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Exploring respiratory system to improve biological learning motivation: resysmart media application

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ABSTRACT

Resysmart is an interactive media on the Respiratory system material, which stands for Smart Respiratory System. This media uses the Adobe Flash CC application. This study aims to measure the effectiveness of Resysmart interactive media in increasing learning motivation. This study used a quasi-experimental method with non-equivalent control group design. The learning model used was problem-based learning (PBL). Samples in this study were students of eleventh grade of social class at SMAN 3 Cibinong, Indonesia, as many as 60 people. The results showed that there was an increase in learning motivation in the experimental class with a pre-test value of 69.20 and a post-test value of 82.00, with a Gain Score of 12.80. N-Gain Score in the experimental class was 0.42, which was classified as moderate, while the control class is 0.08, which was classified as low. After an independent t-test, a significance value of 0.00 <0.05 was obtained, which means there was a significant difference in learning motivation between Resysmart interactive media classes with classes that did not use Resysmart interactive media. This study concluded that Resysmart interactive learning media effectively increases students' learning motivation. Based on these results, it was expected that this interactive media could be developed in other materials so that students' learning motivation can be maintained and improved.

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INTRODUCTION

Education is essential in civilization because through education, it will be born educated generations who can change the destiny of a nation. In the 21st century, education has a vital role in ensuring students have skills to learn and innovate, skills using information technology, media, can work and survive using life skills. In order to achieve success in the 21st century, students also need expertise in the fields of technology, culture, and science that can improve understanding of information. 21st-century capability, according to enGauge consists of digital-age literacy, inventive thinking, effective communication, high productivity (EnGauge, 2003).

Education is closely related to the learning process, namely the collaboration of aspects of learning and teaching that occur in an integrated manner and the interaction between teachers and students (Jihad & Haris, 2012). One of the competencies that must be possessed by a teacher according to Law Number 14 of 2005 concerning Article 10 Teachers and Lecturers are pedagogic, personality, social, and professional competence obtained through professional education. One of the pedagogic competencies of a teacher are preparing and designing learning so that effective learning is created. Effective learning cannot be separated from the role of an effective teacher, the involvement of students, effective learning conditions, and supportive learning resources (Sani, 2016).

In delivering learning, a teacher can use learning media that are available to the materials and infrastructure. Learning media is a tool that functions to carry messages or information aimed at instructional or containing teaching intentions (Arsyad, 2008). Media can also be interpreted as everything that can be used to convey messages from senders to recipients of messages so that they can stimulate students' thoughts, attention, feelings, and interests which in the end the learning process takes place (Sadiman, R., Haryono, & Rahardjito, 2010) In today's digital era, a teacher is required to be able to master technology in the use of learning media, so that learning process can keep up with technological developments.

The development of technology, especially information and communication technology and its ease of use, are critical as the characteristic of 21st-century learning (Faris, 2016). One of the media that are currently developing is interactive multimedia. This media combines and synergizes all media consisting of images, writing, photos, videos, music, animation, narration, and interactivity, which are programmed based on the theory and principles of learning (Warsita, 2008). This interactive multimedia can enhance interaction between teachers and students so that learning can take place effectively (Patel, 2013). The condition of effective learning must include three main factors, namely: (1) Learning Motivation, (2) Learning Objectives, (3) Learning Suitability. Therefore in the preliminary part of learning, before a teacher enters the core material, the teacher is asked to convey the learning objectives and generate learning motivation so that students are ready to receive the learning material that will be delivered (Sani, 2016). This is because a teacher is a facilitator in learning that can provide extrinsic motivation to students (Alhodiry, 2016).

The use of multimedia-based learning media has benefits, including facilitating effective learning, spreading information quickly, stimulating discovery learning, problem-solving, and having deeper understanding (Tudor, 2013). Through multimedia, teachers can convey information in a more innovative form, so that they can more quickly to motivate students (Nazir, Rizvi, & Pujeri, 2012). In developing this media, adjusted to 2013 curriculum that students must have the ability of higher-order thinking skills, including the ability of problem-solving. Problem-solving skills can be implemented through problem-based learning (PBL). PBL encourages students to work in groups to solve complex and challenging problems and to bring in a deep understanding of a problem, through application, prior knowledge, then to produce solutions that are presented in various forms (eg, reports, presentations, leaflets, websites, or product) (Wyness & Dalton, 2018; Allison et al., 2015; Lima, Dinis-carvalho, Sousa, Arezes, & Mesquita, 2018).

