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"ANIMATED VIDEO MEDIA": IMPROVED CONCEPTUAL UNDERSTANDING AND SOLVING MATHEMATICAL PROBLEMS

Mariam Nasution[1*], Helmi Lailia[2]

[1*,2] Pendidikan Matematika, UIN Syekh Ali Hasan Ahmad Addary Padangsidimpuan, Indonesia

**Corresponding author.*

E-mail: mariam@uinsyahada.ac.id [1)]*

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Abstract

Today's educational requirements for entering society 5.0 include requirements for being able to change with the times. The availability of technology plays a significant role and can act as a bridge for educators and students to develop cognitive abilities including conceptual understanding and quantitative problem-solving in the classroom. The study's objectives are to evaluate (1) the ADDIE model's application to the development of animated video media, and (2) the impact of this media on students' conceptual comprehension and capacity for mathematical problem-solving. The method used in the form of Research and Development (R&D) with data collection techniques in the form of observations, interviews, tests and questionnaires with the research population is class VIII-A students with a total of 24 students. Meanwhile, the analysis used inferential statistics in the form of t-test and NGain and descriptive statistics in the form of percentages. Meanwhile, the population of VIII MTs Negeri 6 Mandailing Natal school for the 2020/2021 school year in class VIII-A is 24 students. (1) The study's invention, an ADDIE model with reliable and applicable test results, is one of its findings;(2) The effectiveness of anismation video media may be said to be effective (70.32) for resolving student issues and has a significant impact with a value of (0.00 0.05). However, it can be argued that it is effective (78.4) for helping students learn concepts. The findings of the research and development study on animated videos are significant for enhancing concept comprehension and helping students in the classroom solve mathematical issues.

Keywords: Animated video, concept understanding; learning media; mathematical problem solving

Abstrak

Dewasa ini, memasuki society 5.0 dunia pendidikan memiliki tuntutan berderet untuk dapat beradaptasi perkembangan zaman. Eksistensi teknologi menjadi peranan penting dan dapat menjadi perantara pendidik dan terdidik untuk meningkatkan keterampilan berpikir seperti pemahaman konsep dan pemecahan masalah matematis di kelas. Tujuan penelitian untuk menganalisis (1) Pengembangan media video animasi dengan model ADDIE; (2) Efektivitas media video anismasi terhadap pemahaman konsep dan pemecahan masalah matematis peserta didik. Metode yang digunakan berupa Research and Development (R&D) dengan teknik pengumpulan data berupa observasi, wawancara, tes dan angket dengan populasi penelitian adalah siswa kelas VIII-A dengan jumlah 24 siswa. Adapun, analisis yang digunakan statistik inferensial berupa t-test dan NGain serta statistik deskriptif berupa persentase. Adapun, populasi VIII MTs Negeri 6 Mandailing Natal school tahun ajaran 2020/2021 pada kelas VIII-A yang berjumlah 24 siswa. Hasil penelitian meliputi (1) Pengembangan yang digunakan berupa model ADDIE dengan hasil pengujian valid dan praktis; (2) Efektivitas media video anismasi dapat dikatakan efektif (78,4)untuk pemahaman konsep peserta didik dan berpengaruh secara signifikan dengan nilai (0,00 <0,05) Sedangkan efektivitas media video anismasi dapat dikatakan efektif (70,32) untuk pemecahan masalah peserta didik dan berpengaruh secara signifikan dengan nilai (0,00 < 0,05). Simpulan pada studi penelitian dan pengembangan video animasi memiliki signifikansi terhadap peningkatan pemahaman konsep dan pemecahan masalah matematis peserta didik di kelas.

Kata kunci: Media pembelajaran; pemahaman konsep; pemecahan masalah matematis; video animasi

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INTRODUCTION

Mathematics is one of the most important and foundational sciences because it teaches students to think critically, rationally, analytically, and systematically (Winoto, Y. C., & Prasetyo, 2021; Wiryanto, 2020). In line with Dwijayani (2019) discusses if mathematics may help an individual acquire a critical and analytical mentality. Furthermore, learning mathematics is linked to a number of concepts. One notion and another have a link in mathematical learning (Faidah et al., 2019). Students who comprehend concepts well find it easier to tackle issues in everyday life (Tatsuoka et al., 2015). Zevenbergen, R., Dole, S., & Wright, (2004) mentioning to solve the problem requires adequate understanding.

