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The Effectiveness of Educational Game Learning Media "APAN" on Learning Outcomes of 5th Grade Elementary School Students

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Abstract
Research on the effectiveness of educational game learning media "APAN" on the learning outcomes of fifth grade elementary school students has been carried out and tested on 46 fifth grade students of SDN Kalirejo, using a Quasi Experimental Design research design and research design using Nonequivalent Control Group Design. The population in this study amounted to 66 students spread over 3 parallel classes and the research sample amounted to 46 students taken with simple random sampling technique. Data collection through tests. Data analysis used the Paired Samples t-Test and Independent Samples t-Test tests which had been tested for the prerequisite assumptions of normality and homogeneity of the data. The results of the Paired Samples t-Test test obtained a p-value <0.001 which shows that there are differences before and after the use of learning videos in the control class and experimental class. The results of the effectiveness test using Independent Samples t-Test obtained a p-value <0.001 which indicates that there is a significant difference between the learning outcomes of the experimental class and the control class. Thus it can be concluded that the educational game learning media "APAN" is effective on student learning outcomes.

1. Introduction

The younger generation's educational foundation is mostly built by Indonesia's basic school system. Giving pupils a foundational education in knowledge and skills is the aim of elementary school education, as stated in Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System. The achievement of educational goals is evident from the learning outcomes attained by students. High learning outcomes are an indication that students have good knowledge (Hamdu & Agustina, 2011). Thus, good learning outcomes can enable students to face challenges at the next level of education with more confidence and competence.

Low student learning outcomes are a issue that is frequebtly encountered in the learning process. In Ardila & Hartanto's research (2017), it was discovered that low student learning outcomes were influenced by 4 factors, namely low student interest, lack of student concentration, low student concept understanding, and lack of student discipline in the learning process. Therefore, effective and innovative learning is needed. Effective and innovative learning in elementary schools has a crucial role because at this level of education the formation of students' mindset and basic skills is very important. This is corroborated in Wijaya & Irianti's research (2017) which found an effective and innovative learning design where students receive more meaningful learning with more fun activities.

Education and teaching in primary schools must also be able to keep up with the demands and challenges of the world along with technological developments. The quality of education in Indonesia is increasingly required to improve in order to keep up with the rapidly developing times (Harsiwi & Arini, 2020). Technology enables collaboration between students and teachers and provides more educational resources. This is in line with Aminingtyas & Wardhani's (2023) opinion that technology can help increase students' interest and motivation to learn. However, challenges related to technology accessibility and appropriate use still need to be studied to ensure that technology truly supports the improvement of education quality.

Some of the demands that must be achieved in learning activities in elementary schools in the previous explanation are inversely proportional to the existing reality. Conventional learning media is still the main choice of teachers in some elementary schools. Therefore, students' involvement during the learning process is reduced, restricting students' comprehension of the subject, especially in science content which is fiber of concepts and requires in-depth understanding. In this discussion, the material in question is human respiratory system material. As stated by Utama, et al (2014), there are many components related to human respiratory system material in order for students to struggle if they only learn from books and hear theories from teachers. So it can be said that the material is an abstract study or subject matter.

Meanwhile, the characteristics of elementary school students who range in age from 7 to 11 are in the concrete operational stage. The theory of cognitive development was proposed by Piaget. At the concrete operational stage, the characteristics of students can already do logical reasoning for things that are real, but for things that are abstract, their abilities are still limited (Trianingsih, 2016). Without real objects, students at the concrete operational stage will have difficulty in understanding the material presented or solving problems related to logic. In addition, elementary school students have diverse backgrounds and levels of material mastery. As stated by Ningsih, et el (2021) that students have their own way of collecting, processing, and storing information. So, sometimes learning methods that are effective for one student are not necessarily effective for other students. Therefore, it is important for a teacher to present concrete objects in learning activities.