The selection of eleventh grade of social class is based on the fact that students' Biology learning motivation is low. It can be seen from the results of the initial data collection in the form of

questionnaires to teachers, which amounted to 66.7% of teachers stated that Biology learning motivation of students was low. In line with the fact, based on the results of the questionnaire, students showed that the Biology learning motivation of students was low. The low learning motivation can be seen based on the results of data collection as many as 42.45% of students stated that biology is not related to social class competency, and 47% stated that learning biology was only a demand of the school curriculum. It can happen because, in the social department, Biology material is a Cross Interest material (choice) that must be taken by sudents according to Minister of Education and Culture number 21 of 2016 concerning content standards for primary and secondary schools. So, students must adjust to the rules that have been made.

Motivation is a process that gives energy, directs, and maintains behavior (Santrock, 2008). Also, motivation can be interpreted as an impulse contained in a person to try to make behavior changes that are better in their needs (Uno, 2016). In learning, motivation is essential and influences each other. A student who does not have the motivation to learn will not be possible to carry out learning activities. The position of motivation in learning not only gives the direction of learning activities correctly but more than that, with the motivation, of students will get positive considerations in learning activities (Kompri, 2015). Based on the encouragement to individuals, motivation is divided into intrinsic and extrinsic motivation. Intrinsic motivation is a motive that comes from within an individual. It does not need to be stimulated from the outside, while extrinsic motivation is an active and functioning motive because of the presence of external stimuli (Djamarah, 2015; Santrock, 2008).

In the composition of core and basic competencies in high school, one learning material that is closely related to adolescents is the respiratory system. The primary function of the Respiratory System is to provide oxygen and remove carbon dioxide in the body as a result of metabolism (Gajda & Piwowar, 2009; Isnaini, 2011). Channels that carry air into the lungs are the nose, pharynx, larynx, trachea, bronchi, and bronchioles (Saminan, 2012). Diseases that can attack the Respiratory System include bronchitis, emphysema, asthma, and lung cancer (Adil, Dar, & Firdous, 2012). These diseases are caused by air pollution, especially cigarettes. One of the most common diseases is lung cancer. Complaints found in exposure to lung cancer can include coughing, shortness of breath, chest pain, coughing up blood, nausea, pain, fatigue, and several other complaints (Ananda, Ermayanti, & Abdiana, 2018). It is very difficult to provide education about the dangers of smoking to high school students, especially if only by the lecture method. Therefore, it needs the right strategy in learning to provide education to students about the dangers of smoking. Based on preliminary data collected, as many as 11.8% of students smoked and most started since they were in elementary school.

In this media, it is also explained about the respiratory system in animals. Insects and birds represent invertebrates and vertebrates. The Respiratory system in insects is a tracheal system that is equipped with ten pairs of spiracles (Forster & Hetz, 2010; Centanin, Gorr, & Wappner, 2010; Rusyana, 2011; Pechenik, 2010). Respiratory system in birds use the lungs and air purse, which is the most complex and efficient respiratory device invertebrate animals (Carvalho & Gonçalves, 2011; Pandey et al., 2015).

Besides, based on the results of the initial data collection, the media usually used by Biology teachers is PowerPoint media, while students argue that the media suitable for Biology learning is a video that contains images, sounds, and movements. Therefore, it is necessary to develop interactive media on respiratory system topics, containing video problems, core material, supporting material, and problem training. Video problems are intended to make perception to students about the problems that occur in daily life related to the learning material implemented. With the screening of this problem video, students are expected to be able to construct experiences they have encountered according to learning materials so that students are better prepared to receive the material to be taught. Problem-solving is an essential thing needed in science learning (Simamora & Surya, 2017).

