

Game Education Construct 2 : Generation Z Science Learning Solutions

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Abstract. The use of learning media is very important for students for the learning process as an intermediary to convey messages or information. Game education can affect the cognitive function and motivation of students and stimulate the curiosity of learners, especially when entering tantangan and fantasy elements into an educational game. The purpose of this study is to determine the feasibility of learning media in the form of educational game applications on respiratory system material and student responses in its use. In this study, the media developed was in the form of a construct 2-based game education. This type of research is R&D using a model developed by Robert Maribe Branch, namely the ADDIE model. The results of the research obtained learning media in the form of decent and interesting based game education to be used as learning media. With the average percentage of validation assessments obtained from 85.18% from media experts, 94.79% from material experts and 93.75% from linguist assessments with the category of very decent. The use of game education learning media by students received a response of 81.25% which showed that the media was very interesting and worth using, these results were obtained through filling out questionnaires conducted using two classes.

Keywords: game education, game construct 2, generasi Z

Introduction

Ideal science learning is a teaching and learning process that is not only focused on the results to be achieved by students, but how the ideal stage of the learning process is able to provide good understanding, intelligence, perseverance, opportunity and quality, and can provide good behavior changes and can apply in everyday life (Lestari et al., 2019; Cahyati et al., 2022).

According to Triono, the characteristics of integrated science learning include: 1) learning from different fields of science; 2) a learning approach that connects various fields of study or various concepts in the field of study; 3) combining a number of concepts in several different fields of study; 4) learning planning, learning implementation, and learning assessment are packaged according to certain themes and mutual cohesiveness (Nurul, 2018; Ritonga et al., 2022).

Integrated science learning must have broad enough insight, high creativity, dare to pack, and also develop material (Lestari et al., 2019; Miswami & Nurcahyo, 2020). This integrated science learning process cannot be separated from the role of a teacher in order to become quality learning (Febriyanti et al., 2021; Ouahi et al., 2022). Meanwhile, there are many obstacles found in the integrated science learning process, one of which is students who consider that science learning is a lot of memorization that is difficult to

remember and learn (Wulandari, 2018), from that statement many students have the view that science lessons are difficult subjects. Factors that inhibit students in learning are: a) internal factors are factors derived from students that are biological such as health, disability. Psychological causes such as intelligence, attention, interests and talents; b) external factors namely factors that come from outside students such as family, society, and factors such as children's learning methods that are not good and excessive tasks (Lestari et al., 2019; Adnan et al., 2021). The success of a learner's learning can also be seen apart from the method used also depends on the device used (Bayram-Jacobs et al., 2019).

Using learning media in the learning process stage turns out to be able to arouse desire or interest, generate motivation and stimulation of learning activities and even bring psychological influences on students (Harahap & Sukriah, 2020). If we observe more carefully, at first learning media was only considered as a tool to help teachers in teaching activities. These tools are intended to help teachers to provide more concrete experiences, to motivate and enhance the absorption and memory of students in learning. Creative use of media will improve students learning well and can improve their performance in accordance with the goals to be achieved (Yamin & Karmila, 2020).

Learning media is a means that can be manipulated and can also be used to influence the thoughts, feelings, attention, and attitudes of students, so as to facilitate the learning process. The use of learning media can also increase the effectiveness of learning. Learning media in the science learning process has a position to enhance the process of teacher interaction with students and student interaction with the science learning environment (Gunawan et al., 2020).

The function of the learning media itself is as a teaching aid, which supports the use of teaching methods used by teachers (Indriyani, 2019; Agustawan & Nurcahyo, 2022) Interactive learning media has great potential to stimulate students to respond positively to the learning material delivered by their teachers. The use of this learning media can also provide a meaningful experience for students. The presence of learning media in this learning process will strengthen the communication process between teachers and students (Limbong, 2021; Wulandari & Djukri, 2022).

