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Enhancing Problem-Solving Skills Through Physical Education Learning: A Comprehensive Analysis
Mejora de las habilidades para resolver problemas mediante el aprendizaje de educación física: un análisis integral

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Abstract. Physical education (PE) has long been recognized as an important component of holistic education, contributing not only to physical fitness but also to cognitive, social, and emotional development. This research is to find out whether physical education can improve problem solving skills. The type of research used in this research is associative (relationship) research. This research was conducted on high school students in Padang, West Sumatra with a sample size of 50 people (23 men and 27 women) using a purposive sampling technique. The Problem Solving Inventory (PSI) was the tool used in this research. This instrument consists of (1) problem solving beliefs (r =.85), (2) approach-avoidance style (r =.88), (3) personal control (r -.83). The research results that can be seen in the anti-image matrix table determine the level of suitability of the variables studied. In this case, the three variables in the Problem Solving Inventory all have values > 0.50 with the following details: 1) Problem solving confidence 0.643; 2) Approach avoidance style 0.501 and 3) Personal control 0.501. Furthermore, the Total Variance explained above in the Initial Eigenvalues section only has 1 factor which is formed from the 3 variables used. Because the requirement to become a factor is that the Initial Eigen Value > 1 is able to explain 43.273%, while the Extraction Sums of Squared Loadings value is 1.298 or > 1 and is able to explain 43.273% of the variation. And has a cumulative variation of 43.273%. Based on the research results above, it can be concluded that the problem-based learning model can improve the learning outcomes of high school students in Padang. Problem solving is an important component in life, therefore problem-solving skills must be included in every lesson.
Keywords: physical education, problem solving, problem-based learning, school students

Resumen. La educación física (EF) ha sido reconocida desde hace mucho tiempo como un componente esencial de una educación holística, que contribuye no sólo a la aptitud física sino también al desarrollo cognitivo, social y emocional. Esta investigación tiene como objetivo descubrir si la educación física puede mejorar las habilidades para resolver problemas. El tipo de investigación utilizado en esta investigación es la investigación asociativa (de relación). El Inventario de Resolución de Problemas (PSI) es la herramienta empleada en este estudio. Este instrumento consta de (1) la confianza en la resolución de problemas (r = 0,85), (2) el estilo de acercamiento-evitación (r = 0,88), (3) el control personal (r -0,83). Los resultados de la investigación que se pueden observar en la tabla de la matriz anti imagen determinan el nivel de idoneidad de las variables estudiadas. En este caso, las 3 variables del Inventario de resolución de problemas tienen todas un valor > 0,50 con los siguientes detalles: 1) Confianza en la resolución de problemas 0,643; 2) Estilo de evitación de aproximación 0,501 y 3) Control personal 0,501. A continuación, la varianza total explicada anteriormente en la sección Valores propios iniciales, solo hay 1 factor formado a partir de las 3 variables utilizadas. Porque la condición para convertirse en factor son los valores propios iniciales> 1 y pueden explicar el 43,273%, mientras que el valor de las sumas de extracción de cargas al cuadrado es 1,298 o> 1 y pueden explicar la variación del 43,273%. Y tiene una variación acumulada del 43,273%. Con base en los resultados de la investigación anterior, se puede concluir que los modelos de aprendizaje basado en problemas pueden mejorar los resultados del aprendizaje de los estudiantes de secundaria en Padang. La resolución de problemas se convierte en un componente esencial en la vida, por ello en todo aprendizaje se debe incluir la capacidad de resolución de problemas.
Palabras clave: educación física, resolución de problemas, aprendizaje basado en problemas, estudiantes escolares

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Introduction

Education serves as a pathway to cultivate autonomous and analytical individuals, enabling them to progress and thrive both personally and within society (Bidzan-Bluma and Lipowska 2018; Deng and Yu 2020; Kohl III and Cook 2013; Rasberry et al. 2011; Tarigan, Hendrayana, and Wijaya 2017) Its goal is to unlock each person's capabilities for their own benefit and that of the community (Huzii et al. 2021; Mulrine and Flores-Marti 2014). The quality of education reflects a nation's success, thus necessitating effective teaching methods that can nurture successful generations. A high-quality education system is characterized by an effective teaching and learning process that supports students' meaningful learning experiences with adequate resources (Dubash, Arshad, and Khan 2020; Er 2017; Sánchez-Cabrero et al. 2021). The success of student learning reflects the effectiveness of the educational process, indicating that more impactful learning leads to better student outcomes. There is currently a need for improvement in Indonesia's education system concerning student learning outcomes (Beatty et al. 2021; Miftachudin 2012). The choice of instructional delivery model by teachers strongly influences these outcomes. Teachers are required to act as responsive facilitators in delivering instruction to ensure that it meets the intended goals.