The problems found at SDN Kalirejo based on observations and interviews with fifth grade teachers are the lack of optimal learning activities due to the lack of learning media used. Learning activities are more often carried out only by utilizing package books and worksheets where in these conditions students are less enthusiastic in learning activities, so it is suspected that this is the cause of low student learning outcomes, especially in the material of human respiratory organs. Therefore, the discussion in this study is the use of learning media, namely educational games.

The use of educational games in learning has become an increasingly relevant topic in the educational context. Various studies and articles have highlighted the urgency and effectiveness of using educational games as learning media. In a study conducted by Chaidi & Drigas (2022), it was found that students tend to be more excited and enthusiastic when learning through educational games. Student learning results are significantly impacted by an increase in learning motivation.. This can be corroborated in the research of Hidayah & Prasetyo (2022) who reported in their research that the level of effectiveness of educational game learning media developed can improve student learning outcomes. A notable improvement in the learning outcomes of students is also shown in the research of Tristanti, et al (2021) who conducted research on the application of educational game learning media with the results of improving problem solving skills and understanding concepts better than before using educational game learning media. With more active interaction through games, students become more focused and directly involved in understanding the material being taught.

From the literature review and exposure to the background of the problem above, it can be a guideline for research with the title “Effectiveness of Educational Game Learning Media ‘APAN’ on Learning Outcomes of Grade V Elementary School Students”. The educationalgame “APAN” stands for “Human Respiratory Apparatus” which is a learning media developed by Sulani (2022). The purpose of this study was to analyze the application and effectiveness of educational game learning media “APAN” on the learning outcomes of grade V elementary school students.

2. Method

The subject of this research is the educational game learning media “APAN” which is applied and tested on 23 VA class students of SDN Kalirejo. The trial of the device developed in this study used a Quasi Experimental Design research design and a Nonequivalent Control Group Design research design as described in the following table (Sugiyono, 2016).

Table 1. Experimental Research Design

Group	*Pre-test*	Treatment	*Post-test*
Experiment	O_1	X	O_2
Control	O_3		O_4

Source: (Sugiyono, 2016)

Description:
X = Using educational *game* learning media "APAN"
O_1 = *Pre-test* value of the experimental group before treatment
O_2 = *Post-test* value of experimental group after treatment
O_3 = *Pre-test* value of control group before treatment
O_4 = *Post-test* value of the control group after treatment

This research was conducted using research procedures including the preparation, implementation, and data management and data analysis stages.

In the preparation stage, research planning, literature review, and validation of research instruments were carried out. The validation stage aims to determine the validity of the instrument used in data collection. The validity test was carried out through 2 stages, namely the content validity test and the item analysis validity test. The content validity test was carried out by human respiratory system material experts including M. Luthfi Oktarianto, M.Pd. and Santy Dinar Permata, M.Pd. The item analysis validity test includes validity, reliability, distinguishing power, and difficulty level. Based on the two validity tests that have been carried out, the results of 15 questions are valid and can be used for testing.

In the implementation stage, 2 meetings were held with the time allocation for each meeting of 2 lesson hours (1JP = 35 minutes). Before and after implementation, tests were given to both experimental and control classes. The results of both will be compared to determine the increase in student learning outcomes before and after learning. Implementation in the experimental class was treated using the educational game "APAN", while the control class used a learning video which was the learning media that had been used by the teacher.

Data collection techniques are carried out by giving tests that aim to determine student learning outcomes. Student learning outcomes are divided into 2, namely the pre-test before treatment, and the post-test after treatment. The research data were analyzed quantitatively using hypothesis testing with the prerequisite assumptions of normality and homogeneity.

3. Results and Discussion

3.1. Student Learning Outcomes in the Control Class

Research on the control class was conducted in class VC SDN Kalirejo. Data was gathered for 2 meetings with the time allocation for each meeting of 2 lesson hours (1JP = 35 minutes). The activities carried out in the control class were not all that different from the activities carried out in the experimental class. The distinction between the control class and the experimental class is only in the learning media used, namely the control class using learning video media found on the YouTube platform. Pratiwi & Hapsari (2020) stated that learning videos on the YouTube platform make learning activities interesting so that they can stimulate students' higher-level thinking skills.

