Research and Information Gathering and Planning

1. Needs Analysis Results

Based on the results of observations, it was found that most of the learning media used at SDN Ciherang still use conventional media, while based on the results of the survey, all of them have good ability to use application Game-based, the school also has a good internet network to access those games.

The first step taken by researchers in developing gamification learning media is to conduct a needs and goal analysis. In this case, the researcher tries to find out:

a) The initial conditions of learning social studies in class V
b) Learning media used in learning
c) Student competency achievements
d) Problems and difficulties that arise
e) Availability of supporting facilities for gamification-based learning media
f) Expectations for learning in the classroom

The efforts made by researchers to find out are:

a) Interviews with grade V students
b) Distribute questionnaires to grade V students
c) Conducting instructional analysis for IPAS subjects, especially human gastrointestinal tract

The results of the interviews, questionnaire responses and analysis results that have been carried out by the researcher are as follows:

1) Interview results

Before conducting interviews with teachers, the researcher compiled an interview grid and drafted a question. The results of the interview are as follows:

a) In less-active learning, students are less actively involved
b) It is difficult to find learning media that can create interactive learning in the classroom
c) Teachers often use conventional learning media in the classroom
d) Schools have adequate facilities for gamification learning

2) Questionnaire results

In addition to interviews, data was also taken through questionnaires about interactive gamification learning media. The questionnaire was given on January 22, 2025 with the results as follows:

Ideal conditions:

a) The teacher delivers the material in a structured and systematic manner.
b) Students actively listen, take notes, and ask questions.
c) There is a two-way interaction between teachers and students.
d) Learning is centered on learning objectives.
e) The learning environment supports focus and discipline.

The real condition:

a) Teachers are more dominant, passive students (teacher-centered).
b) Activities are limited to lectures and note-taking.
c) Minimal interaction or exploratory activities.
d) Students quickly feel bored or lose interest.
e) Assessments focus on the test results, not the process.

3) Conducting instructional analysis for IPAS subjects, especially human gastrointestinal tract

Instructional analysis of human gastrointestinal material, which is structured with a systematic approach to support effective learning planning based on learning objectives is expected:

a) Students are able to correctly explain the organs of the human digestive system and their functions
b) Students are able to explain the process of digestion of food in humans in a logical and logical manner
c) Students are able to show a caring attitude towards the importance of maintaining a healthy digestive system properly

B. Design and Develop Preliminary Product

1. Model Draft 1

After the design stage the learning product must be tested, to find out if it is feasible, effective, and how users interact with the medium. This process is called experimentation or product trials, and is an important part of the research and development (R&D) approach to education. The purpose of the product experiment is to collect empirical data on:

a) Visual quality and media capabilities
b) Student's level of understanding of the media after use
c) Educators' and students' responses to the convenience and benefits of using media.

The product tested in this study is an interactive gamification media using digital videos and quizzes, designed to help IPAS students in grade V learn material about the human digestive tract using the Kahoot application.

The development of learning media must not only focus on the material but also consider various important elements so that the media created is really quality, useful, and in accordance with the needs of students. Some of the key aspects that must be considered when developing interactive gamification learning media are as follows:

a) Material Aspects

The material is arranged based on the core competencies and learning objectives listed in the Independent Curriculum for IPAS class V. The material is arranged in order, starting from the introduction of digestive organs, their functions, and how food is digested. In addition, the selection

of media content is in accordance with the cognitive development of elementary school students, so it is easy to understand and not too complicated.

b) Technology Aspects

Media is created using easily accessible digital platforms, such as video (MP4) that can be played on a variety of devices and the web-based Kahoot app. This makes it easier for teachers, especially in schools that have limited devices. Media is created in an easy-to-use format.

c) Aspect of Display

The media is created with an attractive and consistent design that considers proper colors, illustrations, typography, and layout. A good visual component not only makes the medium more engaging, but it also enhances students' understanding of the material. Each visual component has an educational purpose, helping to convey information in a more understandable and fun way.

d) Assessment Aspects

The media has an integrated evaluation tool (in the form of interactive quizzes) so that teachers can see firsthand how students are performing. Evaluations are conducted in real-time through the Kahoot platform, so teachers can immediately use the results for feedback and reflection on learning.

Here's what it looks like in draft 1:

a) Home Page

To access this media previously click the following link https://create.kahoot.it/story/6118760b-6efb-459f-b98a-4d658a9c259c/sistem-pencernaan-manusia . This is the starting page on the Kahoot platform, the teacher clicks on the Library menu Click the course

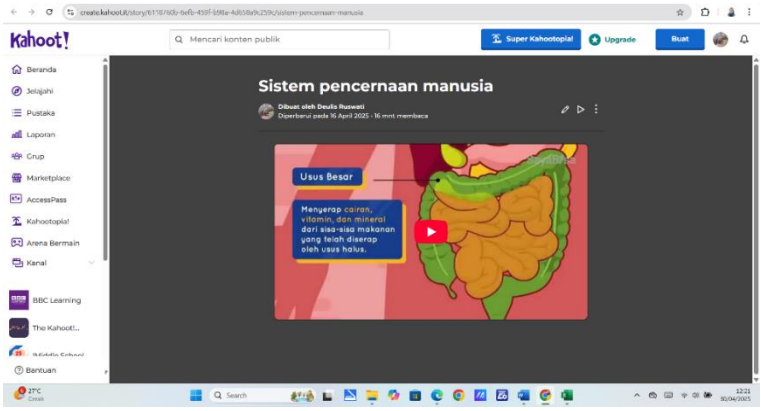


Figure 1. FAST Media Front Page

b) Main menu page

On the human digestive tract course page, two main features appear, namely the learning video feature and the quiz question feature. This is the entrance to learning that will be delivered in class, this display is on the teacher's screen which functions as a controller in learning activities.

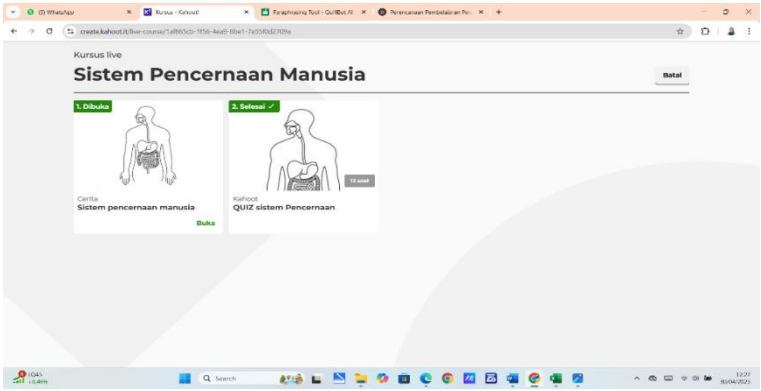


Figure 2. Main Menu Page

c) Learning Video Display

This view first appeared in a learning video. Where in the video shows a series of organs in the human digestive tract.

Figure 3. Learning Video Display Image

d) Interactive Quiz Display for teachers

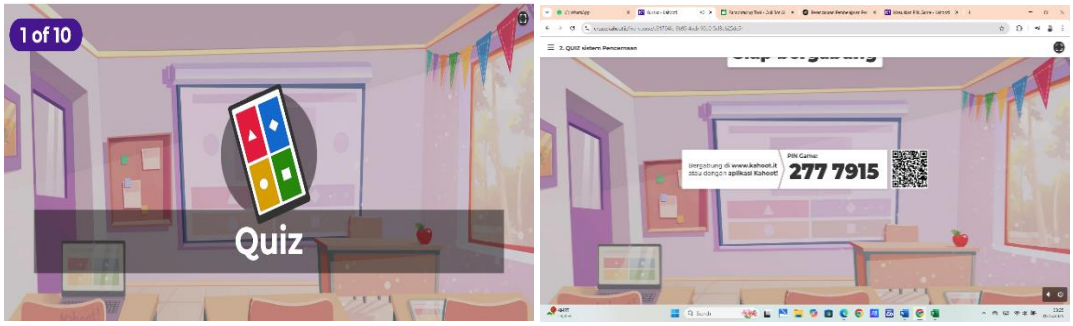


Figure 4. Initial Appearance of the Quiz

e) Quiz View on Student Device

First of all, students log in to Web Kahoot by using the link https://kahoot.it/ enter the PIN number given by the teacher and then click login / login. After there is a countdown, the display is directed to working on the problem.