The teacher assumes the role of a mentor, guiding students in analyzing and resolving answers (Chalapati, Leung, and Chalapati 2018; Halai 2006; Nesterenko and Titova 2017). This approach aims to cultivate creative thinking and

analytical skills among students when addressing learning challenges. Problem-solving is an essential skill for students during the learning process (DeHaan 2009; Kashefi, Ismail, and Yusof 2012; Nigmatov 2015). The development of critical thinking patterns in each student plays a vital role, enabling them to solve problems, demonstrate accountability, collaborate effectively, and confidently engage in discussions and question-asking particularly within subject areas. Mastering problem-solving skills is crucial for students. The teacher's influence is pivotal in nurturing students' problem-solving abilities, especially within physical education (Putri, Lukito, and Wijayanti 2020; Silverman and Mercier 2015; Tay and Toh 2023; Xu, Wang, and Wang 2023).

Physical education plays a vital role in the overall educational process by incorporating planned physical activities that address cognitive, affective, and psychomotor aspects of learning (Coe et al. 2006; Donnelly et al. 2017; Ramires et al. 2023). Insufficient student movement during practical learning can hinder their ability to achieve optimal physical fitness. Effective lesson planning is crucial for teachers in delivering quality physical education within the classroom environment. Encouraging students to ask questions and engage in group or pair study fosters collaboration and problem-solving related to physical activity tasks.

Communication relationships focused on students completing tasks independently aim to enhance collaborative problem-solving skills in learning (Xu et al. 2023; Yang et al. 2021). Problem-solving abilities are crucial for navigating a competitive global environment, and the utilization of problem-solving learning models offers opportunities for creative thinking among students. The development of problem-solving prowess is an essential competency within physical education curricula, necessitating early acquisition by students (Dupri, Risma, and Nazirun 2019). This skill entails formulating unique approaches to effectively address challenges.

The problem-centered learning method has proven effective for over 30 years and is gaining recognition in various fields. This approach focuses on empowering students to conduct research, integrate theory with practice, and apply their knowledge to solve specific problems (Buan, Ali, and Gomez 2021; García-Martínez et al. 2023; Trigueros et al. 2020; Yew and Goh 2016). Problem-based learning not only emphasizes the interdisciplinary nature of knowledge but also encourages active student engagement in learning through problem-solving methods. Ultimately, PBL aims to develop students' critical and creative thinking skills (Harackiewicz, Smith, and Priniski 2016; Sungur, Tekkaya, and Geban 2006; Yew and Goh 2016).

Physical education plays a crucial role in fostering problem-solving skills in individuals. Through physical activities and sports, students can develop their ability to think critically, make quick decisions, and strategize effectively (Abdellatif, and Zaki 2020; Sozen 2012). Whether it's devising game plans, adapting to unexpected challenges on the field, or working as a team to achieve a common goal, physical education provides students with opportunities to hone their problem-solving aptitude in a practical and engaging manner (Broder 2016; Dressel 2020). As a result, students not only improve their physical health but also enhance their cognitive abilities, which are essential for success in various aspects of life.

Physical education also helps in developing important social skills such as teamwork, communication, and leadership (Esteban-Cornejo et al. 2015; Fisher et al. 2011; Purnomo, Ma'mun, et al. 2024). Engaging in team sports and physical activities requires students to work together, communicate effectively, and take on leadership roles when necessary. These experiences can translate into real-life situations, where individuals must collaborate with others, communicate clearly, and take charge when needed (Sullivan 1993)(Esa, Salwa Abd Mutallib, and Nadhia Nor Azman 2015). Additionally, physical education encourages perseverance and resilience in the face of challenges. Students learn to push through physical and mental barriers, teaching them valuable lessons about determination and the importance of overcoming obstacles.