Research on the control class was conducted in class VC SDN Kalirejo. Data collection was carried out for 2 meetings with the time allocation for each meeting of 2 lesson hours (1JP = 35 minutes). The activities carried out in the control class were not much different from the activities carried out in the experimental class. The difference between the control class and the experimental class is only in the learning media used, namely the control class using learning video media found on the YouTube platform. Pratiwi & Hapsari (2020) stated that learning videos on the YouTube platform make learning activities interesting so that they can stimulate students' higher-level thinking skills.

Learning activities in the control class are composed of several learning objectives. In each learning objective, the results will be assessed before and after the use of learning video media in learning activities. Student learning outcomes are calculated on each learning objective and then the average is taken on each learning objective that has been formulated. Student learning outcomes

before and after the use of learning video media on each learning objective are presented in a histogram in Figure 1 below.

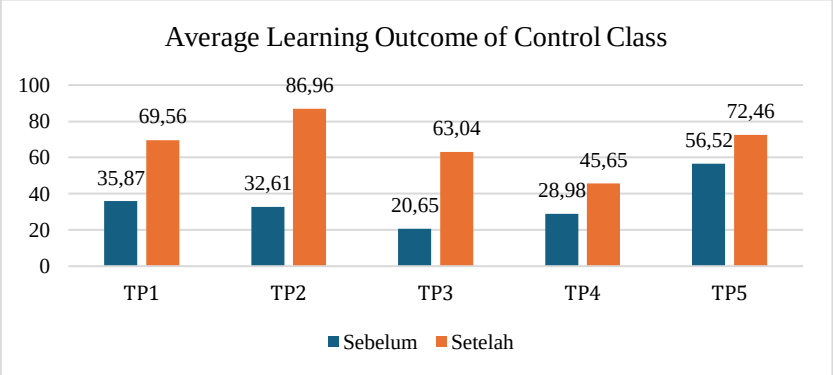

Figure 1. Average Learning Outcome of Control Class

Based on Figure 1, it is shown that there are 5 learning objectives measured on student learning outcomes. Learning objective 1 (TP1) is that through the activity of observing the material of human respiratory organs in the learning video, students are expected to be able to show human organs correctly. The formulation of the first learning objective (TP1) shows an increase in student learning outcomes before and after learning using learning videos. According to cognitive learning theory, the visualization provided by learning videos is quite effective in helping students in the process of assimilation and accommodation of new information (Thobroni, 2015). Learning videos can provide a clear picture of the respiratory organs that support students in developing their knowledge schemes about the subject.

The second learning objective (TP2) expected students to be able to determine the function of each organ in the human respiratory system and explain the role of each organ in the human respiratory process appropriately. Before learning, the average score obtained by students was only 32.61 and after learning using learning videos increased to 86.96. This significant increase shows that learning videos can help students understand the function and role of respiratory organs. By seeing animations and visual explanations, students can more easily understand the complex concepts of the human respiratory system.

From a constructivism perspective, learning videos help students construct their knowledge through visual explanations that are easy for students to follow. Therefore, the improvement in additionally, learning consequences can be observed from the third learning objective (TP3) which formulates that students are supposed to be able to elaborate on their understanding of human respiratory subject and sequence the human respiratory process. The learning video provides a systematic and structured explanation of the breathing process so that it can help students remember and understand the correct sequence. In addition, Isnaini, et al (2023) explained that learning through learning videos can help generate student interest in learning.

The increase in student learning outcomes in the fourth learning objective (TP4) can be seen from the histogram in Figure 5.1. This improvement shows that the learning video helps students in analyzing the difference between chest and abdominal breathing although the improvement is not very big. Through careful observation in the video, students can analyze how each type of breathing works and what the differences are. Despite the lack of direct interaction, the learning video still helps students in analyzing information by providing concrete visual examples. This helps students to understand the differences and functions of each type of breathing well.