Therefore, science learning needs to be supported by technological sophistication. The rapid development of technology can naturally provide benefits in the world of education. But in reality, we still need to work hard to adjust the sophistication of technology to improve the quality of teachers (Tambunan et al., 2021). The use of multimedia in learning activities has not been fully successful, although there have been many studies from experts who state that multimedia is a potential learning medium (Susanto & Akmal, 2019).

One multimedia that today almost every family has is a smartphone. Smartphones in everyday life have many functions such as; communication tools, watching movies, listening to music, calculating tools, internet access, making photos and videos and playing games (Mulida, 2021). Because of the sophistication of smartphones and supported by affordable prices, it becomes reasonable if almost all people begin to depend. If you look at the mena phenomenon in the midst of society, it is a potential to make smartphones an effective teaching medium (Purnamasari & Suryadarma, 2022). One potential that may be developed in smartphone-based teaching is the development of game educations. Games are a potential game to be used as a teaching medium, games can hone children's abilities in learning (Arpiansah et al., 2021).

Learning media in the form of educational games in the learning process has several advantages, namely 1) motivating children's interest in learning the material learned while playing; 2) learners feel happy and comfortable; 3) as a source of self-study; 4) develop

problem-solving skills; 5) Increase confidence in learners as well as learners' self-esteem when they are able to answer and complete games. The main key to why games have the potential to be an effective learning medium is because the motivation to play games for learners is very large. Game education can affect the cognitive function and motivation of students and stimulate the curiosity of learners, especially when entering tantagan and fantasy elements into an educational game (Hardiyanti et al., 2020).

Based on observations in RT 17 Sukarame Village, 20 children who were in junior high school during the Covid-19 pandemic were very intense interacting with games. Games for them are like basic necessities. On the one hand, interactions that are too intense can have a bad impact, both in the academic, social and mental fields. Even the worst can result in a social disorder.

The intense interaction of generation Z with technological sophistication can indeed have bad consequences. Especially if parents tend to ignore children's activities when interacting with digital technology, one of which is games (Sari, 2019). However, there is a covid-19 pandemic where one of the impacts in the world of education is the implementation of online teaching. Online teaching has inevitably opened the tap wide for the millennial generation to interact with smartphones even more intensely and of the 100 children who have interacted with smartphones if asked if you have ever played a game, 100% of them answered that they have. This means that games are no longer foreign to them (Efita, 2019).

Pre-research data is also supported by the fact that in SMPN A Bandar Lampung school, researchers obtained results that in this school most of them have used learning media such as google classroom, e-learning, LCD, Student worksheets (LKPD) due to covid-19 conditions that require online learning, but not optimal enough and still do not use learning media in the form of educational game applications Based on construct 2, because there is still minimal teacher knowledge of this software.

Games are very fun games. Consciously or unconsciously, someone who is busy playing games is actually exerting all their potential to be actively involved in the game (Mulyati & Evendi, 2020). This can be seen from the emotional overflow of someone who is playing games, some are smiling, laughing, shouting hysterically and crying, sometimes we can even meet someone who can't control emotions. A child, who cannot control emotions tends to have a bad impact, both for himself and for others (Ulum, 2018).

Behind the negative things that can be caused by games, there is actually great potential when viewed from the learning side. Games can make people happy, meaning that learning along with playing games allows learning to be more fun (Sei & Cia, 2019). Games require focus and emotion, meaning that learning along with playing games has the potential to increase one's thinking ability and reasoning power (Andini & Saifuddin, 2023). Games require imagination, meaning that learning along with playing games has the potential to develop one's thinking creativity. Of the 3 benefits of playing this game, it is actually a potential that is very prospective to be applied in learning activities. As we all know, learning in a state of happiness, focus, animation and full of imagination will produce much better learning outcomes.

Based on the description above, it is necessary to develop an educative game construct 2 that does not reduce the fun of playing games but can also improve learning outcomes and be able to control the emotions of the players. The purpose of this study is to determine the feasibility of learning media in the form of educational game applications on respiratory system material and student responses in its use.