Sumarno, (2013) Have a perspective if problem-solving ability is one of the indicators that learners must achieve. Branca, n.d. (1980), interpreting problem solving as a goal and a process that must be taught. Some studies Bell (1978) mentions if mathematics can be transferred and applied through a problem-solving situation. However, we do not realize that in learning mathematics there are fundamental problems but have a broad (Winoto, Y. C., & Prasetyo, 2021).

This is a factor in the teaching and learning process being less effective characterized by a limited level of understanding of the material being taught (N. K. C. P. Sari, 2022). One of the materials that must be mastered in mathematics learning such as Pythagoras. Resliana et al., (2020) asserting that the concept in everyday life has great benefits for students. Joyce, B., Weil, M., (2009) argue that good learning includes unlimited experiences, such as the use of media.

In essence, learning media has several variants such as audio, visual, audio-visual, film, television and multimedia media (Nurseto, 2011). In today's modern era, technology has a great influence to increase efficiency and effectiveness in their daily lives (Kayimbaşioğlu et al., 2016). For example, they can be utilized to help the learning process in the classroom by developing animations with motion illusions that are coordinated with audio (Wiana et al., 2018).

The benefits of this animated film, on the other hand, can reduce student boredom by delivering a joyful, amusing, and relaxed atmosphere while not ignoring the material parts that are the primary aspects (Hapsari et al., 2019; Naylor, S., & Keogh, 2010). It is intended that the use of this animation media would have a lasting impact on students' interest and motivation (Kirana, S. A., Permana, A. H., & Nasbey, 2022; Pinter et al., 2012). In response to this, Ponza et al., (2018) suggest animated videos to be used as a medium for learning mathematics, because they are interesting and impressed to students.

The perspectives Ulia (2018) mentioning that learning media has its own urgency in the world of education. Considering that education is an important role in improving the quality of human resources (Manik et al., 2021). Some research also states that the use of video media can make students happy in following the learning process (Bakri et al., 2020). Supported by research results Ratnasari, J. R., & Setiawan (2022) It claims that video media production can boost the completeness of learning outcomes by up to 31%.

Some of these studies, innovations and selling points carried out in this

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research by developing learning media to improve the understanding of concepts and mathematical problem solving of students. Several relevant studies have previously been traced as a state of the art, especially on the point of understanding concepts and solving students' problems in mathematics learning only explaining the analysis of the ability to understand concepts on number material based on Bloom's taxonomy (Murtiyasa, B., & Sari, 2022); Understanding mathematical ideas in two-variable linear equations: Google Classroom's impact on e-learning and blended learning (Huda et al., 2019); The influence of concrete, pictorial, abstract strategies on the conceptual understanding of mathematics and the mathematical representation of students to fractions (Purwadi et al., 2019).

Meanwhile, earlier studies on problem solving only looked at students' mathematical problem solving in PISA issues with Space And Shape content in terms of gender (Romadhoni & Setyaningsih, 2022); Elementary School Students' Mathematical Literacy Skills in Problem Solving Story Problems (Vitantri, C. A., & Syafrudin, 2022); Improving students' mathematical problem solving skills and self-efficacy through problem-based learning models (Irfan, L., Jailani, J., & Susanti, 2022); During the Covid-19 pandemic, high school pupils' quantitative problem-solving capacity in face-to-face instruction is reduced (Norman, A. E., Hidayanto, E., & Muksar, 2022); student numeracy literacy in quadr-ilateral and trapezoidal problem solving (Ratnasari, J. R., & Setiawan, 2022).

Based on the results of the track record of previous research results, it shows the limitations of research in developing animated video media to improve understanding of concepts and solving mathematical problems. So the need for the development of animated video media as a research gap. The research objectives proposed to analyze (1) Development of animated video media with the ADDIE model; (2) Effectiveness of animated video media on concept understanding and mathematical problem solving

METHOD

Research Location

This research was conducted in an area of Mandailing, Natal Regency, North Sumatra, namely MTs Negeri 6 Mandailing Natal. The cause for the location determination is a lack of grasp of mathematical principles in the Phytagoras Theorem which is entirely not the fault of students but educators who are not yet appropriate in the use of strategies and media in mathematics learning.

