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Improving Critical Thinking Skills Using Animated Videos Based on Problem-Based Learning
Mejora de las habilidades de pensamiento crítico mediante vídeos animados basados en el aprendizaje basado en problemas

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Abstract. The materials related to football game tactics and strategies are mostly explained and taught in conventional theory. Students stated that learning tactics and strategy in soccer games is complicated and therefore difficult to understand because it uses conventional methods. Current developments have resulted in the acceleration of technology for learning in various conditions. This study aims to determine the learning outcomes of the twelfth grade students in senior high school by using animated videos based on problem-based learning in learning football games, especially in materials related to defensive patterns, attacking patterns, and football game formations. The method used in this study was experimental research using one group pre-test post-test design consists of 32 twelfth grade students (Male:12; Female:20). The learning process was evaluated using Formative Class Evaluation, and critical thinking skills were measured using critical thinking test instruments, The critical thinking assessment tool was evaluated by 4 experts. Result:This study showed significant differences in students' critical thinking skills before and after applying problem-based learning animated videos [t=6.442; p= 0.000 (<0.05), with an increase of 14.65%. The achievement of student learning outcomes before implementing problem-based learning animated videos scored 66.66 in the poor category. After implementing problem-based learning animated videos, the score increased to 76.41 in the good category. Conclusion The application of animated videos based on problem-based learning in teaching and learning process helps students to theoretically understand football games with its complex tactics and strategies and to fully integrate their knowledge of defensive patterns, attacking patterns and formations in football games. Animated videos based on problem-based learning can provide stimuli that can encourage students to think analytically to improve their critical thinking and keep up with rapid technological developments.
Key Words*:* Critical thinking skills, animated videos, football games, problem based learning

Resumen. Abstracto. Los materiales relacionados con las tácticas y estrategias de los juegos de fútbol se explican y enseñan principalmente en teoría convencional. Los estudiantes manifestaron que aprender tácticas y estrategias en los juegos de fútbol es complicado y por lo tanto difícil de entender porque se utilizan métodos convencionales. Los avances actuales han dado como resultado la aceleración de la tecnología para el aprendizaje en diversas condiciones. Este estudio tiene como objetivo determinar los resultados de aprendizaje de los estudiantes de duodécimo grado de secundaria mediante el uso de videos animados basados en el aprendizaje basado en problemas en el aprendizaje de juegos de fútbol, especialmente en materiales relacionados con patrones defensivos, patrones de ataque y formaciones de juegos de fútbol. El método utilizado en este estudio fue una investigación experimental utilizando un diseño grupal de prueba previa y posterior compuesto por 32 estudiantes de duodécimo grado (hombres: 12; mujeres: 20). El proceso de aprendizaje se evaluó mediante la Evaluación de clase formativa y las habilidades de pensamiento crítico se midieron mediante instrumentos de prueba de pensamiento crítico. La herramienta de evaluación del pensamiento crítico fue evaluada por 4 expertos. Resultado: Este estudio mostró diferencias significativas en las habilidades de pensamiento crítico de los estudiantes antes y después de aplicar videos animados de aprendizaje basado en problemas [t=6,442; p= 0,000 (<0,05), con un incremento del 14,65%. El logro de los resultados de aprendizaje de los estudiantes antes de implementar videos animados de aprendizaje basado en problemas obtuvo una puntuación de 66,66 en la categoría pobre. Después de implementar videos animados de aprendizaje basado en problemas, la puntuación aumentó a 76,41 en la categoría buena. Conclusión La aplicación de vídeos animados basados en el aprendizaje basado en problemas en el proceso de enseñanza y aprendizaje ayuda a los estudiantes a comprender teóricamente los juegos de fútbol con sus complejas tácticas y estrategias y a integrar plenamente su conocimiento de los patrones defensivos, de ataque y de formaciones en los juegos de fútbol. Los vídeos animados basados en el aprendizaje basado en problemas pueden proporcionar estímulos que alienten a los estudiantes a pensar analíticamente para mejorar su pensamiento crítico y mantenerse al día con los rápidos avances tecnológicos.
Palabras clave: Habilidades de pensamiento crítico, videos animados, partidos de fútbol, aprendizaje basado en problemas.