This media was developed using the adobe flash CC application. This interactive media is named Resysmart, which stands for Smart Respiratory System. After the development of interactive media, it is necessary to conduct further research to measure the effectiveness of Resysmart's

interactive media to improve students' learning motivation. Therefore, this study aims to measure the effectiveness of Resysmart's interactive media to increase students' learning motivation. Increased motivation of students studied through the syntax of the PBL, namely (1) identifying problems, (2) establishing problems through thinking about problems and selecting relevant information, (3) developing solutions through identifying alternatives, brainstorming and checking differences of opinion, (4) performing strategic actions, (5) looking back and evaluating the effects of the solutions made (Agustina, Kristiyanto, & Noviandini, 2017).

METHODS

Research Design

This study used a quasi-experiment method with a non-equivalent control-group design. The research design can be seen in Table 1.

Tabel 1.
Pre-test and Post-test Design

Class	Test	Media used	Test
Control	Pre-test	Powerpoint	Post-test
Experiment	Pre-test	Resysmart	Post-test

Population and Samples

The population in this study were all students in Bogor Regency, Indonesia. The selection of sampling sites with purposive sampling at SMAN 3 Cibinong by considering the school's achievements and supporting facilities. Selection of students in class eleventh grade of social program by purposive sampling. The selection of the experimental class in eleventh grade of social 1 class and the control class in the eleventh grade of social 2 class and took 30 students from a total of 31 students for eleventh grade of social 1 class and 30 people from 34 people for eleventh grade of social 2 class by Simple Random Sampling because the population studied is homogeneous.

Instrument

The data in this study were obtained through data collection techniques in the form of student learning motivation scores on Respiratory System material. The measuring instrument of student motivation is a test prepared based on motivation indicators, according to Robbins & Judge (2013). It is contains five answer choices using a Likert scale, which has dimensions (1) intensity (intensity) with indicators (a) enthusiastic in learning, (b) like challenges; (2) direction with indicators (a) having orientation to objectives, (b) planning and time management; (3) persistence with indicators (a) responsibilities, (b) focus on settlement.

Learning motivation instruments were arranged as many as 60 items, then validated using Pearson Product Moment and supported by SPSS 23. After obtaining the value of validity, the results were checked to the PPM correlation r table, at the 0.05 significance level. The test criteria are if $r_{xy} > r_{table}$ means valid and if $r_{xy} < r_{table}$ means invalid. Based on the calculation, by comparing the value of r_{count} with r_{table} of 0.325 for N = 30, the results of 33 valid items were obtained from 60 items.

The reliability of the learning motivation instrument was calculated using the Cronbach Alpha formula with the assistance of SPSS 23. Based on the results of the calculation, the Cronbach's Alpha value was obtained for 0.872 and then compared with the value of 0.60. Cronbach's Alpha value is 0.872> 0.60, which means that the learning motivation instrument is reliable or consistent.

Procedure

The learning model used in the research is problem-based learning (PBL), the syntax of PBL, learning activity and character develoved can be seen in Table 2.

Table 2.
Syntax of PBL, Learning activity and Character Developed

Syntax	Learning Activity	Character Developed
Identifying Problems	• Students make observations of the problem from the video that the teacher shows	Careful
Establish problems through thinking about problems and selecting relevant information	• Each group representative writes the writing board, the problem they observed from the video • Students in the group discuss the themes of each group, which are related to the videos they have observed	Careful, accurate, responsible
Develop solutions through identifying alternatives, exchanging ideas, and checking differences of views	• Students seek from various sources regarding the solutions to the problems that have been identified • Sources that can be used are books or the internet • Students discuss in groups about the group's material	Careful, diligent, honest, responsible, cooperation
Perform strategic actions	• Students in their group's design practical solutions about the themes of each group	Careful, diligent, honest, responsible, cooperation
Look back and evaluate the effects of the solutions made	• Each group presents the results of the discussion alternately • Students in other groups listen to the explanation of the presenter group • Learners conduct a question and answer questions about the material presented • The teacher straightens out concepts that are still wrong, using learning media	Careful, diligent, honest, responsible, cooperation respect, self-confidence