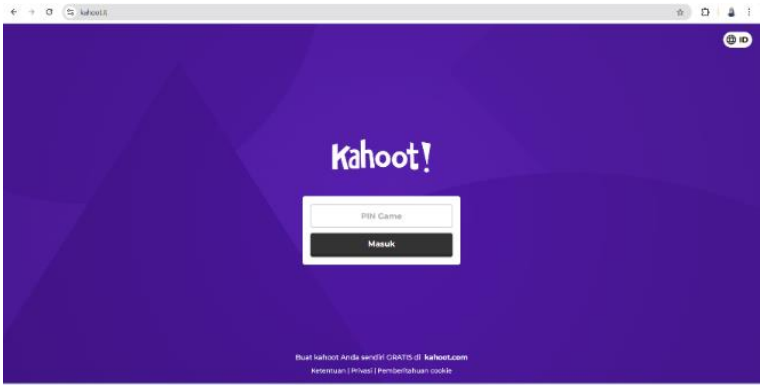


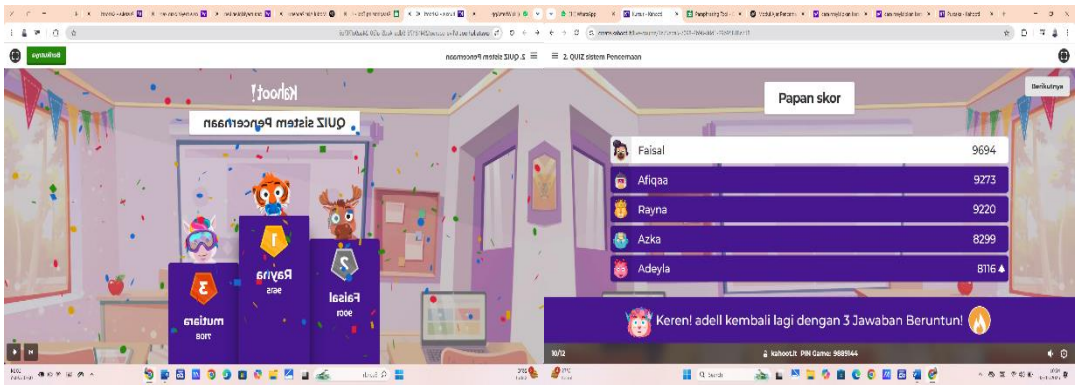
Figure 5. Login Initial View

If the student answers correctly, the correct display will appear, as well as if it is wrong, the tone of the display will be wrong. This is the feedback given to the students' answers.

Figure 6. Feedback Display

f) Ranking Gain View

This will appear when students have done all the questions contained in the quiz.



2. Model Draft 2 (Final Model)

This draft 2 model is the final model where improvements have been made from the previous draft. The repairs were carried out after expert tests from several experts, namely design experts, media experts and material experts. Input was also obtained from students in the small group test process and large group test.

The improvements made include more complete learning features. Here are the improvements made:

a) Product Originality

In the display of learning videos, you must use media that is originally made by yourself instead of the product of others, so the researcher is required to improve the video to bring out more aspects of originality. In this case, the researcher inserted the opening video as an opening in the learning video, also the researcher mentioned the video source used related to the human digestive tract material.

Figure 7. Product Originality Display

b) Adjusting Learning Objectives with Quiz Questions

In the quiz that begins the question is arranged based on the material of the human digestive tract, in this final draft the question is more specific towards the learning objectives so some adjustments are made to make the achievement of the learning carried out more visible

C. Development and Preliminary Field Testing

Results of Feasibility Model Trial Analysis (Model Feasibility) The product feasibility test in this study is an important stage to ensure that *the interactive gamification media FAST (Fun and Smart Testing with Kahoot)* is suitable for use in the learning process. The feasibility test is carried out through a series of evaluations involving expert validation, limited trials, and quantitative and qualitative data analysis.

1. Instructional Design Expert Test

The feasibility test of instructional design was carried out by Dr. Umi Fatonah, M.Pd. she is a lecturer at Ibn Khaldun University Bogor. The following are the results of the feasibility analysis by the Instructional Design Expert:

Table 3. Results of Instructional Design Expert Test Analysis

No	Aspects and Indicators	Value	Quantity (f)
A	Suitability of Learning Objectives		
1	The learning objectives that are prepared are clear and measurable.	4	23
2	Learning objectives are in accordance with the needs and characteristics of grade V elementary school students.	5	
3	The media developed can support the achievement of learning objectives effectively.	4	
4	Learning objectives can be measured using the developed media.	5	
5	Learning objectives are closely related to the material taught in the media.	5	
B	Material Suitability with the Curriculum		
6	The material presented in the media is in accordance with the applicable curriculum.	5	24
7	The learning materials are presented in a way that is easy for students to understand.	5	
8	The media developed is in accordance with the competency standards and basic competencies in the curriculum.	5	
9	The material in the media contains content that is relevant and useful for the development of students' knowledge.	5	

No	Aspects and Indicators	Value	Quantity (f)
10	The material presented in the media contains elements that support students' deeper understanding.	4	
C	Layout and Visual Design		
11	The visual design of the media is interesting and appropriate for the age of grade V elementary school students.	4	
12	The use of colors and fonts in the media is appropriate and does not interfere with the comfort of learning.	4	
13	The layout of the media is easy to understand and does not confuse students in accessing the material.	4	21
14	The visuals used support the understanding of the material being taught.	5	
15	Media design pays attention to aesthetic aspects that are pleasing to students.	4	
D	Media Interactivity		
16	The media allows students to actively interact with the learning material.	5	
17	Interaction with the media can increase students' motivation to learn.	5	
18	The media allows students to repeat learning as per their needs.	5	24
19	Interactive features in the media are easy to use and do not interfere with the learning process.	5	
20	Media interactivity improves students' understanding of human gastrointestinal material	4	
E	Student Engagement and Evaluation		
21	This media can assess students' understanding of the material being taught.	5	
22	The media provides clear and appropriate feedback on mistakes made by students.	5	
23	Evaluation in the media allows students to know their learning progress directly.	5	25
24	This media provides challenges that are in accordance with the abilities of grade V elementary school students.	5	
25	Evaluation in the media can motivate students to improve their learning outcomes.	5	

Based on the results of the instructional design expert's test on the development of interactive gamification media "FAST", the percentage of the results recap was obtained as follows:

$$P = \left(\frac{f}{N}\right) \times 100\%$$

Information:

P : Percentage of answers

f : Total number of answers

N : Maximum score

Table 4. Percentage Acquisition of Instructional Design Aspects

No	Aspects	Frequency (f)	Percentage $P = \left(\frac{f}{N}\right) \times 100\%$	Criterion
1	Suitability of Learning Objectives	23	$P = \frac{23}{25} X\ 100\%$ $P = 92\%$	Highly Worth It

No	Aspects	Frequency (f)	Percentage $P = \left(\frac{f}{N}\right) \times 100\%$	Criterion
2	Suitability of Materials with the Curriculum	24	$P = \frac{24}{25} X\ 100\%$ $P = 96\%$	Highly Worth It
3	Fit of layout and visual design	22	$P = \frac{22}{25} X\ 100\%$ $P = 88\%$	Highly Worth It
4	Media Interactivity Aspects	24	$P = \frac{24}{25} X\ 100\%$ $P = 96\%$	Highly Worth It
5	Student Engagement and Evaluation	25	$P = \frac{25}{25} X\ 100\%$ $P = 100\%$	Highly Worth It
	Average		94,40%	

The recapitulation of the percentage results of the instructional design expert test can be seen through the following graph:

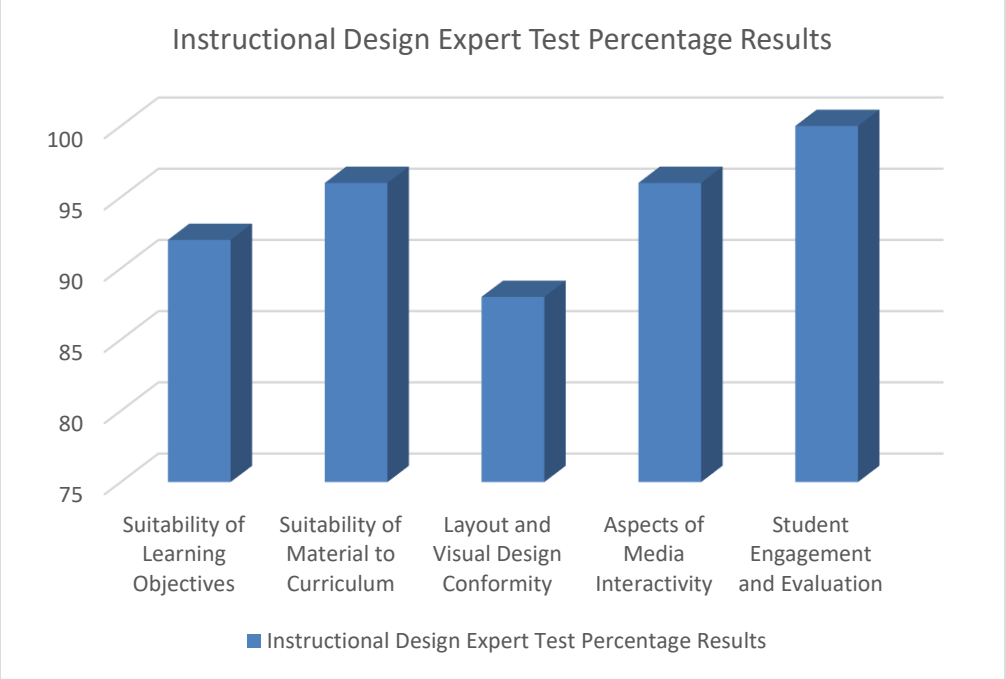


Figure 8. Percentage of Instructional Design Expert Test

Based on the above instruments, the interactive media "FAST" can actively involve students, the evaluations provided can motivate students to improve learning outcomes, have suitability with learning objectives, have suitability with the curriculum, attractive layout and design, and allow students to interact actively. After previously revising the formulation of learning objectives to be adjusted to the indicators in the learning objectives. Based on the results of the recapitulation of the interactive gamification media "FAST" received the criterion of "Very Feasible" for instructional design and can be used in IPAS subjects, especially human digestive tract material.

2. Test Media Experts

The feasibility test for Learning Media was carried out by Dr. Masitowati Gatot M.Pd. she is a lecturer at Ibn Khaldun University Bogor. The following are the results of the feasibility test analysis by the Learning Media Expert:

Table 5. Results of the Learning Media Expert Test Analysis

No	Aspects and Indicators	Value	Quantity (f)
A	Content Fit with the Curriculum		

No	Aspects and Indicators	Value	Quantity (f)
1	This interactive media includes all the materials required in the IPAS curriculum for class V	5	
2	The material presented is relevant to the basic competencies that students must achieve	5	
3	This media conveys concepts in a way that is in accordance with the curriculum standards	5	24
4	This media includes learning objectives that have been set in the curriculum	4	
5	This media supports the achievement of expected competency achievement indicators	5	
B	Media and Learning Integration		
6	This medium can be used effectively in the context of class V learning	5	
7	This media supports a variety of student learning styles, such as visual, auditory, and kinesthetic	5	
8	This medium allows students to actively interact during the learning process	5	24
9	This media encourages students to think critically and creatively in learning	4	
10	This media is easily accessible and used by teachers during learning	5	
C	Visual Appeal and Clarity		
11	The visual design of this media appeals to students of class V	4	
12	The display of this media is quite clear and easy for students to understand	5	
13	The use of colors, fonts, and images in this medium is appropriate and supports the understanding of the material	5	24
14	The visual elements in this medium are not confusing or too much	5	
15	Animations or transitions in this medium support the explanation of the material well	5	
D	Interactivity and Student Engagement		
16	This media provides an opportunity for students to interact directly with the material	5	
17	This media encourages students to actively participate in learning activities	5	
18	This medium allows students to get feedback directly	4	24
19	This media provides challenges or questions that can increase student engagement	5	
20	This media has elements of games or simulations that are interesting for students	5	
E	Technology Feasibility and Accessibility		
21	These media can be easily accessed by students using the available devices	5	
22	This medium is compatible with different types of devices, such as computers and smartphones	5	
23	This medium does not require too high a device or technical specifications to run	5	24
24	This media does not experience any technical glitches or bugs during use	4	
25	This media can run smoothly on an internet connection that is not very fast	5	

Based on the results of the learning media expert's test on the development of interactive gamification media "FAST", the percentage of recap of the results was obtained as follows:

$$P = \left(\frac{f}{N}\right) \times 100\%$$

Information:

P : Percentage of answers

f : Total number of answers

N : Maximum score

Table 6. Percentage Acquisition of Learning Media Aspects

No	Aspects	Frequency (f)	Percentage $P = \left(\frac{f}{N}\right) \times 100\%$	Criterion
1	Content Fit with the Curriculum	24	$P = \frac{24}{25} X\ 100\%$ P = 96%	Highly Worth It
2	Media and Learning Integration	24	$P = \frac{24}{25} X\ 100\%$ P = 96%	Highly Worth It
3	Visual Appeal and Clarity	24	$P = \frac{24}{25} X\ 100\%$ P = 96%	Highly Worth It
4	Interactivity and Student Engagement	24	$P = \frac{24}{25} X\ 100\%$ P = 96%	Highly Worth It
5	Technology Feasibility and Accessibility	24	$P = \frac{24}{25} X\ 100\%$ P = 96%	Highly Worth It
Average			96%	

The recapitulation of the percentage of the Learning Media expert test results can be seen through the following graph:

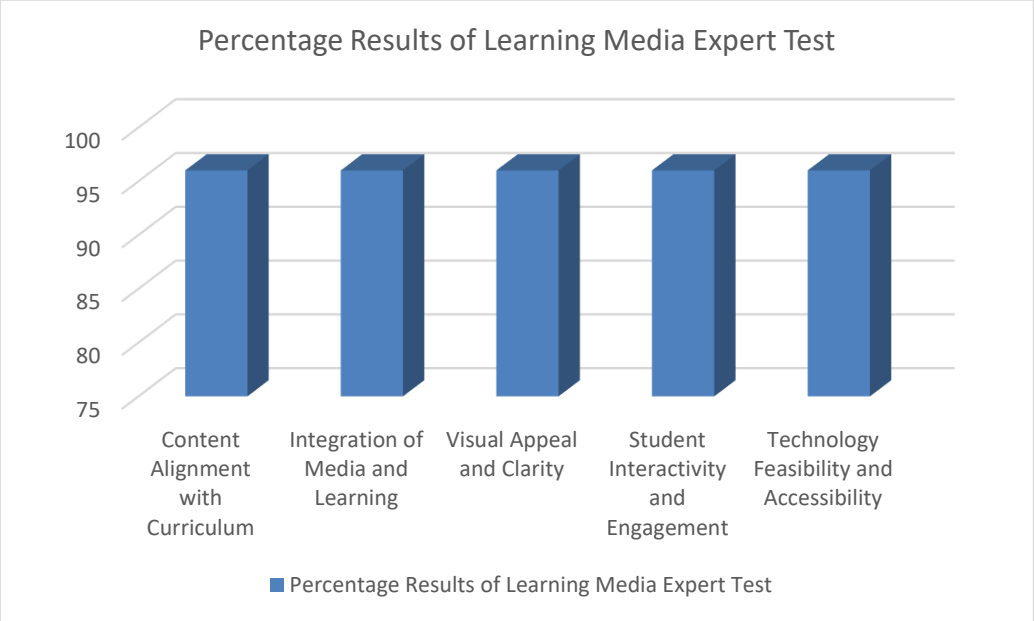


Figure 9. Percentage of Learning Media Expert Test

Based on the above instruments, "FAST" interactive media has content suitability with the curriculum, integration of media and learning, has visual appeal and clarity, has interactivity and student involvement and has technological feasibility and accessibility.