Furthermore, integrating problem-solving activities into physical education classes can enhance the overall learning experience. These activities can range from obstacle courses that require strategic thinking to team-building exercises that promote cooperation and creativity (Alpaslan 2016; Senduran and Amman 2015). By incorporating these elements, educators can create a well-rounded physical education curriculum that not only promotes physical fitness but also nurtures critical thinking and problem-solving skills in students. Physical education goes beyond just promoting physical fitness; it also has a significant impact on mental and emotional well-being (Marheni et al. 2024; McBride, Xiang, and Wittenburg 2002; Saroji et al. 2023). The holistic approach of physical education in schools is essential for the overall development of students. Not only does it improve their physical health and cognitive abilities, but it also instills important life skills that are valuable in various aspects of their lives (Lu and Buchanan 2014; Lupu 2014; Marheni et al. 2022).

In addition to the physical and mental benefits, physical education can also contribute to the emotional well-being of students. Engaging in physical activities and sports can help reduce stress, anxiety, and depression. It provides students with a healthy outlet for their energy and emotions, promoting a positive mindset and overall mental wellness (Lu and Buchanan 2014; Sutherland and Parker 2020; Tong 2019). Furthermore, the inclusion of problem-solving activities in physical education classes not only enhances the students' learning experience but also prepares them for real-life challenges. As they navigate through these activities, students develop resilience, adaptability, and the ability to think on their feet, all of which are crucial for success in their future endeavors (Ginosyan, Tuzlukova, and Ahmed 2020; Martinez et al. 2016). In conclusion, the role of physical education in fostering problem-solving skills, promoting social development, and contributing to overall well-being cannot

be understated. It is an integral part of a comprehensive education that equips students with the tools and abilities they need to thrive in all aspects of life.

In this research there are several questions that will be answered

1. What factors are students' strengths in solving problems?

2. What is the order of the factors based on the student's strength in solving problems?

Materials and Methods

Design

The aim of this research is to describe the role of physical education in providing understanding and skills for problem solving for students at school. To conduct this research, a selective study approach was carried out. Selective studies are one of the most common forms of psychological research based on the use of sampling survey methods, and their fundamental distinguishing feature is the use of self-report techniques to collect empirical information on the research sample. Research that uses design to describe research findings is known as quantitative descriptive research (Ato, López, and Benavente 2013). Research that monitors, observes, and describes the number of samples based on events that occur throughout the research is known as descriptive quantitative research, and it uses this method to reach conclusions (Creswell and Creswell 2018).

Respondence

In carrying out this research, 50 high school students in Padang, West Sumatra were used (23 men and 27 women) (average age 17.8 years) using a purposive sampling technique. Currently the high school curriculum in Indonesia does not require students to take certain subjects, so students take lessons according to their interests and preferred subjects. So, this research only included students who took physical education lessons.

Instrument

The Problem Solving Inventory (PSI) from Heppner and Petersen (1982) was the tool used in this research. By using exploratory component analysis, this instrument looks at the fundamental elements of the personal problem-solving process actually carried out by the community. Apart from that, this instrument has gone through several stages which might be used as a model for a research instrument. Problem-solving confidence (r =.85), approach-avoidance style (r =.88), personal control (r -.83), and overall Problem-Solving Inventory (PSI) (r =.89) were reliability data. It was determined that the instrument was practical and could be used as a research tool even though there was no sample trial and validity and reliability tests based on the reliability data presented above.

The PSI instrument which consists of 3 indicators will be used altogether, with answer choices 1-6 (1=very much less, 6=very much more) according to the original instrument. The PSI instrument is then prepared in the form of a paper project. Next, students are placed in a room that is comfortable, has a low noise level, then students are given a piece of paper for the students to fill in. Students report independently regarding the problem solving they obtain.

Data analysis

Factor analysis is then used to examine the gathered study data. The purpose of this study is to identify the factors that, in relation to other variables, are the most superior and dominating. It will be possible to identify the important factors or components based on the ranking results according to the analysis's findings.

Apart from looking at the calculations and hypothesis testing that have been explained previously, researchers will find out which of the 3 PSI instrument component indicators has the most influence or obtains the best results. The data will then be sorted based on the best value obtained.

Results

Based on the results of the research we have conducted; we have succeeded in collecting significant and relevant data which shows a strong relationship between physical education learning and the ability to solve problems. These data provide in-depth insight into how physical education can serve as an effective tool in building problem-solving skills.