Subject of Research

This study's population is class VIII because the subject matter discussed in this study is the phytagoras theorem material. In this study, researchers selected class VIII-A students as a sample with a total of 24 students. The reason for choosing this class is that the student has an equivalent level of student ability and the student's easy-to-manage character, it is shown by the way that the researcher has conducted with the math teacher.

Research Design

This research is a quantitative research of the type of Development (reseach and development). This study shows the influence of creating 2D or dual-dimensional animation movies in the form of cartoons on improving

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understanding of the phytagoras theorem and mathematical problem solving. Meanwhile, the development model used as a reference for ADDIE. Aldoobie, (2015) mentions the stages in development with the ADDIE model including Analysis (A), Design (D), Development (D), Implementation (I), and Evaluation (E).

Research Procedure

The ADDIE model uses five stages of development including the following:

1) Analysis stage, aims to obtain information about what is needed to develop learning media.
2) Desaign Stage, Aiming to create a media display design that will be developed and adapted to student characteristics and mathematics learning characteristics.
3) Development stage, aims to design the learning media to be created. These activities include the production of learning media, product validation, and product revision.
4) Implementation stage, aims to implement the system that we are or have created. That is, everything developed up to this point has been installed or set up in such a way that it must ideally match to its duty or purpose in order to be implemented.
5) Evaluation stage, aims to evaluate the use of media used by giving a test as a measuring tool to find out changes in students after developing this product.

Data Collection Techniques

Data collection techniques in this study are (1) Observation occurs during the learning process and the usage of learning media; (2) Interviews, teachers and learners of class VIII; (3) Questionnaire, aims to see the response of students after participating in learning; (4) Test, in the form of a description to see to what extent the understanding of students' concepts and mathematical problems.

Instrument Development

The instruments used in this study are instruments of validity, practicality and effectiveness for more details can be seen in Table 1.

Data analysis technique

The data analysis techniques used are specifically presented in Table 2.

Table 1. Test instrument development

No.	Indicator	Indikator of Item	Item	'roduct momer test	Cronbach's Alpha test
1	1) Reiterating a concept	Describes the terms of a triangle	1	Valid	(0,4044)
	2) Classifying objects based on their attributes	based on its side length and angle size			Reliable says Medium
	3) Exemplifying and not exemplifying concepts	Classifies groups of numbers that include triple phytagoras according to groups of numbers			
	4) Presenting concepts in diverse mathematical representations	Determine a pointed, blunt, or right triangle based on the length of the sides of a triangle	2	Valid	
	5) Develop the necessary conditions or	Expressing the phytagoras theorem applicable to a triangle	3	Valid	
	sufficient conditions of a concept	Develop the conditions that apply to a triangle image	4	Valid	
		Determining the length of the sides of a right triangle if the other two sides	5	Valid	

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No.		Indicator	Indikator of Item	Item	'roduct momer test	Cronbach's Alpha test
	6)	Using a specific procedure or operation	Determining the shortest distance of two ports (application of the phytagoras theorem)			
	7)	Making use of problem-solving techniques and algorithms				
2	1)	Understanding the problem	Write down the information presented in the question Include questions on the question Explaining a sketch of the problem	1	Valid	(0,713) Reliable said to be High
	2)	Devising a plan	Drawing up a troubleshooting plan using clear procedures Estimate the troubleshooting plan to be used Presenting the problem with simpler language	2	Valid	
	3)	Carrying out the plan	Create a mathematical model based on a given problem Solve problems based on a pre-conceived strategy Complete the completion steps to communicate the conclusion	3	Valid	
	4)	Looking back	Double-check completion results Drawing up a settlement conclusion Using different ways to solve problems	4	Valid	

Source Modification of (Jihad, 2012; National Research Council, 2001; Prabawa, 2017)