Thus, according to the learning media expert, the interactive gamification media "FAST" based on the results of the recapitulation received the criterion of "Very Feasible" to be used in science studies subjects, especially human digestive tract material.

3. Material Expert Test

The feasibility test of learning materials was carried out by Wawan Setiawan, M.Pd., who is the supervisor of elementary schools in the Nyalindung District area. The following are the results of the feasibility test analysis by the learning material experts:

Table 7. Results of Expert Test Analysis of Learning Materials

No	Aspects and Indicators	Value	Quantity (f)
A	Material Suitability with the Curriculum		
1	Is the material presented in accordance with the IPAS curriculum for grade V elementary school?	5	25
2	Are the learning objectives achieved with the material presented?	5	
3	Is the material easy for elementary grade V students to understand?	5	
4	Can the material encourage students to be active in learning?	5	
5	Is the material in accordance with the cognitive abilities of grade V elementary school students?	5	
B	Media Appropriateness and Learning Objectives		
6	Can the use of interactive media improve students' understanding of the material?	5	24
7	Does the media used attract students' attention?	5	
8	Can the media support the achievement of learning objectives?	4	
9	Does the media provide an enjoyable learning experience for students?	5	
10	Does the medium provide a clear illustration for the material of the human digestive tract?	5	
C	Integration of Content with the Student Experience		
11	Is the content presented in a way that can stimulate students' critical thinking?	5	23
12	Can the media content connect the material to the students' daily experiences?	4	
13	Can students feel the relevance of the material to their lives?	5	
14	Can content increase students' motivation to learn?	5	
15	Does this interactive media provide opportunities for students to interact and discuss?	4	
D	Clarity and Readability of Material		
16	Is the material presented in a language that is easy for students to understand?	5	25
17	Is the structure of the material clearly arranged and in an orderly manner?	5	
18	Is there enough explanation in each topic discussed?	5	
19	Is the material equipped with adequate and easy-to-understand examples?	5	
20	Is the presentation of the material not confusing and easy for students to follow?	5	
E	Relevance and Accuracy of Science		
21	Is the information presented in the material in accordance with the latest scientific knowledge?	5	24
22	Does the material cover all relevant aspects of the concept of the human digestive tract?	5	

No	Aspects and Indicators	Value	Quantity (f)
23	Can the scientific explanations given be easily understood by students?	5	
24	Does the material avoid misinformation or confusing?	5	
25	Can the material expand students' insight into the concept of the human digestive tract in depth?	4	

Based on the results of the test of learning material experts on the development of interactive gamification media "FAST", the percentage of recap of the results was obtained as follows:

$$P = \left(\frac{f}{N}\right) \times 100\%$$

Information:

P : Percentage of answers

f : Total number of answers

N : Maximum score

Table 8. Percentage Acquisition of Learning Material Aspects

No	Aspects	Frequency (f)	Percentage $P = \left(\frac{f}{N}\right) \times 100\%$	Criterion
1	Material Suitability with the Curriculum	25	P= $\frac{25}{25}$ X 100% P = 100%	Highly Worth It
2	Media Suitability with Learning Objectives	23	P = $\frac{23}{25}$ X 100% P = 92%	Highly Worth It
3	Integration of Content with the Student Experience	24	P= $\frac{24}{25}$ X 100% P = 96%	Highly Worth It
4	Clarity and Readability of Material	24	P= $\frac{24}{25}$ X 100% P = 96%	Highly Worth It
5	Relevance and Accuracy of Science	25	P= $\frac{25}{25}$ X 100% P = 100%	Highly Worth It
Average			96,8 %	

The recapitulation of the results of the percentage of the learning material expert test can be seen through the following graph:

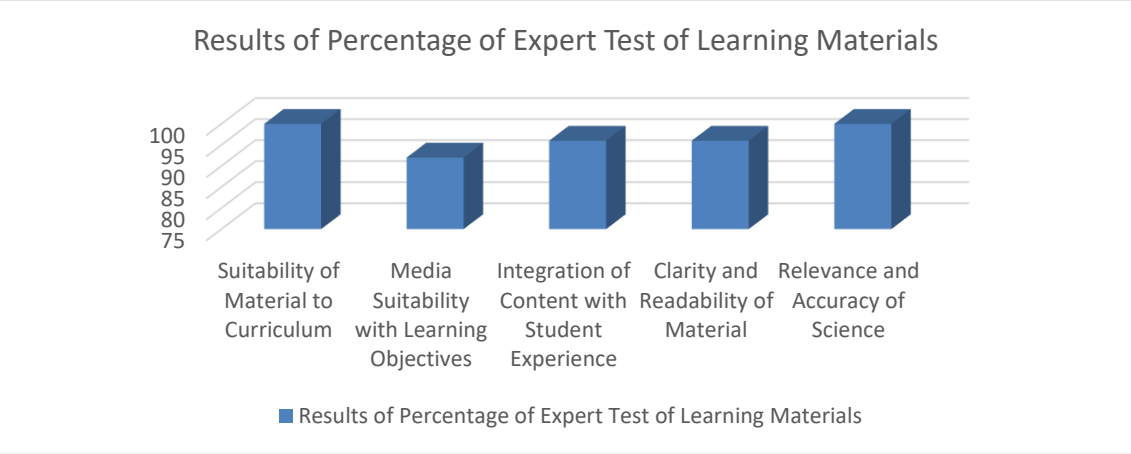


Figure 10. Percentage of Learning Material Expert Test

Based on the media instruments, FAST has the suitability of the material with the curriculum, has the suitability of the media with the learning objectives, has the integration of content with the student's experience, has the clarity and readability of the material, and has the relevance and accuracy of science

Thus, according to the expert, the learning material on the interactive gamification media "FAST" based on the results of the recapitulation obtained the criterion of "Very Feasible" to be used in science subjects, especially human digestive tract material.

4. Small Group Test

The resulting draft model 1 was then tested in a small group consisting of 1 instructional design expert, 1 learning media expert and 6 students using the Guttman scale questionnaire instrument

Table 9. Small Group Test Results

No	Aspects and Indicators	Student Grades						Sum
		1	2	3	4	5	6	
A	Material							
1	The material in this media is in accordance with the learning objectives using gamification media	1	1	1	1	1	0	
2	Human digestive tract material is presented in a massage and logical manner	1	1	1	1	1	1	22
3	The language used is easy for elementary school students to understand	1	1	1	1	1	1	
4	The material in the quiz includes important knowledge that needs to be mastered	0	1	1	1	1	1	
B	Technology							
5	Media can be accessed smoothly on digital devices (laptops/cellphones)	1	1	0	0	1	1	
6	Navigation or use of Kahoot is easy for students to do	1	1	1	1	0	1	15
7	Quizzes can be used interactively by all students	1	1	1	1	1	1	
C	Visual Display							
8	Animations or visual elements don't interfere with learning focus	1	1	1	1	1	1	
9	Colors, images, and designs support material understanding	1	1	0	1	1	1	17
10	Font and text size are easy to read	1	1	1	1	1	1	
D	Valuation							
11	Quizzes provide immediate feedback after students answer	1	1	1	1	1	0	
12	The results of the quiz can be used by teachers to find out students' understanding	1	1	1	1	1	1	11

Based on the results of a small group test on the development of interactive gamification media "FAST", the percentage of recap of the results was obtained as follows:

$$P = \left(\frac{f}{N}\right) \times 100\%$$

Information:

P : Percentage of answers

f : Total number of answers

N : Maximum score

Table 10. Percentage Gain of Small Group Tests

No	Aspects	Frequency (f)	Percentage $P = \left(\frac{f}{N}\right) \times 100\%$	Criterion
1	Material	22	$P = \frac{22}{24} X\ 100\%$ $P = 92\%$	Highly Worth It
2	Technology	15	$P = \frac{15}{18} X\ 100\%$ $P = 89\%$	Highly Worth It
3	Visual Display	17	$P = \frac{17}{18} X\ 100\%$ $P = 94\%$	Highly Worth It
4	Valuation	11	$P = \frac{11}{12} X\ 100\%$ $P = 92\%$	Highly Worth It
	Average		91,75%	

Based on the percentage of small group tests, the results were 91.75%, meaning that the product is very suitable for use.