Table 1.
Output of KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.502
Bartlett's Test of Sphericity	Approx. Chi-Square	4.338
	df	3
	Sig.	.002

Table 1 output of KMO and Bartlett's Test above is used to determine the feasibility of a researched variable. In this study, there are 3 variables used to assess the Problem-Solving Inventory. From the table data above, it is obtained that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy obtained a value of 0.502> 0.50 and the value of Bartlett's Test of Sphericity (sig.) 0.002 < 0.005, which means that the research that has been carried out meets the requirements and then proceeds to the next analysis.

Table 2.
Anti-image Matrices

		Problem-solving confidence	Approach avoidance style	Personal control
Anti-image Covariance	Problem-solving confidence	.999	.017	.012
	Approach avoidance style	.017	.912	-.269
	Personal control	.012	-.269	.913
Anti-image Correlation	Problem-solving confidence	.643a	.018	.012
	Approach avoidance style	.018	.501a	-.295
	Personal control	.012	-.295	.501a
Measures of Sampling Adequacy (MSA)				

Based on the table above, it is known that anti-image matrix analysis was carried out to assess the level of suitability of the variables being studied. In this case, analysis was carried out on three variables included in the problem-solving inventory. The anti-image matrix provides a measure of the correlation between each variable and the other variables in the dataset. The values obtained indicate the degree to which each variable shares variation with other variables, with higher values indicating stronger associations.

Eligibility criteria for further analysis usually involve ensuring that the anti-image value for each variable is above a certain threshold, often set at 0.50 or higher. Values below this threshold indicate that the variable may not be sufficiently correlated with other variables and may not make a meaningful contribution to the analysis.

In this analysis, the anti-image matrix produces the following values for each variable:

- Problem Solving Confidence: 0.643
- Approach Avoidance Style: 0.501
- Personal Control: 0.501

These values indicate the degree of correlation between each variable and other variable. All three variables had anti-image values that exceeded the 0.50 threshold, indicating significant levels of correlation with other variables in the problem-solving inventory.

These results mean that all variables meet the requirements for further analysis. High anti-image values indicate that each variable makes a significant contribution to the overall variation in the dataset and is therefore suitable for inclusion in subsequent analytical procedures. Researchers can proceed with confidence in using these variables to explore their relationships, patterns, and implications in the context of studies of problem-solving skills.

Table 3.
Communalities

	Initial	Extraction
Problem-solving confidence	1.000	.012
Approach avoidance style	1.000	.644
Personal control	1.000	.643

Extraction Method: Principal Component Analysis.

Table 3 Communalities above have a fungus to determine which variables can explain the existing factors. One of the prerequisites to explain the factor is that the Extraction value must have a value > 0.50. Based on the table above, it is explained that the Problem-solving confidence variable has a value of 0.12, which means that the variable cannot explain the Problem-Solving Inventory.

Table 4.
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.298	43.273	43.273	1.298	43.273	43.273
2	.997	33.242	76.515			
3	.705	23.485	100.000			

Extraction Method: Principal Component Analysis.

The Total Variance Explanation section in Table 4 provides insight into the factor structure derived from the variables studied. This analysis aims to identify the number of factors formed and their explanatory power in explaining variations in the dataset. Initial Eigenvalues represent the eigenvalues for each factor before extraction. In this analysis, it was noted that there was only one factor formed from the three variables used. The condition for a variable to become a factor is that the initial eigenvalue must be greater than 1.

The Extraction Sums of Squared Loadings value provides a measure of the total variation explained by the extracted factors. In this case, the value obtained is 1.298, which is greater than 1. This indicates that the extracted factors are able to explain most of the variation in the dataset. The extracted factors can explain 43.273% of the total variation in the dataset. This percentage represents the proportion of the total variability in the observed variables that can be explained by the extracted factors. Cumulative variation refers to the total amount of variation explained by the extracted factors cumulatively. In this analysis, the cumulative variation explained by one factor is also 43.273%.

Based on Figure 1 of the scree plot, it can also be seen that the variable with a value > 1 is only 1. This is the same as the explanation in the previous table. In fact, the second variable is close to the value of 1 but is still below the value of 1.