Table 2. Research data analysis techniques

Stages	Aspect Assessment	Instrument	Observed data	Respondents
Analysis	Needs Analysis	- Interview Guidelines - Observation Sheet	Development Needs Analysis Product	Teachers and Students
Design	Product Prototype Draft	Questionnaire	Product validity	Material, Media and Language Expert
Development	Product Validity	Questionnaire	Product validity	Students
Implemen-tation	Product Practicality	Questionnaire	Practicality of the product	Students
Evaluation	Product Effectiveness	Learning Outcomes Test	Student learning outcomes regarding understanding concepts and solving mathematical problems by knowing the category of NGain with theory Hake (1999) for the category of < value 40 (ineffective); 40-55 (less effective); 56-75 (quite effective); >76 (effective). As well as the decision of the t-test results (Ghozali, 2016) i.e. if the significance value of the t test is > 0.05 then H_0 is accepted and Ha is rejected (influential), If the significance value of the t test is < 0.05 then H_0 is rejected and Ha is accepted (has no effect).	Students

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RESULTS AND DISCUSSION

1. Animation Media Development with ADDIE Model

This ADDIE development approach has five stages of development: analysis, design, development, implementation, and evaluation. Here's the complete presentation.

Analysis Stage

Several analyses, including needs analysis, are performed throughout the analysis step. According to the findings of interviews with subject teachers *"..... Mathematics subjects are less attractive to students because of their abstract subjects, expecting innovations in learning activities so that they can attract students to pay more attention to learning. Especially on understanding concepts and how learners can solve a mathematical problem in the classroom. These innovations can be made in the learning media used....." (Field Results, 2022).*

Furthermore, interviews were also conducted with students who provided information that *"..... Generally, they think that mathematics is a difficult lessonbecause there are many formulas to memorize, which makes students dislike the lesson which causes low learning outcomes due to lack of understanding of mathematical concepts....." (Field Results, 2022).*

Continuing with the K-13 curriculum analysis, mathematics instruction is required to provide children with logical, methodical, critical, and creative thinking skills, as well as systematic problem-solving skills. The content of the medium is tailored to the text, leading students to be active participants in their learning.

Design Stage

At this stage, several storyboad preparation activities are carried out, namely compiling a concept map, outline of media content containing media points that will be displayed in a video-based learning media product animation of the subject matter of the phytagoras theorem, and preparation of learning media scripts. Meanwhile, the design concept map used has been presented in Figure 1.

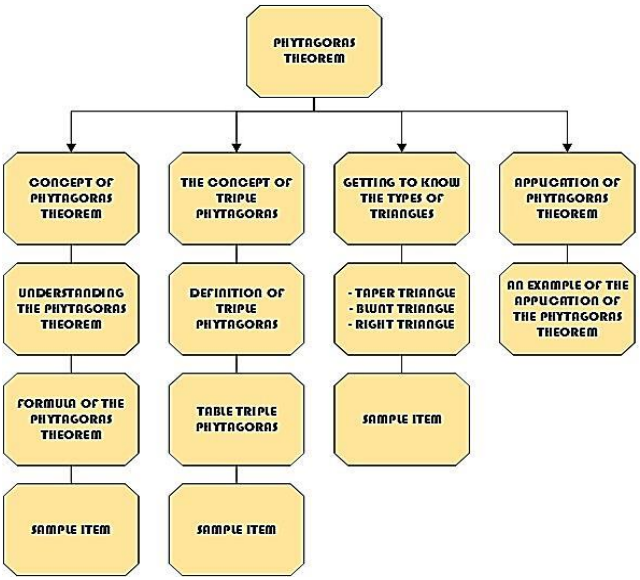

Figure 1. Learning material concept map

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Development Stage

The development stage of the activities performed is to design learning media that will be made with multiple activities, notably learning media production, product validation, and product revision. Then the editing and correction process is carried out to make the animation video look more attractive and become a complete animation video-based learning medium. Specifically the series of criticisms and suggestions from expert tests have been presented in Table 2.