The fifth learning objective (TP5) is designed so that students can predict external factors that affect the health of human respiratory organs through observing the material in the learning vido. The improvement in students' learning outcomes is also evident in this learning objective. Before learning, the average score of students in predicting these factors was 56.52 which shows that students have a basic understanding of the factors that can affect respiratory health, but are still lacking in the ability to analyze and predict the impact of these factors. after learning activities using learning videos, there was an increase in the average score of students to 72.46.

The difference in student learning outcomes based on the results of the Paired Samples t-Test test on the learning outcomes of control class students, obtained a p-value <0.001 which indicates that Ha is approved because the Sig value is <0.05. This means that there are differences in student learning outcomes before and after the use of learning video media. The effect of student understanding in the control class can be seen through the average value of the pre-test and post-test given at the beginning and end of learning. The average value of the pre-test in the control class was 33.04 and increased in the post-test value of 67.24. The increase in the average score indicates that students were able to improve their understanding significantly. This shows that learning videos function as an effective tool in helping students internalize and understand the concepts taught. Research conducted by Sadewo & Purnasari (2021) proves that learning videos can attract students' interest and curiosity to learn. Through interesting visualization and presentation of information, learning videos can stimulate better cognitive engagement of students.

3.2. Student Learning Outcomes in the Experimental Class

Learning activities in the experimental class are more or less the same as the control class which is composed of several learning objectives. In each learning objective, the results will be assessed before and after the application of the "APAN" educational game in learning activities. Student learning outcomes are calculated for each learning objective and then the average is taken for each learning objective that has been formulated. Student learning outcomes before and after the application of the educational game "APAN" on each learning objective are presented in a histogram in Figure 2 below.

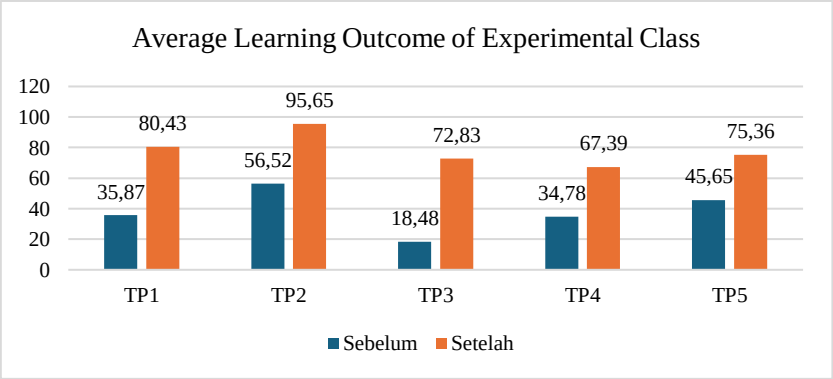

Figure 2. Average Learning Outcome of Experimental Class

The first learning objective (TP1) is that through playing the educational game "APAN", students are expected to be able to correctly point out the human respiratory organs. Based on the histogram, the average score of students increased significantly after the implementation of the educational game "APAN". This significant increase can be attributed to the interactive nature of education that makes students more active in learning. One of the games that supports the achievement of this learning objective is the puzzle. Students learn a lot about the shape of the human respiratory organs that are packaged attractively in the game so that in addition to increasing students' knowledge, they are invited to think critically and remember information better.

Through playing the educational game "APAN", students are expected to determine the function of each organ in the human respiratory system and explain the role of each organ in the respiratory process. Based on the histogram, the second learning objective (TP2) can be achieved well. It can be interpreted that students can understand the function and role of human respiratory organs well after learning with the "APAN" educational game learning media. The game can encourage students to construct their knowledge through exploration and discovery of the functions of each human respiratory organ. This is in line with the theory of constructivism which has the nature of building thoughts so as to produce new thoughts (Suryana et al., 2022).