Methods

Researchers use the type of research and development. This development method is carried out to develop new products or perfect existing products that can be accounted for. The research will follow a model developed by Robert Maribe Branch, namely the ADDIE model. The stages of research to be carried out are as follows:

Table 1. Game Development Work Steps with ADDIE Model

	Analyze	Design	Develop	Implement	Evaluate
Concept	Identify causative factors	Determine how to solve problems and methods of evaluation	Develop and validate products	Prepare the environment, classroom, and learners for product implementation	Assess product quality and implementation process
Steps	Identify the strengths and weaknesses of existing games Assessing the potential of school resources	Create game design and game validation stages	Develop games according to the design that has been made	Communicate with teachers and students to try validated games for learning	Define evaluation criteria Define evaluation devices Conduct analysis of emotions, interests and stress levels of learners
	Analysis summary	Initial design	Product Module	Implementation strategy	Evaluation plan

Data collection techniques in this study are interviews and questionnaire dissemination. In this study, the questionnaires used were validation questionnaires for experts, namely media, material, and language experts, educator questionnaires and student questionnaires. While qualitative data is generated from suggestions and input from validation experts, while quantitative data comes from the results of validation that has been done. For the validation assessment of material, media, and language tests carried out with Likert scale calculations as follows (Riduwan, 2015)

Table 2. Likert scale

Quantitative Analysis	Statement	
	+	-
Totally agree (SS)	4	1
Agree (S)	3	2
Disagree (TS)	2	3
Strongly disagree (STS)	1	4

The level of measurement in this study uses intervals, interval data can be analyzed by calculating the percentage of ideal answers on the questionnaire with the number of components of the research results divided by the number of minimum scores on the questionnaire.

Table 3. Media Eligibility Criteria

Average score (%)	Category
0 - 25	Not worth it
26 - 50	Less viable
51 - 75	Proper
76 - 100	Very decent

The construct 2-based educational game application on the respiratory system material is said to be feasible if the average score obtained is $\geq 51\%$. To determine the attractiveness of media assessed by students using quantitative measurements that have been modified by (Riduwan, 2015).

Table 4. Attractiveness criteria

Average score (%)	Category
0 - 25	Very unattractive
26 - 50	Unattractive
51 - 75	Pull
76 - 100	Very interesting

The storyboard games developed are as follows:

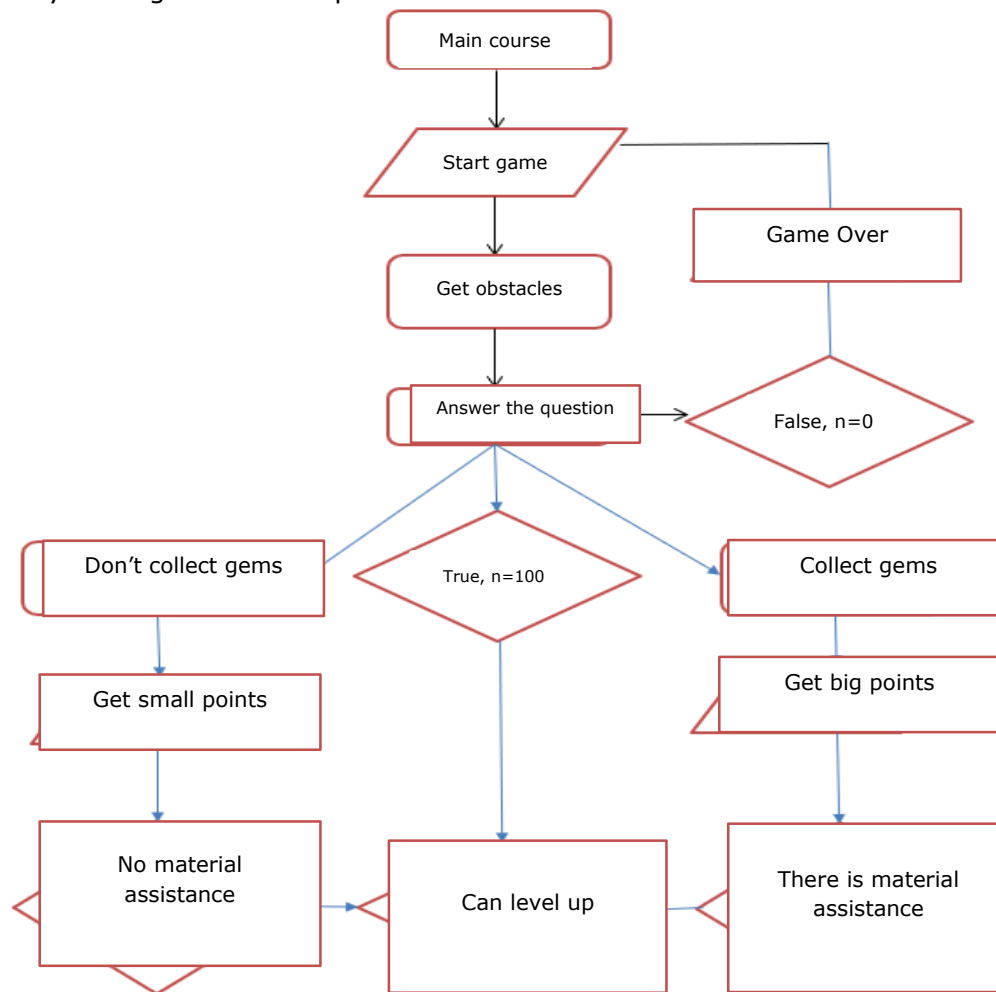


Figure 1. Storyboard Stages Game Construct 2 (Agustiawan & Nurcahyo, 2022)

Results and Discussion

In this study, researchers developed learning media in the form of construct 2-based educational games on respiratory system material in class VIII humans. Construct 2 is software specifically used for making games with the use of simple coding or programming languages that make it easier to use. In making games using construct 2, which is an HTML5-based tool where specifically for the 2D platform, the construct 2 application was developed by Scirra (Muhammad et al., 2020).

The first step is for researchers to conduct research and data collection conducted at SMP Negeri 9 Bandar Lampung, which obtained data results that learning media in schools have used package books available at school, power points to support learning at school. The use of textbooks makes learners less interested and interested in learning. In line with Prastowo who said that the quality of learning becomes low when an educator is only fixated by conventional teaching materials (Gularso et al., 2023).

From the results of pre-research stated that students want interactive media as a learning medium at school. And love games as an interactive medium in learning. Based on the facts from the pre-research results, researchers were motivated to develop learning media in the form of construct 2-based educational games on respiratory system material in class VIII humans which aims to foster student learning interest with interactive learning media. Furthermore, researchers carried out product planning in making this educational game, namely the determination of the concept of gameplay that is adapted to games that are easily understood by students so that it is easy to use and in accordance with the material, game design that is made attractive, the suitability of images and text, the selection of appropriate fonts and sizes, the use of sound that supports game gameplay, as well as designing the ease of using educational game applications so that they can be used easily by students and teachers. At the planning stage in terms of this media, images with attractive colors are used which are useful so that students are interested in using the media. In line with Muthukrishnan (2019) and Mellisa & Saputri (2023) who said that image media is a stage to understand the world and is useful for helping students think creatively.

The next stage is the development of the product design process in the form of construct 2 based educational games on the material energy in human life. In this development process, researchers use software in the form of construct 2 for the basis for making educational game applications. The development of this game, the gameplay is made in advance for each step of the instruction in the flow of the game or often called a flowchart. The following is a look at construct 2 software for making educational games.