Table 2. Expert assessment of animated video products

No	Assessment Aspects	Indicator	Score	%	Category
1	Material	Material Conformity	28	80,00	Valid
		Benefits	15	76,00	
		Serving	12	80,00	
		Total	55	79,00	
2	Media	Media Display	11	73,00	Valid
		Design Quality	15	75,00	
		Serving	19	76,00	
		Benefits	12	80,00	
		Total	57	76,00	
3	Language	Conformity	34	98,00	Valid
		Serving	19	95,00	
		Communicative	19	93,00	
		Total	72	95,00	

Source: Field Data (2022)

According to Table 2, the total percentage of three validators of material experts, media experts, and linguists acquired an average of 83.3% with a very valid category, indicating that the quality of video-based learning media is possible to use in the classroom during the learning process.

Reviewed product practicality, based on a questionnaire of student responses to mathematics learning using animated video-based learning media including practical categories. For the aspect of interest, a percentage result of 76% was obtained with the practical category, then from the material aspect, a result of 79% was obtained with the practical category, and from the language aspect, an 81% result was obtained with the practical category. Overall, the average percentage of some aspects has a percentage of 79% with practical categories. In this case the use of the product in the learning process is declared practical.

Several inputs were also given to improve the feasibility of the product including the feasibility of the material has been presented in Figure 2.

Before revision *After revision*

Figure 2. Material expert due diligence

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Based on Figure 2, it is known that in the animated video too many objects on the introduction of the phytagoras theorem are already simpler. Followed by the media due diligence presented in Figure 3.

On the video there is an error writing the formula of Phytagoras i.e. AB2 = BC2 + AC2

Before revision

Writing theorem formulas phytagoras are fixed $AB^2 = BC^2 + AC^2$

After revision

Figure 3. Media expert due diligence

Based on Figure 3. it is known that in the video there is a writing error in the phytagoras formula, namely AB = BC2 + AC2 has been corrected to $AB^2 = BC^2 + AC^2$ and audio errors of words in the audio narration. Followed by the language test, which is presented in Figure 4.

Lack of examples of questions given in applicative form

Before revision

Sample questions have been added in the form of applicative

After revision

Figure 4. Linguist due diligence

Based on Figure 4, it is known that animated videos do not have examples of questions given in the application of phytagoras theorem in everyday life as a form of student response, related questions have been added.

Implementation Stage

This is the most crucial stage, namely the use of animated video-based learning medium in mathematics learning to students of class VIII MTs N 6 Mandailing Natal, a total of 24 students, before using the media students are first given a pretest then the application of animated video-based learning media as many as three meetings. After that, a posttest test was carried out and students were also given a questionnaire to find out the practicality and effectiveness of the learning media.

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Evaluation Stage

This phase is carried out to determine whether the product produced in this case to determine the increasing understanding of mathematical concepts, students are carried out by administering pretest questions prior to the application of animated video-based learning media, and then administered posttest questions. The findings of the pretest and posttest values are then compared. This evaluation procedure also examines whether or not a decision was made based on comprehensive, correct, and accurate data.

2. Effectiveness of Animated Video Media on Concept Understanding and Mathematical Problem Solving

Measuring the effectiveness of animated video-based learning media development products can be through giving tests to students, carried out in two stages, namely a concept understanding test before using the learning media through pretests. Then after the use of the learning media through the postest in class VIII. In this study, the effectiveness was reviewed from the level of understanding and solving mathematical problems of students. Meanwhile, a graph of the effectiveness of the product on the understanding of the concept of learners has been presented in Table 3.

Table 3. Effectiveness of animated video media on concept understanding and mathematical problem solving

Aspect	Test	N	Min	Max	Mean	Std.Dev	Uji T-test	Category (Arikunto, 2010)	N-Gain	Category (Hake, 1999)
Concept Under-standing	Pretest	24	38	82	61,08	13.755	0,00	Influential	78,4	Highly effective
	Posttest	24	45	97	78,21	12.514				
Mathematical Problem Solving	Pretest	24	30	74	60,35	13.881	0,00	Influential	70,32	Quite effective
	Posttest	24	42	82	74,82	12.412				

Source: Data Management Results (2022)

According to Table 3, the average value of the posttest is greater than that of the pretest. This is known from the value of the mean in each aspect of understanding concepts and solving mathematical problems. Significantly, the t-test conducted also showed a number below < 0.05 which has a significant effect. However the difference in categorization is seen in the N-Gain value based on Hake (1999), The development of animated video media is more likely to be high for the understanding of learners' concepts compared to the mathematical problem solving of learners.