Data Analysis Techniques

A prerequisite analysis test is carried out, namely the normality and homogeneity test. The normality test used The Kolmogorov-Smirnov test at $\alpha = 0.05$ and homogeneity test used variance test (F test). The increased motivation was assessed through the gain score between the posttest and pretest values in the experimental class and the control class, then calculated the Normalized Gain Score according to Hake's (1999) and the normalized gain score category can be seen in Table 3 as follows.

$$\text{Normalized Gain (g)} = \frac{\text{Score (Posttest)} - \text{Score (Pretest)}}{\text{Score (Ideal)} - \text{Score (Pretest)}}$$

Table 3. Normalized Gain Score category

G Score	Category
$g > 0.7$	High
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

Source: Hake (1999)

To test the hypothesis used the t-test. Hypothesis testing was carried out three times the t-test, namely (1) t-test between pretest and posttest in the experimental class (dependent t-test), (2) t-test between posttest experimental class with posttest control class (independent t-test), (3) test t Value of normalized gain score.

RESULTS AND DISCUSSION

This research is a follow-up study of previous research on the development of Resysmart interactive media developed by researchers. Test the effectiveness of learning media on student learning motivation begins with the preparation of learning motivation instruments. Learning motivation instruments are compiled and modified from the writings of Robbins & Judge (2013), with aspects of intensity, direction, and perseverance.

Table 4.
Pre-test and Post-test Score of Learning Motivation

Class	Average Score		Gain Score	N-Gain	Category
	Test	Scores			
Experiment	Pretest	69.20	12.80	0.42	Medium
	Posttest	82.00			
Control	Pretest	67.97	2.40	0.08	Low
	Posttest	70.37			

Measurement of learner motivation was carried out before learning in the form of a pretest, and after learning in the form of the posttest. The value was then compared and calculated the level of trust (significance) through the t-test. After that, the N-Gain score was calculated in each class. The pretest and posttest values of learning motivation can be seen in Table 4 an the results of measuring student motivation for each indicator can be seen in Table 5.

Table 5
Motivation Scores of Learning for Each Dimension

Dimension	Experiment Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Intensity	68	81	67	70
Direction	71	83	70	71
Persistance	69	82	67	70
Class Average	**69.20**	**82.00**	**67.97**	**70.37**

Before hypothesis testing was carried out, a prerequisite analysis test was done, namely the normality and homogeneity test. The normality test used The Kolmogorov-Smirnov test at $\alpha = 0.05$ and homogeneity test using variance test (F test), can be seen in Table 6.

Table 6.
Calculation Results of Normality and Homogeneity

Test	Class	The calculation results	Alpha	Conclusion*
Normality	Experiment	0.200	0.05	Normal
	Control	0.200	0.05	Normal
Homogeneity	Experiment	0.565	0.05	Homogenous
	Control	0.232	0.05	Homogen

* by comparing Calculation Results and Significance Values

The next step in the effectiveness test was the calculation of the Normalized Gain Score. Then it was compared with the category of Normalized Gain Score According to Hake (1999). From the results of calculations in the experimental class, it was obtained the value of Normalized Gain Score of students who are classified as low as many as ten people, while 17 people, and a height of 3 people. Overall, Normalized Gain Score 0.37 is obtained, which means that the pretest to posttest score is moderate.

The next step was to test the hypothesis using the t-test. Hypothesis testing was carried out three times the t-test, namely (1) t-test between pretest and posttest in the experimental class (dependent t-test), (2) t-test between posttest experimental class with posttest control class (independent t-test), (3) test t Value of Normalized Gain Score. The results of the t-test can be seen in Table 7.

Table 7
T-test results

T-test	Calculation result	α	Conclusion
Dependent	0.00	0.05	There are differences in learning motivation before and after using Resysmart interactive learning media.
Independent	0.00	0.05	There are differences in classroom learning motivation using interactive learning media and those that do not use Resysmart interactive learning media.
Normalized Gain Score	0.00	0.05	There are significant differences in the value of Normalized Gain Score between classes that use interactive learning media and those that do not use Resysmart interactive learning media.