Figure 2. Construct 2 start view

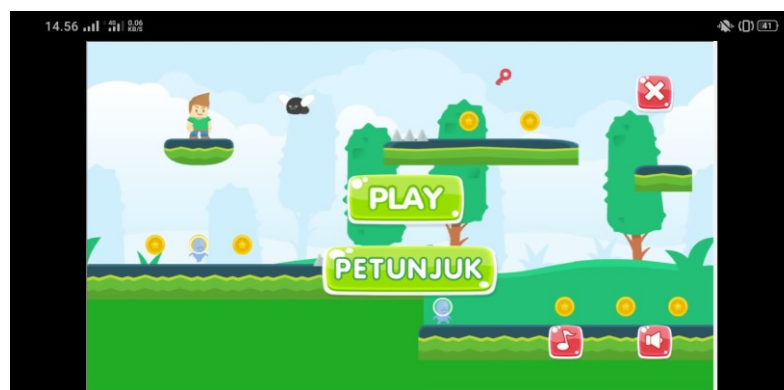


Figure 3. Menu Initial Display



Figure 4. Navigation Button Instructions Display

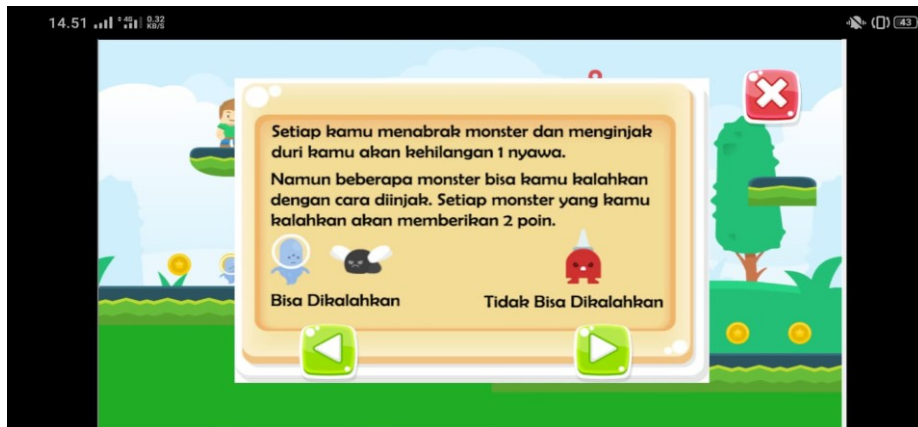


Figure 5. Display Hint Icon Game



Figure 6. Game Level Selection Display

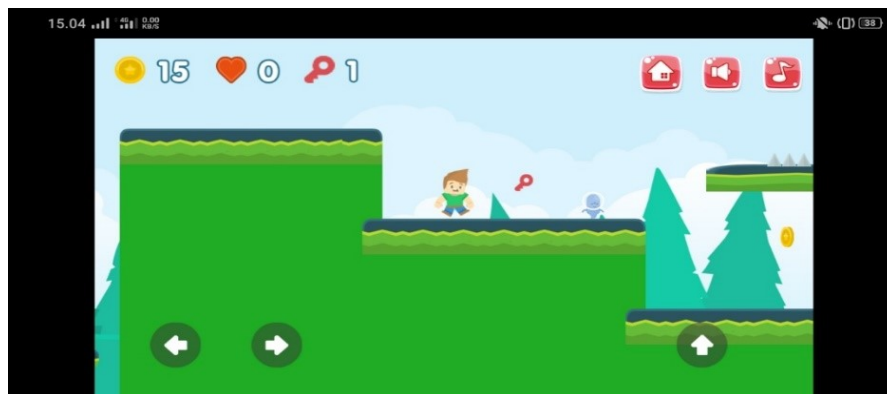


Figure 7. Game Display

After the product is developed, a limited trial is carried out, namely in the form of validation involving material expert lecturers, media expert lecturers, and linguist lecturers to see the feasibility of the developed product. This validation activity is also in accordance with previous researchers, namely Iklamah & Mala (2018), Purnama (2018) who conducted validation tests by 2 lecturers each expert.

Each validator assesses the product according to their field, just as a media expert will assess three aspects namely software, visual communication, and functional which are broken down into 25 statements (Table 5). Based on the average assessment of the results of the media expert test, it is known that the results of all assessments of the first validator, namely VD 1, amounted to 83.33% and were included in the category of media criteria are very feasible. While the validation of the average assessment of the second media expert test by the second validator, VD 2, received a score of 87.03% and was included in the category of very feasible media criteria. Then the percentage results of the two are added together to find out the total average percentage of media expert tests. The percentage result obtained is 85.18% which is included in the category of very feasible in terms of media criteria.