Thus, according to small group tests, FAST gamification media is very feasible to be used in IPAS learning, especially human gastrointestinal tract material.

5. Large Group Test

Furthermore, the researcher conducted a large group test on 30 students in class V, the following results were obtained:

Table 11. Percentage Gain of Large Group Tests

No	Aspects	Frequency (f)	Percentage $P = \left(\frac{f}{N}\right) \times 100\%$	Criterion
1	Material	112	$P = \frac{112}{120} X\ 100\%$ $P = 93\%$	Highly Worth It
2	Technology	83	$P = \frac{83}{90} X\ 100\%$ $P = 94\%$	Highly Worth It
3	Visual Display	85	$P = \frac{85}{90} X\ 100\%$ $P = 92\%$	Highly Worth It
4	Valuation	54	$P = \frac{54}{60} X\ 100\%$ $P = 90\%$	Highly Worth It
	Average		92,25%	

Based on the acquisition of a large group test percentage, 92.25% results were obtained, which means that the product is very suitable for use. Based on the results of the summary above, it can be explained that the material aspect, the technological aspect, the visual appearance aspect, and the assessment aspect are very good. The percentage of the overall is 92.25% which means that the "FAST" gamification media is very feasible to use.

From the entire product feasibility test, it can be concluded as shown in the following table:

Table 12. Recapitulation of Test Results

No	Feasibility Testing	Value	Criterion
1	Instructional Design	94,40%	Highly Worth It
2	Learning Media	96%	Highly Worth It
3	Learning Materials	96,8%	Highly Worth It
4	Small Group Trials	91,75%	Highly Worth It
5	Large Group Trials	92,25%	Highly Worth It

Based on the recapitulation of the results of the feasibility test, it can be said that the interactive gamification learning media "FAST" is very feasible to be used in learning science studies in class V, especially gastrointestinal materials in humans. As seen in the graph of the plot:

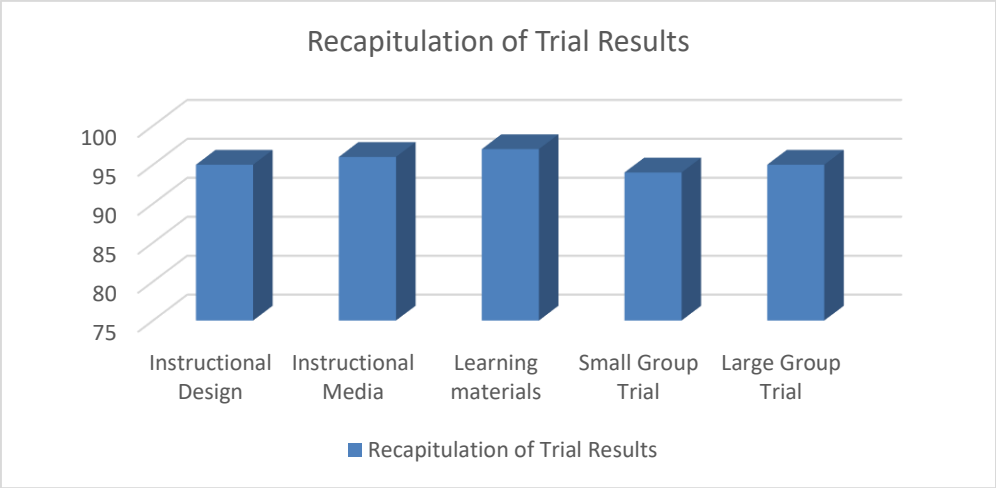


Figure 11. Recapitulation of Test Results

D. Implementation and Operational Field Testing)

1. Model Effectiveness Testing

The effectiveness test is an important stage in research to measure the extent to which the developed media is able to improve learning outcomes or achieve the learning goals that have been set. In the development of FAST (Fun and Smart Testing with Kahoot) media, an effectiveness test is carried out after the product is declared *proper* by experts and through limited trials.

The feasibility test of FAST's interactive gamification media is carried out through several aspects, namely instructional design, learning media, and learning materials. Each aspect is analyzed using the percentage formula from Sugiyono (2014):

$$\text{Percentage (\%)} = \frac{\text{Score obtained } (\sum x) \text{ x } 100\%}{\text{Ideal Maximum Score}}$$

The results of the percentage of each aspect are then interpreted based on the conversion rate of achievement by Sugiyono (2014). Based on the results of the feasibility test percentage analysis in the table above, all aspects tested showed a qualification of "Excellent" with a percentage value of above 90%. This means that FAST's interactive gamification media is considered very feasible to be used in learning without the need for revision. Both in terms of design, materials, media, and the results of small and large group trials, all support the conclusion that this media meets the overall feasibility criteria.

The effectiveness of the model was tested to determine the extent to which FAST's interactive gamification media was able to increase students' understanding of human digestive tract material in the learning of Natural and Social Sciences (IPAS) class V. The effectiveness of the model was tested through a quantitative approach by comparing student learning outcomes before and after using the media, using test instruments in the form of pretest and posttest questions.

The analysis of the effectiveness of FAST (Fun and Smart Testing with Kahoot) interactive gamification media on improving student understanding was carried out using the N-Gain test. This test aims to determine the improvement of student understanding by comparing the results of pretest and posttest scores using the N-Gain calculation carried out with the formula:

$$\text{N-Gain} = \frac{\text{Post Test Score} - \text{Pre Test Score}}{\text{Ideal Score} - \text{Pre Test Score}}$$

According to Hake's (1999) classification, the interpretation of the N-Gain score is as follows:

Table 13. N Value Category – Gain Score

Value N - Gain	Category
$g > 0.7$	Tall
$0.3 \leq g \leq 0.7$	Keep
$g < 0.3$	Low

Table 14. Pretest Score Recapitulation

No	Name	Question Number												True Amount	Score
		1	2	3	4	5	6	7	8	9	10	11	12		
1	Adra Noer Maulidia	1	0	1	0	1	0	0	0	1	1	0	0	5	42
2	Adam Kurniawan	1	0	1	0	0	1	0	1	0	1	0	1	6	50
3	Adellia Sofyani	0	1	1	0	1	0	0	0	1	0	0	0	4	33
4	Adeyla Meysa Bella	1	0	1	0	1	1	0	0	0	0	0	1	5	42
5	Adif Rezika	0	1	0	1	1	0	1	1	0	1	0	1	7	58
6	Afiqa Humaira Azzalea	1	0	0	0	1	0	1	0	0	0	0	1	4	33
7	Ahmad Aqila Atalla	0	1	1	1	0	0	0	1	0	0	1	1	6	50
8	Aldebaran Alby N	0	1	0	1	1	0	1	1	0	1	0	0	6	50
9	Alvin Rizki Pratama	0	1	0	0	1	0	1	0	1	0	1	0	5	42
10	Anatasya	1	0	0	1	0	1	0	1	0	1	0	0	5	42
11	Arvind Elvino Albar	0	0	1	0	1	0	1	0	1	0	1	0	5	42
12	Azka Naufal Akbar	0	1	0	1	0	1	0	1	0	1	0	1	6	50
13	Daffa Pebrian Pratama	1	0	1	0	0	1	1	0	1	0	0	1	6	50
14	Fathya Mischa Atthaya	0	1	1	0	0	0	1	1	0	1	0	0	5	42
15	Gibral Febriansyah	1	0	1	1	0	1	0	1	0	0	0	1	6	50
16	Habibie Apriyadi	1	0	0	1	1	0	1	0	0	0	0	1	5	42
17	Herlan Herliana	1	0	1	0	1	1	0	0	0	0	1	0	5	42
18	Emperor Hani	0	1	1	0	1	0	0	1	0	1	0	0	5	42
19	Khazya Khaiyra A	0	1	0	0	1	0	1	0	1	0	1	1	6	50
20	Muhamad Faisal	1	0	1	1	0	1	1	1	0	1	0	0	7	58
21	Muhammad Fabian Putra	0	1	0	0	1	0	0	1	1	0	1	1	6	50
22	Pearl Adzkia S	0	0	0	1	0	1	0	1	1	1	0	1	6	50
23	Raka Permana Putra	1	0	1	0	0	1	0	0	0	0	1	1	5	42
24	Queen Velisa Meiraz	1	0	0	1	0	0	1	0	1	0	1	1	6	50
25	Queen Sapphire	0	1	1	0	1	0	1	0	1	1	0	0	6	50
26	Holiday rentals in Ramadhani	1	0	0	1	1	0	1	1	0	0	1	1	7	58
27	Rian Rinopaldi	1	0	1	0	0	1	0	1	0	1	0	1	6	50
28	Siti Alifah Hamdani	0	1	0	1	0	1	0	0	0	1	1	0	5	42
29	Tesya Ariyana	0	1	0	1	0	0	1	1	1	0	0	0	5	42
30	Zahra Putri Febriani	1	0	1	0	1	1	0	0	1	0	1	1	7	58
	Sum														1.400
	Average														47
	Maximum Value														3.000
	Percentage (%)														47