In cognitive theory, learning involves sequencing steps and processes, such as describing the breathing process which requires deep understanding and critical thinking skills. The improvement in the results of learning objective 3 (TP3) shows that the educational game "APAN" is very effective in helping students understand and describe the human respiratory process. The learning results

before implementation showed that students' understanding of the human respiratory process material was very low. After the application, the results obtained showed a significant increase.

The educational game "APAN" can help students in analyzing the differences between chest and abdominal breathing. This is evidenced by the increase in the average student learning outcomes in learning objective 4 (TP4), namely analyzing the differences between chest and abdominal breathing. Before the application of the media, students' ability to analyze chest and abdominal breathing only reached an average of 34.78 which then increased to 67.39 after the application. This increase of 32.61 points indicates that learning with the "APAN" educational game media is effective in this learning objective. through the visual and interactive elements available in the game, students can understand the mechanisms involved in each type of breathing. Students can listen to the material in a fun way and can be directly involved in the learning process.

The last learning objective (TP5) is more about the influence on the health of the human respiratory system. Students can predict the external factors that affect the health of the human respiratory system. After learning some material about the human respiratory system, it is important to relate it to health. It is intended that students can apply the knowledge they have learned in a real context related to students' daily lives. The application of educational game learning media "APAN" not only succeeded in improving student learning outcomes, but also provided a more meaningful learning experience.

The difference in student learning outcomes based on the results of the Paired Samples t-Test test on the learning outcomes of experimental class students, obtained a p-value <0.001 which indicates that Ha is approved because the Sig value is <0.05. This means that there are differences in student learning outcomes before and after the application of educational game learning media "APAN". The increase in student understanding in the experimental class can be seen through the average pre-test and post-test scores given at the beginning and end of learning. The average pre-test score in the experimental class was 34.78 and increased in the post-test score of 78.54. The results obtained show that the application of educational game media "APAN" has a significant impact on student learning outcomes in the experimental class.

3.3. Effectiveness of Educational Game Learning Media "APAN" on Human Respiratory Equipment Material on Student Learning Outcomes

The results showed a significant increase in student learning outcomes in both the control and experimental classes, but the increase in the experimental class was more significant than the control class. After learning with different learning media, the results on each learning objective in each class were obtained as follows.

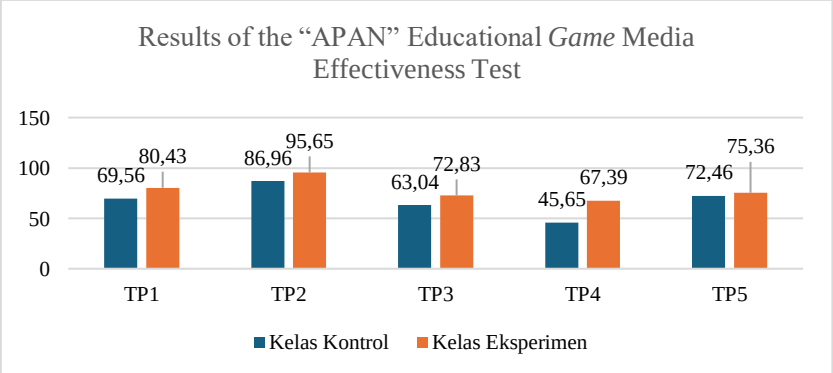

Figure 3. Results of the "APAN" Educational Game Media Effectiveness Test

Based on the histogram data in Figure 5.4 above for each learning objective, it can be seen that student learning outcomes in the experimental class are higher than the control class in all learning objectives. In TP1 the difference is 10.76 points, in TP2 it is 8.69 points, in TP3 it is 9.79 points, in TP4 it is 21.74 points, and in TP5 it is 2.89 points. Overall, student learning outcomes in the experimental class using the "APAN" educational game showed better achievement compared to the

control class using the learning video media. Although both classes showed progress, the experimental class was better able to increase student engagement and motivation, which contributed to a deeper understanding of the material taught.

