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Integrating analytical thinking skills into physical education to improve student learning outcomes

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Abstract: In the education curriculum in Indonesia, physical education is a medium for developing the potential of student learning outcomes in a comprehensive (cognitive, affective, and psychomotor) and sustainable manner. However, at the same time, teachers have not maximized analytical thinking supplements in learning and mastering student movements to optimize their physical education learning outcomes. This research used quantitative methods to examine the effect of analytical thinking skills on student learning outcomes. The participants were 24 elementary school students (mean age = 10.17±0.38) who were determined using a purposive sampling technique. Data on thinking skills were collected using instruments and rubrics for assessing analytical thinking skills. While the learning outcomes data use the final value of physical education learning. Data analysis used descriptive statistics and simple linear regression analysis. Descriptive analysis showed that students' analytical thinking skills were moderate (58.34%), and learning outcomes were good (100%). There is a significant influence between analytical thinking skills on student learning outcomes ($t = 2.312$, $\alpha = 0.031$) with a determination value of 19.6%. Considering the essence of analytical thinking skills for learning outcomes and supporting students' life skills, the orientation of physical education learning outcomes parameters and the comprehensive and sustainable integration of analytical thinking into students' physical activities must be discussed further.
Keywords: analytical thinking, HOTS physical education, physical education learning outcomes.

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INTRODUCTION

Improving student learning outcomes seems easy for teachers, but the process risks teacher competence because it involves complex struggles and activities from teachers and students (Blegur et al., 2019). Improving student learning outcomes should ideally be evident in changes in behavior, both short, medium, and long-term (Yulianti et al., 2021) through changes in cognitive, affective, and psychomotor domains (Anderson et al., 2001). To maximize the improvement of student learning outcomes, teachers must show interest and motivation in exploring the key factors that influence student learning outcomes while at the same time focusing their learning on an integrated and sustainable transformation of knowledge and skills (Asim et al., 2021). Then, the teacher formulates a lesson plan which is the key to learning (Suhardi et al., 2023) comprehensively so that students can go through a holistic self-actualization experience (Negash, 2019) to ensure the contribution of physical education (PE) learning to improve student academic achievement (Marques et al., 2016) as well as advancing education that helps students develop souls, abilities, religion, character, intelligence, and noble character that are useful for themselves, society, nation, and country (Putra & Winarno, 2023).

Physical education learning uses physical activity to achieve national education goals (Blegur et al., 2023) and even global education goals so that students can survive and adapt in the future (Nugroho et al., 2018). However, at the same time, the teacher has not optimized learning and mastery of students' movements with other supplements (including analytical thinking) to make physical education more meaningful and impactful for their students. This case impeded exploring students' potential through

physical activity (including higher-order thinking). Research by Vedøy et al. (2021) and Lambert et al. (2022) has provided empirical evidence that students' physical activity needs to be integrated with various other skills to make their learning outcomes more optimal and comprehensive. In addition, when planning physical education lessons, teachers must promote students' physical literacy and prioritize mastery of physical fitness (Hobbs et al., 2018). The reason is that physical literacy is critical because it offers a multidimensional concept that describes the holistic basis of student involvement in physical activity (Cornish et al., 2020) so that students are also analytical and critical in deciding the impact and benefits of participating in physical activity and mastering the movements they learn.

Based on the findings above, severe problems in PE learning should be reformed for students' self-actualization and to develop more comprehensive and sustainable student learning outcomes. For example, the proportion of developing students' analytical thinking skills needs to be increased when the teacher prepares the lesson plan (Kul et al., 2018; Osborne et al., 2016) because analytical thinking helps students solve problems (Suyatman et al., 2021a). Students need to be trained to use differentiation thinking (able to differentiate relevant or important parts from irrelevant or unimportant parts of the material presented), organizing (able to organize how elements fit or function in a structure), and attribution (able to determine the angle viewpoints, biases, values, or intentions underlying the material presented (Anderson et al., 2001; Sternberg, 2006).

If we examine Quennerstedt (2019) critical notes, one of the teacher's primary responsibilities in learning is to teach students about an assessment and choices about how and why it is done (for example, why does the student need to learn movement skill mastery rather than just doing the movement skill). Belton et al. (2022) then reiterated that teachers must prioritize PE learning outcomes that focus on improving students' attitudes and motivation toward physical activities. Thus, while learning, the teacher should not partially teach students to be monotonous in simply replicating and imitating the motion of the results of their observations. Instead, it encourages students' analytical thinking processes and rationalizations about why and how the physical activity they do is crucial for their potential future development and survival.

The Independent Curriculum has mandated learning oriented on Higher-Order Thinking Skills (HOTS) for students in Indonesia. One is the concept of HOTS, namely the ability to think analytically (Anderson et al., 2001; Astuti et al., 2021). Students with high analytical thinking skills can build chronological reasoning and construct valid arguments when uncovering a phenomenon (Darmawan, 2020), can describe facts in detail (Kesorn et al., 2020) and can improve students scientific arguments (Perdana et al., 2019). Thus, analytical thinking skills make it easier for students to explore and develop their abilities (Mahyastuti et al., 2020) through a critical process in diagnosing the contribution of a construct to a phenomenon that occurs so that they are careful when making decisions to solve problems or develop science and knowledge.