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Introduction

Education has progressed and developed in the 21st century (Kurniawan et al., 2024).The 21st-century skills are essential that everyone must master in order to succeed in facing challenges, problems, lives, and careers in the 21st century (Redhana, 2019). To improve the quality of education, many ways can be done such as increasing innovation in learning, and providing the right educational infrastructure (Kurniawan et al., 2024). Therefore, 21st-century learning prepares students to use technology and learning media that aim for creativity, innovation, communication, research and problem-solving or to improve student life skills as a provision in facing life challenges in the future. In this regard, the learning provided must not only provide material,but must also involve students in learning actively, creatively, communicatively and collaboratively (Thamrin et al., 2024). This 21st-century learning applies creativity, critical thinking, cooperation, problem-solving, communication, and character skills. The 21st-century skills include (1) life and career skills, (2) learning and innovation skills, and (3) information media

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and technology skills (Wijaya et al., 2016). In this regard, it can be concluded that the purpose of 21st-century learning, in general, is that students are expected to be able to form critical thinking skills, be able to solve problems, have creativity, be able to communicate and collaborate and be able to utilise knowledge, information, and opportunities in innovative ways. Critical thinking is a crucial student ability to develop in schools. Teachers are expected to be able to create learning that can activate and develop students' critical thinking skills. Critical thinking skills are one of the things that students must have. However, in reality, there are still few students who have high critical thinking skills (Thamrin et al., 2024). According to Sumargono et al. (2022), the ability to think critically is an ability that is indispensable for a person to face various problems in personal and community life. It is because critical thinkers can analyse and evaluate information, raise vital questions and problems, arrange questions and problems clearly, collect and assess relevant information using abstract ideas and open-mindedness, and communicate it effectively. It is essential to improve students' critical thinking skills. Students' critical thinking skills can be trained with learning that requires students to explore, investigate, discover and solve problems. Students' critical thinking skills can be honed using the problem-based learning model.

Problem-based learning (PBL) is a learning approach that emphasises real problem-solving. According to (Megayani & Yasin, 2019), the use of PBL will involve all students in solving a problem to develop their critical thinking skills, practice problem-solving skills and improve mastery of learning materials. Therefore, critical thinking skills allow students to make decisions from various points of view carefully, thoroughly, and logically. Yulianti & Gunawan (2019) conducted a research showing the application of the problem-based learning model affects students' understanding of concepts and critical thinking.

Based on the results of pre-research interviews with senior high school students in Yogyakarta, it was found that there were several problems in the learning process, especially in learning about football game tactics and strategies. The problems were: students only receive theoretical explanation; the learning model used was still teacher-centred, so students tended to be passive; and complicated football tactics and strategies were problematic for students to understand. Beside the importance of the learning model, learning media also plays important role in delivering material to students.

The teaching and learning process in the classroom cannot be separated from the use of learning media that supports the delivery of material from teachers to students. At present, there are constant changes and adaptations to the digital environment, it is important to have a good disposition to learn and continue to practice skills oriented to the use of technology (Bernate & Fonseca, 2023). In today's digital age, technology has become part of various aspects of life, including in the field of education (Arif et al., 2024). One of the learning media that teachers can use is animated videos. The role of teachers and digital competencies is currently increasing and it is expected that teachers will be at the forefront of the changes presented and propose new teaching methodologies (Bernate & Fonseca, 2023). Visual-based media plays a vital role in the teaching and learning process (Lisnawati, 2022). Interesting learning makes it easier for students to understand the material comprehensively (Arif et al., 2024). It can facilitate students to better understand and strengthen their memories. Learning media by utilising technology can help teachers determine the learning process. Education must be ready to face challenges by unlocking technology by improving the way it generates, organizes, disseminates , and accesses knowledge (Bernate et al., 2021). Technology as a means and instrument of professional teaching is therefore an important teaching strategy (Bernate et al., 2021). Technological innovations in education can be integrated into existing curriculum and teaching practices (Arif et al., 2024).Animated videos can also generate student interest and provide a connection between the content of the lesson and the real world. Animated videos as a learning medium can explain something complicated or complex easily. In addition, through animated videos, obtaining information is carried out through the senses of hearing and seeing, where the student's learning experience is not abstract. According to Arsyad (2016) in Kamila (2014), learning experience is 75% obtained from the sense of seeing (eyes), 13% through the sense of hearing (ears), and the rest of it through the other senses. By using animated media, football game tactics and strategies will be made as simple as possible in the form of football game animation. In addition, educating through media can make students more advanced, rich of information, and it is important that students must use digital media technology effectively (Bernate et al., 2021). Therefore, this study aims to determine the improvement of critical thinking skills using problem-based learning animated videos.