Table 15. Recapitulation of Postest Values

No	Name	Question Number												True Amount	Score
		1	2	3	4	5	6	7	8	9	10	11	12		
1	Adra Noer Maulidia	1	1	1	1	1	1	1	1	1	1	1	1	12	100

No	Name	Question Number												True Amount	Score
		1	2	3	4	5	6	7	8	9	10	11	12		
2	Adam Kurniawan	1	1	1	1	1	1	1	1	1	1	1	1	12	100
3	Adellia Sofyani	1	1	1	1	1	1	0	0	1	1	1	1	10	83
4	Adeyla Meysa Bella	1	1	0	1	1	1	0	1	1	0	1	1	9	75
5	Adif Rezika	1	1	1	0	0	1	1	1	1	1	1	1	10	83
6	Afiqa Humaira Azzalea	1	1	1	1	1	1	1	1	1	1	1	1	12	100
7	Ahmad Aqila Atalla	1	1	1	1	1	1	0	1	0	1	1	1	10	83
8	Aldebaran Alby N	1	1	1	1	1	1	1	1	1	1	1	1	12	100
9	Alvin Rizki Pratama	1	1	1	1	1	1	1	1	1	1	1	0	12	100
10	Anatasya	1	1	1	1	1	1	1	1	1	1	1	1	12	100
11	Arvind Elvino Albar	1	1	1	1	1	1	1	1	1	1	1	0	11	92
12	Azka Naufal Akbar	1	1	1	1	1	0	1	0	1	1	1	1	10	83
13	Daffa Pebrian Pratama	1	1	1	0	1	1	1	1	0	1	1	1	10	83
14	Fathya Mischa Atthaya A	1	1	1	1	1	1	1	1	1	1	1	1	12	100
15	Gibral Febriansyah	1	1	1	1	1	1	1	1	0	1	0	1	10	83
16	Habibie Apriyadi	1	1	1	1	1	1	0	1	1	1	1	1	11	92
17	Herlan Herliana	1	1	1	1	1	1	1	1	1	1	1	1	12	100
18	Emperor Hani	1	1	1	0	1	1	1	1	1	1	1	1	11	92
19	Khazya Khaiyra A	1	1	1	1	1	1	0	1	1	1	1	0	10	83
20	Muhamad Faisal	1	1	1	1	1	1	1	1	0	1	1	1	11	92
21	Muhammad Fabian Putra	1	1	1	1	1	1	1	1	0	1	1	0	10	83
22	Pearl Adzkia S	1	1	1	1	1	1	0	1	1	1	1	1	11	92
23	Raka Permana Putra	1	1	1	1	1	1	1	0	0	1	1	1	10	83
24	Queen Velisa Meiraz	1	0	1	1	0	1	1	1	1	1	1	1	10	83
25	Queen Sapphire	1	1	1	1	1	1	0	1	1	1	1	1	11	92
26	Holiday rentals in Ramadhani	1	1	1	1	1	1	1	1	1	1	1	1	12	100
27	Rian Rinopaldi	1	1	1	1	0	1	0	1	1	1	1	1	10	83
28	Siti Alifah Hamdani	1	1	1	1	1	1	1	1	1	1	1	1	12	100
29	Tesya Ariyana	1	1	1	1	0	1	1	1	1	1	1	1	11	92
30	Zahra Putri Febriani	1	1	1	0	1	1	1	1	1	1	0	1	10	83
	Sum														2.717
	Average														91
	Maximum Value														3.000
	Percentage (%)														91

E. Evaluation and Disemination

Table 16. Media Effectiveness Recapitulation

No	Name	Score		Ideal pretest	Postest-Pretest	N-Gain	%
		Postest	Pretest				
1	Adra Noer Maulidia	100	42	58	58	1,00	100
2	Adam Kurniawan	100	50	50	50	1,00	100
3	Adellia Sofyani	83	33	67	50	0,75	75
4	Adeyla Meysa Bella	75	42	58	33	0,57	57
5	Adif Rezika	83	58	42	25	0,60	60
6	Afiqa Humaira Azzalea	100	33	67	67	1,00	100
7	Ahmad Aqila Atalla	83	50	50	33	0,67	67
8	Aldebaran Alby N	100	50	50	50	1,00	100
9	Alvin Rizki Pratama	100	42	58	58	1,00	100
10	Anatasya	100	42	58	58	1,00	100
11	Arvind Elvino Albar	92	42	58	50	0,86	86
12	Azka Naufal Akbar	83	50	50	33	0,67	67
13	Daffa Pebrian Pratama	83	50	50	33	0,67	67
14	Fathya Mischa Atthaya	100	42	58	58	1,00	100
15	Gibral Febriansyah	83	50	50	33	0,67	67
16	Habibie Apriyadi	92	42	58	50	0,86	86
17	Herlan Herliana	100	42	58	58	1,00	100
18	Emperor Hani	92	42	58	50	0,86	86
19	Khazya Khaiyra A	83	50	50	33	0,67	67
20	Muhamad Faisal	92	58	42	33	0,80	80
21	Muhammad Fabian Putra	83	50	50	33	0,67	67
22	Pearl Adzkia S	92	50	50	42	0,83	83
23	Raka Permana Putra	83	42	58	42	0,71	71
24	Queen Velisa Meiraz	83	50	50	33	0,67	67
25	Queen Sapphire	92	50	50	42	0,83	83
26	Holiday rentals in Ramadhani	100	58	42	42	1,00	100
27	Rian Rinopaldi	83	50	50	33	0,67	67
28	Siti Alifah Hamdani	100	42	58	58	1,00	100
29	Tesya Ariyana	92	42	58	50	0,86	86
30	Zahra Putri Febriani	83	58	42	25	0,60	60
	Average	91	47	53	44	0,82	82

This study aims to develop and test the effectiveness of FAST (Fun and Smart Testing with Kahoot) interactive gamification media in improving the understanding of grade V students of Ciherang State Elementary School on human gastrointestinal tract materials. To measure the effectiveness of this media, a trial was carried out on 30 students through the provision of pretest and posttest as well as analysis using the N-Gain formula and percentage of achievement.

1. Pretest and Posttest Results

   Before the use of media, students took the pretest and obtained an average score of 47. After the learning process using FAST media, a posttest was carried out which resulted in a score of 91. Achieving an average score of 82, this media was declared effective in learning the human digestive tract, there was a significant increase in the score of 44 points.

2. N-Gain Analysis

   Data processing was carried out using the N-Gain formula to measure the improvement of student learning outcomes after using FAST interactive gamification media. Based on the calculation results, an average N-Gain value of 0.82 was obtained, which according to the classification of Hake (1999) is included in the high category ($g > 0.7$). These findings show that the use of FAST media is very effective in improving students' understanding of learning materials. In more detail, as many as 10 students (33.3%) achieved a maximum N-Gain score of 1.00, which reflects an improvement in full learning outcomes. Meanwhile, the rest are in the medium to high category range, which still shows a significant

increase. These results indicate that FAST media is able to make a positive and equitable contribution to student understanding, while supporting the success of an active, interactive, and fun learning process.

2. Discussion

The results of the study showed that the use of FAST (Fun and Smart Testing with Kahoot) interactive gamification media significantly improved students' understanding of the material of the human digestive system. This increase is evidenced by an increase in the average score from 47 in the pretest to 91 in the posttest, as well as an N-Gain value of 0.82 which is included in the high and effective category.