In terms of the findings from testing the usefulness of developing animated video learning media for understanding concepts and solving mathematical problems supporting the results of previous research such as Apriadi (2021) mention that mathematical animation videos using a contextual approach are useful for enhancing mathematical idea understanding. Continued F. R. Sari (2018) mentioned that the application of non-example learning assisted by

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mathematical animation videos can improve students' understanding of concepts. Twozia (2021) also published the results of data analysis showing that the use of animated video media has an influence on understanding the concept. Continued with Afandi, I. A., Wahyuningsih, E. D., & Rokhman (2021) mention if there is a significant influence of the use of animated videos on the understanding of mathematical concepts of students in the classroom.

According to some experts, the usage of animated video media is a sort of direct learning that is thought to boost students' conceptual knowledge and process abilities (Chairam et al., 2015). Speaking of understanding concepts, Pitaloka et al. (2014) argue the urgency of this ability, in addition to being able to help students to understand the meaning in learning mathematics. National Council of Teacher Mathematics (2000) declaring five standards of Learning Principle Mathematics, one of which is conceptual understanding or known as concept understanding.

In essence, the understanding of concepts is a manifestation and reflection of the learner's ability to explain accompanied by reasons for contexts or situations that involve careful and measurable application (Mulyono & Hapizah, 2018). Molina, (2014) In particular, if in teaching mathematics, you must prioritize concepts over algorithms accompanied by practical solutions and avoid naked numbers.

The study's findings, on the other hand, suggest that animated video media is not only beneficial for enhancing students' knowledge of mathematical topics, but it's also fun, but also effective for improving mathematical problem solving as well. Some of the results of previous studies such as Baeti et al. (2020) Releasing research results that show role playing learning models with animated video media are effective in students' mathematical problem-solving abilities. Harsela, J., Subhananto, A., & Al Fuad (2022) also mentioned if the video is animated to improve students' problem-solving ability.

According to the findings of this study, the utilization of animated movies has a good impact on pupils' problem-solving abilities. Gunantara, G., Suarjana, I. M., & Riastini (2014) mentioning the ability to solve problems has a crucial position in finding solutions to various problems in everyday life. Capuno et al. (2019) mentioning that learning mathematics means involving learners to be more active in experimentation, analysis, reasoning and problem solving.

Highlighting some positive significance results for students regarding improving their understanding of concepts and problem-solving skills, The usage of previously prepared learning media motivates this. Several studies have found that using learning material in the classroom is beneficial. is one of the indicators to determine success (Lisnawati, 2021). Media has an instructional function to contain information that involves the thinking and mentality of students in the learning process (Kirana, S. A., Permana, A. H., & Nasbey, 2022; Sukiman, n.d.).

The match is Jatiningtias (2017) who conducted a media development study that concluded, if the teaching orientation will improve the process's effectiveness through classroom learning activities. Based on the presentation of the results of this study, it can be concluded that the

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development of animated video media has a positive impact on students, especially on increasing understanding of concepts and problem solving on the substance of the Phytagoras Theorem material for mathematics learning in the classroom.

CONCLUSIONS AND SUGGESTIONS

This downstream development emphasizes improving the understanding of concepts and problem solving of students who were previously observed. Several stages such as validation and practicality are carried out to provide a feasibility for a product. The results of this stage show that the product developed is valid and practical to be applied in the classroom. Furthermore, the study's principal investigator discovered various data indicating that animated video learning mediums have a considerable impact on students' conceptual understanding and arithmetic problem solving.

The findings of this study are predicted to be useful for future researchers in producing unique and creative products to improve students' knowledge of concepts and mathematical problem solving, as well as to promote curiosity in order to achieve effective learning in the classroom. Each study has its own limitations, this study has a tendency with a not wide sample allocation, so it is advisable for subsequent research to conduct R&D studies with extensive samples in several school locations to improve high data accuracy.

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