Material & Methods

The method used in this study was an experimental study using the pre-test post-test design on 32 twelfth grade students of SMA Negeri 1 Seyegan (Male:12; Female:20). The research will be carried out in 2023 with student approval. The learning process was evaluated using Formative Class Evaluation (FCE) (Takahashi, 2005; Usra et al., 2023), and critical thinking skills were measured using critical thinking test instruments. Data during the pre-test and post-test are then input into the Microsoft Excel program to facilitate data recording. Meanwhile, to facilitate the calculation of research IBM SPSS Statistic version 26 was used.

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Table 1.
Critical Thinking Instruments

No	Rated aspect	Σs	V	Information
1	How do the questions prepared match the material and animated videos presented?	16	1	Very high
2	Are the questions prepared in accordance with the indicators of critical thinking abilities in the material on attack patterns, defense patterns and formations in the game of football?	15	0,9375	Very high
3	Are the materials and videos used able to make students actively ask questions and answer questions from an explanation?	16	1	Very high
4	Can the PBL learning model grow students' abilities in sorting and choosing the learning resources to use?	15	0,9375	Very high
5	By using the PBL model, students can observe and consider the answers to their observations?	16	1	Very high
6	Can students deduct and consider the results of the deduction by using the PBL model?	16	1	Very high
7	Do students induce and consider the results of induction by using the PBL model?	15	0,9375	Very high
8	Can students make and determine the results of considerations by using the PBL model?	15	0,9375	Very high
9	Can students define terms and consider them by using the PBL model?	15	0,9375	Very high
10	Can students identify assumptions by using the PBL model?	15	0,9375	Very high
11	With the PBL model, students can determine an action?	16	1	Very high
12	Can students interact with other people by using the PBL model?	16	1	Very high

The table above shows the results of instrument validation by 4 experts on the critical thinking assessment instrument which was analyzed using the Aiken V method. The scores from each validator for each item were added up and calculated using the Aiken V formula, to obtain the V value in the table. Of the 12 validated items, all of them obtained a V value ranging from 0.9375 to 1. If you look for the average, all items have a V value of 0.96875. Based on the Aiken V table (Aiken, 1985) with four raters, five scale choices, and an error rate of 5%, the minimum V value for an item said to be valid is 0.88. Therefore, development can be considered valid to carry out. From the Aiken V validation results, this instrument was declared valid for use.

Reliability test results of critical thinking assessment instruments

Reliability Statistics

Cronbach's Alpha	N of Items
.957	14

Based on the results of the reliability test, it was found that Cronbach's Alpha value was 0.957. According to Ghozali (2018), Cronbach's Alpha value is acceptable if it is greater than 0.6. Because the Cronbach's Alpha value in this research is 0.957, it can be concluded that the instrument is reliable and can be used. A Cronbach's Alpha value close to 1 also indicates a high level of internal consistency reliability.

Results

A summary of descriptive statistics on the results of students' critical thinking skills before and after the implementation of problem-based learning animated videos is presented in Table 2. The data showed increased students' critical thinking skills between pre-test and post-test.

Table 2.
Results of Critical Thinking Ability N Mean Pre-test and Post-test

	Mean	N	Std. Deviation	Std. Mean Error
Pre-test	66.6014	102	14.99532	1.48476
Post-test	78.4313	102	11.61048	1.14961

In Table 3, differences in statistics for pre-test and post-test data were analysed using a paired sample t-test for the total score of students' critical thinking skills. The calculation results showed the ability to think critically before and after applying Problem-based learning-based animated videos [t= 6,442; p= 0.000 (<0.05) with an increase of 14.65%.

Table 3.
Paired Sample T-test

Pre-Post	t	P-Value	Enhanced
Effectiveness	6.442	0.000	14.65%

Experimental learning is assessed during the learning process, in addition to the content's validity before the learning process. Assessment is carried out in the form of an FCE questionnaire filled out by students after learning. In general, in the opinion of students in the first stage of the test, the effectiveness of problem-based learning animated videos is good.