Why is FAST Media Effective?

The effectiveness of FAST media in improving student learning outcomes can be explained through several key factors contained in its design:

1. The application of gamification elements such as scores, leaderboards, awards, and time challenges creates a competitive yet fun learning atmosphere. These elements stimulate students' intrinsic motivation and achievement drive, in accordance with the *Self-Determination theory* of Deci & Ryan (2023) which emphasizes the importance of competence, autonomy, and interconnectedness in increasing learning motivation.
2. Media interactivity through the Kahoot! platform allows students to actively engage in the learning process, not only as passive recipients of information, but as participants who directly process, respond and reflect on their understanding. This approach is in line with the *constructivist* theories of Bruner (2023) and Jonassen (1999), which states that meaningful learning occurs when students build knowledge through active experience.
3. The visualization and interesting quiz format assist students in understanding abstract material such as the human digestive system that is difficult to imagine verbally alone. This supports the visual and kinesthetic learning styles common to elementary school students, and helps bridge complex science concepts.

With a combination of systematic instructional design aspects (ADDIE), a real needs-based development approach (Borg & Gall), and reinforcement of motivational elements, FAST media effectively addresses the learning needs of students at the elementary school level.

To corroborate the external validity of these findings, the results of this study were compared with other studies that raised similar themes:

1. Akbar et al. (2024) in his research on multimedia-based interactive media on digestive system materials in class V showed a significant increase in students' understanding after the use of visual media. This shows the similarity of positive effects on the same material and level of education, although Akbar does not explicitly use gamification elements.
2. Fauzi et al. (2022) examines the influence of game-based educational media on the learning interest of science students in elementary school. The results showed that students who learned with game-based media had a higher level of interest and understanding than conventional learning. This corroborates the findings of this study that the aspect of play and fun in learning contribute greatly to learning outcomes.

However, there are also differences that are unique to this study compared to previous studies:

1. Most previous studies used only one development model, whereas in this study, the synergy between the Borg & Gall and ADDIE models was used in an integrated manner. This provides advantages in terms of product feasibility and instructional effectiveness.
2. Previous research has often focused on increasing interest or motivation to learn, while this study quantitatively measured improved comprehension with pretest-posttest tests and N-Gain analysis, providing stronger empirical evidence on the effectiveness of media.

Overall, the results of this study are in line with previous findings that show that interactive learning media, especially those based on games and technology, are effective in improving the learning outcomes of elementary school students, especially in science materials. These similarities in results and context

reinforce the external validity of this study, namely the possibility that FAST media can also be applied effectively in other classrooms and schools with similar characteristics.

However, the systematic, integrative, and focused approach on quantification of understanding used in this study contributes novelty and added value to the research treasure of gamification-based learning media development in Indonesia.

2.1. Implication

This research supports the theory of constructivism which states that students will more easily understand complex concepts through active, contextual, and fun learning activities. Gamification as an innovative learning approach is clear evidence that classical learning theories such as those of Piaget and Bruner remain relevant in today's technology-based learning. FAST media provides a more interesting learning alternative for teachers and students, especially in science subjects. Through a gamification approach, teachers can create a competitive, interactive, and fun learning atmosphere, which will ultimately improve students' learning achievements. This research provides a model for the implementation of digital platform-based media development that can be used as a reference by other learning media developers. The Kahoot-based approach has proven to be accessible, flexible, and expandable for a wide range of materials and levels of education. In the context of the Independent Curriculum which emphasizes differentiated and digital-based learning, the results of this study show that gamification can be a strategy that supports the application of learning according to the needs and character of students.

2.2. Research Contributions

This research makes several contributions to the world of education, especially in the field of learning technology and interactive media development (1) Contribution to the development of gamification-based learning media: FAST is a concrete example of Kahoot-based digital media! which is designed with a systematic instructional approach and gamification principles. This media can be a reference for the development of similar media for other topics or subjects. (2) Contribution to learning practices in elementary schools: This study shows that a game-based approach can be applied effectively in science/science learning, so that it can improve the quality of teaching-learning interactions and student learning outcomes. (3) Contribution to academic literature: This study enriches scientific studies on the effectiveness of gamification in science learning at the elementary school level, especially in Indonesia, which is still relatively limited. The findings of this study can be the basis for further research with a broader and comprehensive approach. (4) Contribution to technology-based educational innovation: FAST is clear evidence that the use of technology in the form of interactive media based on online quizzes can be adjusted to students' learning needs and curriculum goals, and can motivate students to learn more independently and actively

2.3. Research Limitations

The limitations of this study include:

1. The material developed in the media covers only one topic, which is the human digestive tract. In fact, science subjects in class V cover various other organ systems. This causes the media to be limited in thematic nature, and have not been designed for the needs of IPAS learning as a whole. This limitation is due to the focus of research directed at testing effectiveness in a single dense and representative topic.
2. Kahoot has advantages in terms of ease of access and interactivity, but it is highly dependent on the availability of devices and a stable internet connection. There are technical obstacles such as signal interference, uneven internet access, and limited student devices.
3. In terms of design and assessment instruments, this study only uses instruments in the form of multiple-choice tests (pretest and posttest) to measure student understanding, as well as questionnaires to measure students' responses to the media. The assessment of students' skills and attitudes has not been worked on in depth, even though the Independent Curriculum emphasizes holistic and authentic assessments. These limitations are mainly influenced by the limitations of the time and resources available during the research process.
4. On the technical side of media development, the media used has not fully met the principles of accessibility and personalization. Support features for students with special needs, such as voice narration for students with reading difficulties, or local language options for students in certain areas,

are not yet available. In addition, the media has not provided automatic enrichment and remedial, which is actually a great potential of digital-based media.

The limitations also come from the technical capabilities of the researcher in terms of graphic design and digital platform management, so that the media produced is still simple and has the potential to be developed visually and functionally by professionals in the field of educational multimedia.

2.4. Suggestion

1. For Teachers

   It is hoped that teachers can start using gamification-based learning media as a variation in the learning process, especially in abstract and difficult to understand materials. Teachers should also develop their competence in utilizing digital platforms such as Kahoot and compiling quizzes that are relevant to learning outcomes.

2. For Schools

   Schools need to provide support in the form of technological infrastructure facilities (such as internet access and digital devices) to support the implementation of gamification-based learning. Schools are also advised to hold training or workshops on the development of digital learning media for teachers.

3. For Further Researchers

   It is recommended to develop this FAST media in other subjects such as Mathematics or Social Studies, as well as at other levels of education to test the universality of its effectiveness. Advanced research can also measure the impact of these media use on students' critical thinking skills, communication skills, and collaboration as part of 21st century skills.

4. For Educational Media and Technology Developers

   It is necessary to further develop FAST media by adding personalization features, automatic reporting, and multimedia integration to be more adaptive to diverse student learning styles. Mobile learning-based gamification can also be used as a future development so that learning can be done anywhere and anytime.

D. Conclusion

Based on the results of the research and development that has been carried out, it can be concluded that:

1. The development of FAST (Fun and Smart Testing with Kahoot) interactive gamification media has been successfully implemented by integrating the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model which is systematically combined with measures from Borg & Gall. The integration of these two models ensures that the developed media is not only visually appealing, but also pedagogically robust and can be used in learning.
2. Based on the results of the feasibility test from experts, the "FAST" media developed shows very high quality. The assessment from instructional design experts showed a feasibility percentage of 94.4%, from learning media experts 96%, and from learning material experts at 96.8%, all of which were in the very feasible category. These results confirm that the "FAST" media is considered very valid, relevant, and effective for use in learning.
3. Based on the results of the N-Gain calculation, an average increase score of 82 was obtained, which is included in the high category. These findings show that the use of FAST interactive gamification media is significantly able to increase students' understanding of human gastrointestinal tract material in class V science subjects. It can be concluded that this media is not only visually and interactive, but also effective in improving student learning outcomes in a real and measurable way.

E. Acknowledgments

The writer expresses his highest gratitude and appreciation to:

1. Mr. Prof. Dr. H. Endin Mujahidin, M.Si, as the Rector of Ibn Khaldun University Bogor as well as the supervisor I, who has provided support for this academic activity.