Table 5. Aspects of Media Expert Assessment

No.	Question Indicator
1.	Provisions for the selection of software types (Construct 2) for making educational games used in the development of learning media.
2.	The use of applications in the form of educational games can be managed easily.
3.	The smooth application of the software (Construct 2) in the form of educational games is easy to use and simple to operate.
4.	Creativity and innovation in learning media.
5.	Clarity of instructions for using learning media.
6.	Opportunities for the development of learning media towards the development of science and technology.
7.	Communicative in accordance with the message and acceptable or in line with the wishes of the target.
8.	Creative in the following ideas pouring ideas in media making.
9.	Simple and alluring.
10.	Suitability of audio selection (sound effects, background, music) for the game section
11.	Suitability of visual development selection (layout design, typography).

No.	Question Indicator
12.	Determination of the selection of moving media (animation, avatar) and its resolution.
13.	Accuracy of interactive layout selection (navigation icon).
14.	Suitability of typeface selection.
15.	Font size selection adjustments.
16.	Text and image size fit.
17.	Suitability of image illustrations to the material.
18.	The color clarity of the image illustration.
19.	Menu Display on the application.
20.	Game information.
21.	Back navigation during the game.
22.	Level 1 view.
23.	Level 2 view.
24.	Level 3 view.
25.	Finish view.

Material experts assess three aspects of assessment, namely the suitability of the material, the correctness of the material concept, and the accuracy of the scope of the material which is described into 12 statement indicators to determine the feasibility of the material in the game education product developed (Table 6).

Table 6. Aspects of Media Expert Assessment

No.	Question Indicator
1.	Compatibility of the material with KI.
2.	Compatibility of the material with KD.
3.	Suitability of the material to the Indicators.
4.	Suitability of the material to the Learning Objectives.
5.	The truth of the concept of material in the educational game application.
6.	The material contained in the educational game application is in the form of energy in human life class VIII.
7.	The material contained in the educational game application is presented systematically.
8.	The difficulty level of the question corresponds to the material Energy in Human Life.
9.	Energy matter in human life is easy to understand.
10.	The truth of the problem in theory and concept.
11.	Accuracy of answer key with questions.
12.	Providing feedback on the results of the evaluation.

Based on the average assessment validation table of material expert test results, it is known that the results of all assessments of the first validator, namely VM 1, are 95.83% and fall into the category of media criteria are very feasible. While the validation of the average assessment of the second material expert test by the second validator, VM 2, received a score of 75% and was included in the category of feasible material criteria. Then the percentage results of the two are added together to find out the total average percentage of media expert tests. The percentage result obtained is 85.41% which is included in the category of "very feasible" in terms of material criteria.

Linguists to assess the use of language rules in accordance with the enhanced spelling in the material in the developed educational game play which is translated into 9 statement indicators (Table 7). Based on the results of linguist validation with both lecturers obtaining VB 1, the average percentage result is 100% which is included in the very decent category. Meanwhile, the second validator, VB 2, obtained the average percentage of linguist validation tests, which is 91.67%, which is included in the very decent category.

Table 7. Aspects of Media Expert Assessment

No.	Question Indicator
1.	Sentence structure accuracy.
2.	Use effective sentences.
3.	Standardity of terms.
4.	Understanding of messages or information.
5.	Language accuracy.
6.	Spelling accuracy.
7.	Accuracy of punctuation use.
8.	Consistency of use of terms.
9.	Consistency of symbol or icon usage

Products that have been tested are then subject to limited trial revisions because there are some inputs and suggestions given by special experts who are material experts. After completing the limited trial revision, then validated again to see the feasibility of the product. The average percentage of feasibility assessment is >50% so that the product is said to be feasible, and the results of the trial revision get an average percentage of >50% in each field so that the product is said to be suitable for use as a learning medium to help grade VIII students on respiratory system material in humans. The following are some revisions from material validation experts:

The revised product then enters the next stage, namely the wide-scale trial stage carried out by grade VIII teachers at SMP Negeri 9 Bandar Lampung and also students. Wide-scale trials were carried out in two stages, the first was product trials on a smaller scale, involving only 15 class VIII E respondents. From the results of product trials on a smaller scale, the average percentage result was 81.92% so that it fell into the "very interesting" category. The second wide-scale trial involving 29 respondents of class VIII E obtained an average percentage of 83.95% and class VIII F with an average percentage of 81.80% which stated that the application of construct 2-based educational games on respiratory system material in humans was categorized as "very interesting". In line with research (Salas-Rueda et al., 2020) said that in addition to helping to face the new era of learning, the existence of audiovisual technology with the use of educational games provides an important role for education. Then, according to Kara (2021) and Kalogiannakis et al. (2021) educational games, it plays a role in supporting learning success and becoming a more interactive and fun learning tool because it displays exciting features so that it does not cause boredom when participating in in-game learning. In addition, this game application product will be assessed by teachers at SMP Negeri A Bandar Lampung, getting the average presentation results from filling out the questionnaire, which is 81.25%, which falls into the "very interesting" category. This trial is calculated by calculating the measurement scale of variables with reference from Riduwan (2015) which explains the calculation of the average percentage scale in the study.

The objectives to be achieved in this research are in the form of interactive learning media and suitable for use in learning. The result of this development is in the form of an

educational game based on construct 2 on the material of the respiratory system in humans. This educational game application can be accessed via a smartphone that is owned, making it easy to use anytime and anywhere as a learning medium by students. This educational game can also foster students' interest in learning where students can play while learning, because this game has five levels and to get to the last level the step that must be completed is to answer the questions in the game so as to make students want to learn and read material to complete the levels in the game (Kurniawan et al., 2017; Tahir & Wang, 2020). This is in agreement with (Haka et al., 2020; Syara et al., 2020) that interesting media can increase student learning motivation because of the creation of variety in learning. This also agrees with that Jabaliah et al. (2021) and Gani et al. (2020) motivation is crucial in the learning process to support optimum learning outcomes and students learning effort.

The same research was also conducted by Wook et al. (2020) who conducted research on making educational games with the aim of attracting attention and increasing learning effectiveness, with material expert validation of 86%, media expert validation of 82%, and field practitioners of 93% with participants' responses to educational games included in the very decent category. From the results of the feasibility percentage that has been carried out in the product development stage in the form of construct 2-based educational game applications on respiratory system material in humans, it is declared interesting and feasible to be used as a class VIII learning media specifically for respiratory system material in humans. The response of students to the products developed is happy because students can learn while playing, and also the form of educational game applications that can be accessed on smartphones makes it easier to use learning media to be used anywhere and anytime. The response of students can also be seen from filling out questionnaires from both classes which obtained the sum of the average percentage results of the two classes, which is 82.87% which is included in the category of very interesting and very suitable for use. The advantages of this learning media are also that it can be used without using data packages or the internet, educational game media with a new atmosphere so that it makes it more interesting and fun and can be used anywhere. While the shortcomings of the media products developed are only accessible on the type of smartphone, cannot be installed from the playstore, and is only limited to respiratory system material in class VIII humans.

Conclusion

The conclusion of this study is the feasibility of learning media in the form of educational game applications on respiratory system material in humans aware of the results of expert validation percentages, namely: media experts 85.18%, material experts 94.79%, and linguists 95.81%. Furthermore, the average percentage of student responses from the two classes is 82.87% with the category "very interesting". The response from educators was 81.25% with the category "very feasible" as a class VIII learning media. The response of students to this learning media is happy because students can learn while playing, and also the form of educational game applications that can be accessed on smartphones makes it easier to use learning media to be used anywhere and anytime. The use of game education learning media by students received a response of 81.25% which showed that the media was very interesting and worth using, these results were obtained through filling out questionnaires conducted using two classes.

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