Table 4.
Component Results

Component	First Meeting	Second Meeting	Third Meeting
Result	2.76	2.78	2.8
Motivation	2.80	2.86	2.96
Method	2.55	2.74	2.81
Collaboration	2.78	2.80	3
Average	2.74	2.79	2.89
Category	Good	Good	Very Good

Discussion

Critical thinking is a vital thinking ability for students to develop in school. Teachers are expected to be able to create learning methods that can activate and develop students' critical thinking skills (Norrizqa, 2021). Critical thinking, as one aspect of high-level thinking, is a process to find, produce, analyse, collecting and conceptualise information as a reference with personal awareness and the ability to increase creativity. Therefore, students' critical thinking skills can be developed through learning that requires students to explore, investigate, find, and solve problems. Therefore, in this learning process, students must be active. Critical thinking components include: (1) drawing conclusions, (2) assumptions, (3) deduction, (4) interpreting information, and (5) analysing arguments

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(Prayogi et al., 2017). These critical thinking components are a benchmark for a person's critical thinking skills. Prayogi et al. (2017) assert characteristics of a person who can think critically are being able to solve a problem with a particular purpose, analysing and generalising ideas based on existing facts, and being able to draw conclusions and solve problems systematically with the correct arguments. Therefore, students who can only solve problems without knowing the reasons for the concept being applied can not be said to have the ability to think critically. The ability to think critically can be developed by applying a problem-based learning model. It is reinforced by the application of problem-based learning (Fakhriyah, 2014). The ability to think critically can develop because the ability to think critically observed in this study is in the form of the ability to identify, analyse, solve problems, think logically, make decisions appropriately and draw conclusions.

The problem based learning model is a learning that requires students to explore, investigate, discover and solve problems. It is because in problem-based learning, to obtain essential knowledge and concepts from subject matter, students are given a problem. Students conduct investigations, inquiry and problem-solving to build concepts and principles from a material with their own abilities that integrate previously understood skills and knowledge. In addition, the problem-based learning model requires students to be active in the learning process and have the opportunity to find and apply their own ideas in solving problems so that students can develop their creative thinking skills. According to Arends in Lestari et al. (2017), there are five phases in implementing problem based learning (PBL), namely (1) orienting students on the problem; (2) organising students to research; (3) assisting independent and group investigations; (4) developing and presenting works; (5) analysing and evaluating the problem-solving process., the problems used in PBL are problems faced in the real world. The PBL learning model is one of the learning models that can provide a learning environment that supports critical thinking (Lestari et al., 2017). Therefore, PBL is based on a problematic and confusing situation to arouse students' curiosity so that they are interested in understanding the problem. In addition to the learning model playing an important role, the use of learning media is also crucial for delivering material to students so that learning is more interesting for students. One of the learning media is animated videos.

According to Johari et al. (2016) video learning media is a tool used to convey learning materials through moving images projected to form the same character as the original object. Busyaeri et al. (2016) explain video as the audio-visual media used to convey the message presented that can be factual, fictional, informative, educational or instructional. Meanwhile, Johari et al. (2016) add that animation is the motion of an object or image so that it can change position, motion, shape and colour. It can be concluded that animated videos are audio-visual media in the form of images made following the original characters so that the images look alive. These animated videos can be used to convey material in the learning process that is informative, educational, and instructional. Animated videos in learning allow students to think critically and creatively and develop curiosity about the videos displayed. Animated videos can help the student's learning process in understanding an existing problem and finding solutions to solve it. Thus, the teacher does not need to explain repeatedly because the material can be played by students many times. The teacher can design animated videos according to the needs of students.

Conclusion

Overall, it can be concluded that students experienced an increase after the application of problem-based learning animated video, and there were significant differences in critical thinking skills before and after the application of animated videos based on problem-based learning. The application of animated videos based on problem based learning in learning helps students understand the game of football which has complex tactics and strategies to be understood theoretically and fully integrates their knowledge of the material on defence patterns, attack patterns and formations in the football game. If teachers want to improve students' critical thinking skills, they must provide opportunities to reinvest their thinking and realisation through observation and critical thinking. Students must be allowed to test the knowledge they have learned (from the results of involvement and critical thinking) in learning. In constructing knowledge and knowing how to do things, students must have the opportunity to experiment in real experiences to integrate what they have learned. Through this process, teachers will create a collaborative learning environment that includes critical thinking and potentially helps students better understand and fully integrate their knowledge of various games and sports, particularly football game tactics and strategies. Animated videos based on problem-based learning can provide stimuli that can encourage students to think analytically so that they can improve their critical thinking. Therefore, learning using animated videos based on problem-based learning is more effective and easier to understand than using conventional theory. It can help teachers, students, and educational implementers carry out transformational education through exciting and enjoyable learning experiences to increase student involvement in the learning process that can improve students' critical thinking.

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