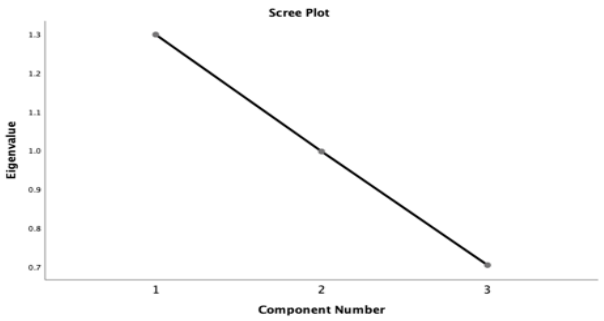

Figure 1. Scree Plot

Table 5.
Component Matrix[a]

	Component
	1
Problem-solving confidence	-.109
Approach avoidance style	.802
Personal control	.802

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Based on table 5 of the Component Matrix, it can be seen that variables 2 and 3 can fill and meet the prerequisites to enter component 1. While variable 1 cannot enter because the value obtained is less than 1. Thus, it can be concluded that:

Table 6.
Priority of Problem-Solving Components

Item	Priority/Rank
Approach avoidance style	1
Personal control	2
Problem-solving confidence	3

Based on table 6 above, it is found that in solving the problem of Approach avoidance style, The last personal control and urgency in the problem-solving item is Problem-solving confidence. Based on the results above, it will be a future study on which components should be the main focus in improving the assessment of problem-solving.

Discussion

Based on the research results, it can be explained that: *Problem-solving confidence* has a negative correlation (-0.109), indicating that the level of self-confidence in solving problems does not contribute significantly to the success of problem-solving in this research. This indicates that although a person may feel insecure, this factor does not directly hinder their ability to solve problems; *Approach avoidance* style has a strong positive correlation (0.802), indicating that the style of approaching or avoiding problems greatly influences the effectiveness of problem-solving. Individuals who tend to approach problems with a proactive attitude tend to be more successful in solving problems compared to those who tend to avoid them; *Personal control* also shows a significant positive correlation (0.802). This shows that individuals' belief in their control over the outcome of the problem greatly influences success in problem-solving. Individuals who feel they have control over a situation are more likely to be successful in solving problems.

Improvements in thinking and learning processes will increase the measure of achievement assessed by teachers (Taradi et al. 2005). As a result, learning design is an approach that is always being developed to raise the standard of instruction and make it more creative and effective (Bagus et al. 2022). Yustivar et al. (2021) found that when students engage in problem-based learning activities, their cognitive, psychomotor, and emotional competencies improve, leading to improved learning outcomes. Model of learning Students that use problem-based learning first identify what they already know, then look at the areas where they have found knowledge gaps, and then provide the appropriate answer (Bethell and Morgan 2011).

In contemporary culture, the word "teacher" has a broad definition. Whether the student likes it or not, the instructor must communicate this information (Hafiar et al. 2024; Purnomo, Aisyah, et al. 2024). It might be argued that instructors need to be experts or professionals in all subjects since they also need to be aware of current developments and correctly adapt to them in order to solve challenges linked to teaching and learning, particularly those involving student discipline (Hashim et al. 2020; Marheni et al. 2021).

To maximize students' abilities in solving problems, teachers can carry out various activities such as the following. *Challenge Based Activities*: uses physical activities that require students to think critically and make quick decisions. Examples of activities such as obstacle courses, adventure games, or scavenger hunts can stimulate students' problem-solving skills; *Collaborative Approach*: encourage teamwork through games and activities that require collaboration. Games such as soccer, basketball, or other team games require students to work together, develop strategies, and solve problems together; *Real Scenario Simulation*: implementing simulations or role-playing that involve real situations that require problem solving. For example, rescue scenarios or emergency situations where students must work together to find effective solutions; *Project-Based Learning*: implementing long-term projects that involve planning and implementing problem-solving strategies. This project could involve planning and executing a sporting event, where students have to overcome various obstacles and make important decisions; *Structured Reflection and Discussion*: provide time for reflection and discussion after physical activity. Talk about what worked and what didn't, and how they felt during the problem-solving process. This will help students understand their approach and how they can improve their problem-solving skills; *Self-Confidence Development*: showing a negative correlation between self-confidence and problem-solving success, it is important to continue to develop students' self-confidence. This can be done through constructive praise, recognition of effort, and giving them the opportunity to try and learn from mistakes.