In the effectiveness test in this study is to measure the learning motivation of students before and after learning. As explained in the study of theory, many experts have defined motivation. According to Slavin (2009), motivation is something that causes a person to step, keep moving, and determine where the person is trying to step. Besides, motivation can also be interpreted as a process of movement, including encouragement from within yourself, situations that give escalation to encouragement, as well as behaviors that result from these drives (Sobur, 2013). When associated with the learning process, motivation is an essential thing in learning. Motivation and learning are two things that influence each other. A person who has no motivation in learning will not be able to carry out learning activities (Kompri, 2015).

Motivation has three dimensions, namely, intensity, direction, and perseverance (Robbins & Judge, 2013). Intensity describes how hard the efforts of students to achieve goals, directions describe which direction the effort is carried out, while perseverance describes how long students can maintain their effort until they reach the goal.

Before the research was conducted, first, the initial data collection was completed about the learning motivation of biology students. The teacher considers that the learning motivation of students of eleventh grade of social class on biology learning is low. This is also observed during the learning process of the respiratory system. Some students seemed not enthusiastic in the discussion activities, especially in the control class that used conventional learning media in the form of Microsoft power points. While students in the experimental class are more enthusiastic in discussing, mainly when the discussion uses interactive learning media.

This is supported by the results of table 4 that show that the increase in learning motivation before and after learning is higher in the experimental class than in the control class. In the experimental class, the average pretest results were 69.20, and the posttest results were 82.00, with Gain Score 12.80. Whereas in the control class, the results of the pretest average were 67.97 and the results of posttest were 70.37, with Gain Score 2.40. Calculation of Normalized Gain Score in the experimental class is included in the medium category while in the control class, including the low category.

These results indicate that there are differences in classroom learning motivation that use Resysmart's interactive learning media and those who do not use Resysmart interactive learning media. Based on table 5, the highest dimension in measuring motivation in the experimental class and the control class is the Direction dimension, which is equal to 83 in the experimental class and 71 in the control class. The direction dimension has indicators oriented towards goals and time planning and management. This shows that referrals are the highest aspect that can influence

motivation. According to Elsbach (2003), Someone who can conceptualize goals will be able to develop strategies to achieve goals, bring motivation, and maintain motivation. The second highest value is perseverance, and the next is intensity.

The interactive learning media used are one of the factors that can influence the motivation of students. According to Santrock (2008), motivation consists of two types, namely intrinsic motivation and extrinsic motivation. Intrinsic motivation is an impulse that comes from within (internal) to do something for the sake of the thing itself, while extrinsic motivation is an impulse that comes from outside so that the individual does something to get something else (the way to achieve the goal).

Each student has a different level of intrinsic motivation; this is where the task of a teacher provides extrinsic motivation to increase students' intrinsic motivation. According to Alhodiry (2016), the personality of a teacher and the right method chosen by a teacher can increase students' motivation, even though students come to schools with low intrinsic motivation, this can be improved through the role of a teacher. The interactive learning media is one of the extrinsic motivations that teachers use to increase students' intrinsic motivation. Because, according to Kompri (2015), intrinsic motivation is stronger and better than extrinsic motivation. Interactive learning media can increase learning motivation because it is packaged with interest, contains visual and audio content, so students are more interested in learning. As in the research conducted by Williams & Williams (2011) states that there are five primary keys in increasing motivation, namely teachers, students, methods or processes, content, and environment. The method in question is the method used to represent the content

The study conducted by Owen (2015) also mentions that by redesigning learning, in this case, the material and methods, it will be able to increase students' learning motivation. Interactive learning media includes methods used by teachers to increase motivation by promoting the contents of the respiratory system to be more exciting and enjoyable. According to Keller (2008), increasing the attention of students is one aspect that affects learning motivation.

Research from Juminah, Ugiyo, & Awalya (2019) states that the use of Adobe Flash-based learning media becomes more attractive and effective in attracting students' attention, so students are more motivated to learn and learning becomes more fun. This is in line with the opinion of Arsyad (2008) that the use of learning media in the classroom will clarify the presentation of messages, foster motivation to learn, and can overcome the limitations of space, time, and senses. According to Yusnaeni, Lika, & Hiul (2019), the use of learning media as a learning resource can increase learning motivation, clarity and facilitate students in learning activities, including the success of biology learning.