2. Mr. Prof. Dr. KH. Didin Hafidhuddin, MS and all the ranks who always support and facilitate us in completing the postgraduate master's program
3. Mr. Dr. Zainal Abidin Arief, M.Sc as the head of the educational technology study program for the support and assistance to the author in completing the lectures of the educational technology study program
4. Mr. Dr. Rudi Hartono, M.Pd as the Secretary of the Educational Technology study program as well as the second supervisor in this research, along with the ranks of educational technology study programs who have guided and provided convenience to the author during lectures at the Master of Educational Technology Study Program at UIKA Bogor
5. All lecturers, expert examiners and staff of the UIKA Bogor Postgraduate Program, for the knowledge, guidance, and motivation provided during the study period.
6. School Supervisors, teachers, and students of SD Negeri Ciherang Sukabumi Regency, who have given permission, support, and participation in the implementation of this research.
7. My beloved husband and three children, who always provide endless prayers, encouragement, and moral and material support.

F. Author Contribution Statement

DR: designing the concept and structure of FAST interactive gamification media, developing Kahoot-based quiz content and design, compiling research instruments, carrying out data collection, analyzing research results, and writing and revising the overall article manuscript.

EM: provides direction in the development of gamification-based learning products, guides the selection of development models (ADDIE and Borg & Gall), and evaluates the suitability of the media with learning theory and instructional design principles.

RH: guide in the process of developing FAST media prototypes, provide input on the design of expert validation instruments, assist in media effectiveness analysis, and direct the preparation of test results reports and data interpretation in article writing.

References

Agbedahin, A. V. (2019). Sustainable development, Education for Sustainable Development, and the 2030 Agenda for Sustainable Development: Emergence, efficacy, eminence, and future. *Sustainable Development*, *27*(4), 669–680. https://doi.org/10.1002/sd.1931

Akbar, A. N., Nurlina, & Magfirah, N. (2024). Penerapan Media Pembelajaran Berbasis Multimedia Interaktif Pada Materi Sistem Pencernaan Manusia Dalam Mata Pelajaran Ipa Kelas V Sdn 98 Bontomanai Bulukumba. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, *09*(2), 466–477. https://doi.org/10.23969/jp.v9i03.16678

Alenezi, M., Wardat, S., & Akour, M. (2023). The Need of Integrating Digital Education in Higher Education: Challenges and Opportunities. *Sustainability (Switzerland)*, *15*(6), 1–12. https://doi.org/10.3390/su15064782

Alsawaier, R. S. (2017). The Effect of Gamification on Motivation and Engagement. *The International Journal of Information and Learning Technology*, *35*(2), 109–123. https://doi.org/10.1108/IJILT-02-2017-0009

Amirova, N. (2025). Traditional vs . Non-Traditional Teaching in Secondary Education : A Comparative Analysis. *Porta Universorum*, *1*(3), 101–109. https://doi.org/10.69760/portuni.010309

Arkanudin, A., Ahmad, H. B., Qur, I. A.-, Raden, U. I. N., & Lampung, I. (2025). Challenges and Opportunities in Implementing the 21st Century Skills Learning Model for Fiqh Subjects. *Al-Bustan: Jurnal Pendidikan Islam*, *2*(1), 58–80. https://doi.org/10.62448/ajpi.v1i2.92

Chans, G. M., & Castro, M. P. (2021). Gamification as a strategy to increase motivation and engagement in higher education chemistry students. *Computers*, *10*(10), 1–24. https://doi.org/10.3390/computers10100132

Fauzan, F., Ansori, R. A. M., Dannur, M., Pratama, A., & Hairit, A. (2023). The Implementation of the Merdeka Curriculum (Independent Curriculum) in Strengthening Students' Character in Indonesia. *Aqlamuna: Journal of Educational Studies*, *1*(1), 136–155.

https://doi.org/10.58223/aqlamuna.v1i1.237
Fauzi, M. H., Mutaqin, E. J., Rusmana, A., & I.Taofik, D. B. (2022). Pengaruh Media Pembelajaran Game Edukasi Terhadap. *CaXra : Jurnal Pendidikan Sekolah Dasar*, *2*(2), 134–141. https://doi.org/10.31980/caxra.v2i2.853
Hasram, S., Nasir, M. K. M., Mohamad, M., Daud, M. Y., Abd Rahman, M. J., & Mohammad, W. M. R. W. (2021). The Effects of WordWall Online Games (WOW) on English Language Vocabulary Learning Among Year 5 Pupils. *Theory and Practice in Language Studies*, *11*(9), 1059–1066. https://doi.org/10.17507/tpls.1109.11
Luo, Z. (2022). Gamification for educational purposes: What are the factors contributing to varied effectiveness? *Education and Information Technologies*, *27*(1), 891–915. https://doi.org/10.1007/s10639-021-10642-9
Mazelin, N., Maniam, M., Jeyaraja, S. S. B., Ng, M. M., Xiaoqi, Z., & Jingjing, Z. (2022). Using Wordwall to Improve Students' Engagement in ESL Classroom. *International Journal of Asian Social Science*, *12*(8), 273–280. https://doi.org/10.55493/5007.v12i8.4558
Oliveira, W., Hamari, J., Shi, L., Toda, A. M., Rodrigues, L., Palomino, P. T., & Isotani, S. (2023). Tailored gamification in education: A literature review and future agenda. In *Education and Information Technologies* (Vol. 28, Issue 1). Springer US. https://doi.org/10.1007/s10639-022-11122-4
Osatuyi, B., Osatuyi, T., & De La Rosa, R. (2018). Systematic review of gamification research in is education: A multi-method approach. *Communications of the Association for Information Systems*, *42*(1), 95–124. https://doi.org/10.17705/1CAIS.04205
Pitoyo, M. D., Sumardi, & Asib, A. (2020). Gamification-based assessment: The washback effect of quizizz on students' learning in higher education. *International Journal of Language Education*, *4*(1), 1–10. https://doi.org/10.26858/ijole.v4i2.8188
Puspitarini, Y. D., & Hanif, M. (2019). Using Learning Media to Increase Learning Motivation in Elementary School. *Anatolian Journal of Education*, *4*(2), 53–60. https://doi.org/10.29333/aje.2019.426a
Putri, F. A., Islam, U., Sulthan, N., Saifuddin, T., & Belajar, M. (2025). Peningkatan Motivasi Belajar Siswa Melalui Penerapan Pendekatan Contextual Teaching and Learning pada Mata Pelajaran Ilmu Pengetahuan Alam dan Sosial Kelas IV Madrasah Ibtidaiyah Negeri 2 Bungo. *Edu Society: Jurnal Pendidikan, Ilmu Sosial, Dan Pengabdian Kepada Masyarakat*, *5*(1), 1321–1328. https://doi.org/10.56832/edu.v5i1.1015
Resti, N., Ridwan, R., Palupy, R. T., & Riandi, R. (2024). Inovasi Media Pembelajaran Menggunakan AR (Augmented Reality) pada Materi Sistem Pencernaan. *Biodik*, *10*(2), 238–248. https://doi.org/10.22437/biodik.v10i2.34022
Saleem, A. N., Noori, N. M., & Ozdamli, F. (2022). Gamification Applications in E-learning: A Literature Review. *Technology, Knowledge and Learning*, *27*(1), 139–159. https://doi.org/10.1007/s10758-020-09487-x
Selviari, S., Rosidah, C., & Rosmiati, R. (2025). Peningkatan Hasil Belajar IPAS Materi Sistem Pencernaan Manusia melalui Penerapan Game Based Learning pada Siswa Kelas V SDN Dukuh Kupang 3 / 490 Surabaya. *Dinamika Pembelajaran : Jurnal Pendidikan Dan Bahasa*, *2*(1), 2025. https://doi.org/10.62383/dilan.v2i1.1178
Uz Bilgin, C., & Gul, A. (2020). Investigating the Effectiveness of Gamification on Group Cohesion, Attitude, and Academic Achievement in Collaborative Learning Environments. *TechTrends*, *64*(1), 124–136. https://doi.org/10.1007/s11528-019-00442-x