Student learning outcomes in the experimental class that used the “APAN” educational game showed a more significant increase compared to the control class that used the learning video. The educational game “APAN” offers interactivity, visualization, and simulation that make learning more interesting and effective, thus helping students understand the material better. The effectiveness of the “APAN” educational game learning media in improving student learning outcomes has been proven through various indicators that show its superiority compared to learning video media. The educational game “APAN” has several excellent features that make it more effective in delivering learning materials and increasing student engagement.

To measure student learning outcomes, a measuring instrument in the form of a test whose questions have been tested for validity, reliability, differentiating power, and difficulty level. Some of these tests need to be done to be able to describe the real learning outcomes. The research instruments used in this study have been validated and declared very valid. The results of instrument validation according to material experts using Aiken's item validity index showed a value of 0.82813, which was categorized as very valid. The validation of the questions was also carried out by testing the questions with fifth grade students in the 2023/2024 school year who had taken the material on the human respiratory system. Of the 20 questions given, it was found that 15 valid questions would be used in testing. In terms of reliability, it is stated that the 15 questions are reliable. In the test of differentiating power and difficulty level of the questions, the results were also obtained in accordance with the criteria. This shows that the questions used to test the effectiveness of the educational game “APAN” have a high level of accuracy in assessing student abilities.

In addition, the results of the validation of the educational game product “APAN” also showed very positive results. Validation by material experts showed that aspects of material content, language, material presentation, and independent character were all declared very valid with an average validation of 3.6 or 90% very valid category. Validation by media experts also showed similar results with aspects of software/application, appearance, educational game parts, language, material presentation techniques, and independent characters being declared very valid with an average score of 3.7 or 90% very valid category. User validation also confirmed the validity of aspects of material content, material coverage, software, appearance, game parts, language, material presentation techniques, independent character, practicality, and attractiveness. This shows that the educational game “APAN” has been well designed and developed, meets high quality standards, and is suitable for use in learning.

The results of the Independent Samples t-Test statistical test support this finding, with a p-value of <0.001. This shows that there is a significant difference between the learning outcomes of students in the experimental and control classes. The effectiveness of the “APAN” educational game learning media is also supported by the N-Gain test results obtained. N-Gain test results obtained. The calculated results of the N-Gain test show that the average value of the N-Gain of the experimental class is 0.678 and in the control class is 0.49. These results shows that both classes get a moderate Gain (improvement) category according to the criteria formulated by Hake in Istiqomah, et al (2017). While the category of interpretation of effectiveness obtained experimental class is quite effective because it gets a percentage of 67.84% and less effective in the control class because it gets a percentage of 49%. Interval category interpretation of the effectiveness of N-Gain is also formulated by Hake in Fauziah, et al (2022).

Based on research conducted at SDN Kalirejo Bangil on July 17, 2024 to July 18, 2024, it was found that the effectiveness of educational game learning media “APAN” on student learning outcomes. in learning activities carried out during the study, students who were treated using educational game learning media “APAN” tended to be more active than students who were not treated. Students are very enthusiastic and able to build good cooperation with their group friends during learning activities. Students show a good attitude of responsibility in working on group worksheets. Students' curiosity increased when solving problems given by researchers.

In contrast, in the control class, students were more likely to be silent and only listen to the explanation of the learning video played. Students' curiosity was also less than the experimental class. Students' attitudes were also more individualized when working on group worksheets. The more dominant students worked on the group worksheets themselves, while the less dominant students were silent and even joked with other friends. In addition, researchers also found students in the control class who slept during learning activities.

This finding is relevant to the cognitive learning theory proposed by Jean Piaget and constructivism learning theory by Lev Vygotsky. According to cognitive learning theory, effective learning involves a process of assimilation and accommodation where students build new knowledge based on existing schemas (Thobroni, 2015). Meanwhile, from a constructivism perspective, learning occurs in a social context where interaction with learning media and peers plays an important role (Karwono & Mularsih, 2019). The concept of Zone of Proximate Development (ZPD) is very relevant in the results of this study where learning media acts as scaffolding that helps students achieve higher understanding. Cognitive theory emphasizes the importance of mental processes in learning, where students construct new knowledge based on previous experiences.