The results of this study are also supported by the results of previous studies, including research conducted by Ariska (2018), which states that learning media using Adobe Flash-based on metacognition can increase the motivation of Madiun Scholar Vocational School students. In line with the results of Ariska's research (2018), the results of research conducted by Lin, Chen, & Liu (2017) stated that classes that using technology in learning have higher motivational results than classes using conventional media. This is because technology-based learning media can influence the learning climate of students so that students are more enthusiastic in the discussion when using technology-based learning media. In addition to influencing students' motivation, the use of technology-based learning media can also improve teacher teaching professionalism. Students can realize the enthusiasm of the teacher in teaching when the teacher prepares technology learning media, which of course has a positive effect on improving students' learning motivation.

Students who have high learning motivation will get good learning outcomes because students will be enthusiastic in understanding the material delivered by the teacher. According to Darmawan et al. (2019), increasing motivation to learn can have a positive impact on learning outcomes. This is in line with Dunn & Kennedy (2019), who states that the use of technology in learning can increase learning motivation, which of course will improve student learning outcomes. According to Negovan, Sterian, & Colesniuc (2015), students who have high motivation will have a stronger concept of

learning, and students will understand that learning is a process of self-change, social development and is a continuous process and is a task that must be run.

Increasing motivation of students can be seen through the syntax of the PBL learning model, namely (1) Identifying problems, (2) Establishing problems through thinking about problems and selecting relevant information, (3) Developing solutions through identifying alternatives, brainstorming and checking differences of opinion, (4) Performing strategic actions, (5) Looking back and evaluating the effects of the solutions made (Agustina, Kristiyanto, & Noviandini, 2017). Imaging video problems on Resysmart media can bring up problem-solving skills and students' critical thinking skills so that students can continue to be motivated to find solutions of problems that exist in everyday life. This is by Permana & Chamisijatin (2019), application of the Problem-Based Learning model can arouse the curiosity of students so that students can find the best strategies for solving problems faced. Resysmart interactive media is developed originally by writer and team, based on a suggestion from content expert, media expert, and linguist expert. The slide of video problems can be seen in Figure 1.

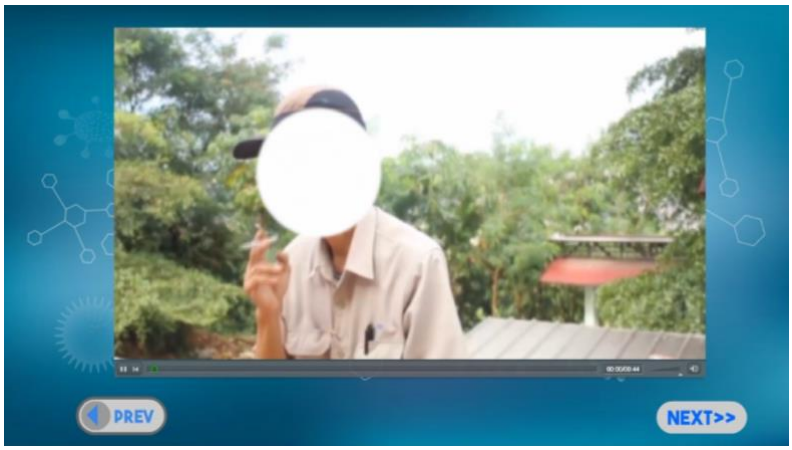

Figure 1. Slide of Video Problems

In the development of Adobe Flash-based interactive learning media material respratory systems still have disadvantages, including limited human resources that process the making of learning media and full school activities cause some students often be absent from class when the research was conducted.

CONCLUSION

Based on the results and discussion, it can be concluded several points as follows: (1) learning motivation in the experimental class got a pretest value of 69.20, which was low, and the posttest value was 82.00, which was high. It means that there is an increase in motivation to learn in classes that use Resysmart interactive media and Based on Normalized Gain Score in the experimental class is included in the medium category; (2) After the t-test was obtained the results of 0.00 <0.05 significance value can be concluded that there are differences in learning motivation between classes that use Resysmart interactive media with classes that do not use Resysmart interactive media. So, it can be stated that Resysmart interactive media effectively increases students' learning motivation.

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