Greater understanding through increased self-realization and how to establish interactions with the world as social beings have been identified as critical factors in developing the learning process (Roberts, Newcombe, and Davids 2019). The learning process is not only about how students understand a teaching material, but more than that, students should need to evaluate themselves in a conscious effort to improve self-competence. Problem-based learning shapes students to learn to be responsible in completing schoolwork. Problem-based learning is a crucial first step in developing students' critical thinking and creativity since it allows for repeated study of the material and helps students comprehend the concepts presented in the problems. According to Nurrohma & Adistana (2021), The goal of the problem-based learning approach is to help students acquire critical thinking skills so they can solve issues and understand the content. Innovative and creative teaching methods are needed in the classroom to ensure that students grasp the subject being taught as well as how it applies to and is relevant to their daily lives. The role that teachers play is crucial because they are expected to utilize more creativity and innovation when implementing the learning models that will be used in the classroom, such as the Problem Base Learning (PBL) learning model. A learning strategy known as "problem base learning" employs actual issues as a setting in which students may develop critical thinking and problem-solving abilities as well as gain crucial (Ismatulloh and Ropikoh 2021).

The use of suitable assessments, different teaching models, classroom disciplines, and beliefs about how children learn and grow have all been influenced by the methods of teaching in physical education (Hemphill et al. 2015). A learning approach called "problem-based learning" has the ability to make connections between many issues that arise in daily life, including those that affect pupils (Faqiroh, 2020). In a particular context, high school students can indirectly hone their critical, creative, and systematic thinking to achieve core competencies in each subject taught by the teacher

The experimental learning process requires the application of the right learning model in carrying out the teaching and learning process. A learning model that always uses problems to make it easier for students to learn is Problem Based Learning (PBL) (Dupri et al. 2020). According to (Tosun and Taskesenligil 2013), Problem Base Learning is implemented as an answer to the question of how to improve conventional learning systems and how to help students grow as learners who are experts in solving complex problems. According to (Suzianto and Damanik 2019), professional teachers must be able to formulate physical education learning objectives intended for students to be able to master the material taught, and teachers are also required to have competence in their approach to teaching, strategies, techniques, teaching methods and learning models. One of the teacher competencies that need to be developed in managing learning programs is the selection of varied learning models so that students will be active in the teaching and learning process.

Conclusion

The problem-based learning paradigm has been proven to be an effective method in developing students' abilities in facing learning challenges. By immediately recognizing the challenge, students can focus on solving the problem rather than being burdened by worry, which in turn improves their psychomotor abilities. This process not only strengthens cognitive aspects, but also trains students' critical thinking skills, forming a solid foundation for their academic progress.

Educators play a central role in directing societal development and national development. By understanding the need to adapt to dynamic changes in science and technology, educators are faced with the important task of designing education systems that are responsive to global demands. Awareness of this role encourages teachers to consistently update their knowledge and skills, as well as adopt relevant and effective teaching methods.

The key to a successful education is the teacher's willingness to face challenges with creativity and high responsibility. By understanding that the learning process must always be adapted to students' needs, teachers can prepare a learning environment that stimulates intellectual and emotional development. This includes developing a dynamic curriculum, implementing innovative educational technology, and fostering supportive relationships between teachers and students.

The importance of thorough preparation in the teaching and learning process cannot be overstated. Teachers must carefully plan each learning session, choose appropriate methods, and provide adequate resources to support student success. In this way, teachers not only act as learning facilitators, but also as role models who inspire and motivate students to achieve their best potential.

Along with changes in the educational paradigm, developing teacher professionalism becomes increasingly important. Teachers must be able to adapt to continuous changes in curriculum and technology, and implement best teaching practices supported by empirical evidence. By taking part in regular training and self-development, teachers can update and improve their skills, thereby making a greater contribution to educational progress and social development. In the end, problem-based learning has a significant positive impact on student progress in various aspects of learning. The important role of educators in shaping society and national development emphasizes the need for adaptation to developments in science and technology. Awareness of the teacher's responsibility as the main driver of the teaching and learning process paves the way to achieving better educational goals. Thus, investing in teacher development and adapting the education system is the key to creating a generation that is skilled, creative and ready to face future challenges.

Conflicts of Interest

The authors state that there is no conflict of interest.

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