By using educational games, students not only passively receive information, but also engage in activities that encourage them to think critically and solve problems. The constructivism approach emphasizes that students learn better through direct experience and social interaction. The educational game “APAN” provides opportunities for students to collaborate and discuss, thus strengthening their understanding. Relevant research from Liani & Tambunan (2023) shows that interactive learning media, such as educational games, can significantly improve student learning outcomes compared to more traditional learning methods, such as videos. Therefore, the use of the educational game “APAN” is proven to be more effective in improving student learning outcomes compared to learning videos.

The significant increase in student learning outcomes in the experimental class shows that the educational game “APAN” not only attracts students' attention but is effective in improving their understanding of human respiratory material. The game provides various challenges and activities that stimulate students' cognitive engagement, making learning activities more fun and more meaningful for students. In addition, the educational game learning media “APAN” allows students to learn according to their own pace of understanding. Students can repeat parts that they find difficult, stop to find the information provided, and continue the game again. This provides flexibility that is rarely found in conventional learning. The educational game “APAN” also allows students to explore the structure and function of respiratory organs interactively. In line with research conducted by Kurnia, et al (2023) who conducted research on educational game media with the analysis conducted that educational games can facilitate students in learning the material well. Students not only do evaluation questions or quizzes but can also play. Students can visualize the breathing process, understand the function of each organ, and see how all components work and form a unified human respiratory system that can be felt every day. This helps students to build a more holistic and comprehensive understanding of the human respiratory system.

Overall, this study shows that the educational game learning media “APAN” is more effective than learning video media in improving student learning outcomes on human respiratory material. Supported by several relevant studies from Juhaeni, et al (2023), Liani & Tambunan (2023), Kurnia, et al (2023), Hidayah & Prasetyo (2022), Wijayanto (2017), and Aniyawati, et al (2023) who have conducted research on learning media with the overall result that the learning media used can improve student learning outcomes. By utilizing the principles of cognitive learning theory and constructivism, the educational game “APAN” can be said to be successful in improving students' understanding and helping them achieve better learning outcomes.

4. Conclusion

Based on the research that has been conducted, the results of the analysis show that there is a significant difference in student learning outcomes in human respiratory material before and after using learning video media in the control class. The average score of students increased from 33.04 in the pre-test and to 67.24 in the post-test. It can be stated that learning video media is effective in improving student learning outcomes. This shows that learning videos are useful for improving student learning outcomes.

From the analysis of differences in student learning outcomes before and after the application of the "APAN" educational game learning media in the experimental class, the data obtained showed a significant increase from the pre-test average value of 34.78 to 78.54 in the post-test. The greater increase compared to the control class shows that the educational game "APAN" has a more substantial impact in improving student learning outcomes on the material of the human respiratory apparatus. The interactive and engaging "APAN" educational game succeeded in involving students more actively in the learning process, thus significantly improving their learning outcomes.

In the analysis of the effectiveness of educational game learning media "APAN" on the learning outcomes of fifth grade students of SDN Kalirejo Bangil, the results of the Independent Samples t-Test statistical test showed a p-value <0.001, indicating a significant difference between the experimental and control classes. In addition, the N-Gain test results showed a higher average value in the experimental class (0.678) compared to the control class (0.49). This confirmed the effectiveness of the educational game "APAN" in improving student learning outcomes. Thus, it can be concluded that the educational game "APAN" is a more effective and efficient learning media in teaching the material of human respiratory organs to grade V elementary school students.

Author Contributions

CrediT roles: Riska Aida Tazkiyah: Conceptualization, Data curation, Formal analysis, Investigation, Resources, and Visualization. Candra Utama: Methodology, Roles/Writing—original draft. Sri Estu Winahyu: Writing—review and editing. All authors have equal contributions to the paper. All the authors have read and approved the final manuscript.

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