Optimizing analytical thinking supports student success in learning (Huincahue et al., 2021; Mayarni & Nopiyanti, 2021). It stimulates researchers to develop and test learning models contributing to students' analytical thinking skills. For example, developing a Guided Inquiry Model (Annisa et al., 2016; Qomariya et al., 2018), developing a Problem–Based Learning Model (Assegaff & Sontani, 2016; Dewi et al., 2021; Ware & Rohaeti, 2018; Yulianti et al., 2018), as well as developing a Research-Based Learning Model (Suyatman et al., 2021b). Although not developed for PE subjects, at least the three models have provided empirical evidence that exploratory experiences on a particular object or case can train and improve students' analytical thinking skills through specific learning experiences.

Research reporting on the contribution of analytical thinking to students' PE learning outcomes is minimal. Only Whittle et al. (2018) confirmed that students with low thinking skills have below-average PE learning outcomes. Other research is limited to testing the effects of STEM-integrated movement activities on movement and analytical thinking skills Phuseengoen & Singhchainara (2022), reporting the application of HOTS learning (Dewanti et al., 2021; Kurniawan, 2021), localizing HOTS to decision-making skills, execution skills, and support skills (Nopembri et al., 2022), exploring critical thinking skills and problem-solving (Bayu et al., 2022; Nopembri et al., 2019; Pill & SueSee, 2017), as well as investigating creative thinking skills (Dupri et al., 2021; Ridwan & Nikmah, 2022; Vidaci et al., 2021). Thus, this study aims to: 1) describe analytical thinking skills and student learning outcomes and 2) examine the effect of analytical thinking skills on student PE learning outcomes.

METHOD

Participants

There were 24 participants involved in this study, 14 men and 10 women (mean age 10.17±0.38). They are Grade VI students from an elementary school in Kupang City, East Nusa Tenggara Province, Indonesia. They were determined using a purposive sampling technique, considering that their PE teachers were Activist Teachers Batch III Program of the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia.

Procedure

The teacher integrated analytical thinking skills into the physical activity of throwing and catching games for students using a scientific learning model protocol from the Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia (2014): observing, questioning, experimenting, associating, and communicating. After the students finished learning (3 meetings), the researchers scored nine essay questions (analytical thinking skills instrument) from Blegur et al. (2023) and distributed them to participants to test their analytical thinking. Participants answered essay questions according to the allotted time. The researchers collected their work again to be assessed using the analytical thinking skills assessment rubric from Blegur et al. (2023) with a 4-level scale. The assessment results of students' analytical thinking skills were then transferred to Microsoft Excel to facilitate tabulating and analyzing data. Next, the researchers collected data on student learning outcomes from the PE teacher's documentation scores. After the two data were collected, the researcher conducted descriptive analysis and linear regression testing using SPSS version 24 to test the effect of the analytical thinking skill variables on student learning outcomes.

Instruments

Instruments and rubrics for assessing analytical thinking skills were adopted from Blegur et al. (2023). The instrument is in the form of nine essay questions constructed using the concept of analytical thinking skills from Anderson et al. (2001) to test the analytical thinking of elementary school students in PE learning. This instrument has also passed the Aiken–V content validation testing process (≥0.74). Meanwhile, construct validity uses factor analysis ($\lambda = 0.433–0.679$), Pearson correlation (0.457–0.654), and Cronbach's alpha reliability value of 0.712. The participants' work results (answers) were assessed using a four–graded scale rubric (unable to able) from Anderson and colleagues' analytical thinking concepts. While the data on student learning outcomes were taken using documentation data, namely the learning outcomes of PE subjects (cognitive, affective, and psychomotor).

Statistical Analysis

The analysis process used descriptive statistics to describe as well as profile analytical thinking skills using formulas from Widoyoko (2012), namely: 1) 9–18 (poor), 2) 19–27 (moderate), and 3) 28–36 (good), and the learning outcomes used categories from the school, namely: 1) <65 (poor), 2) 65–76 (moderate), 3) 77–88 (good), and 4) >89 (very good). Meanwhile, simple linear regression analysis was used to test the influence and determination value (R-Square) between analytical thinking skills on PE learning outcomes for elementary school students. The hypothesis is accepted if the significance value is less than 0.05. The entire testing process used the help of Microsoft Excel and SPSS version 24.

RESULT AND DISCUSSION

This phase only describes the research variables without carrying out categorization (high-low). The presentation of data is only looking for a minimum, maximum, mean score, standard deviation, skewness, and kurtosis to investigate student work and then explore its meaning.

The results of the descriptive analysis show that the distribution of student work is spread over values 1 to 4, with the lowest mean score being on the question item "*What will you do if the ball thrown by a teammate is fast?*". While the highest mean score is on the statement item "*How do you pass the ball to a teammate who is out of reach?*". Items 1 and 2 have a mean score that does not approach the value of 2 of the 4 rating scales. Students' thinking skills in differentiating could be more optimal on these items. Students did not maximally distinguish the relevant or essential parts from irrelevant or unimportant parts of the material presented. For example, in the first question item "*In what situation*

do you catch the ball with both hands?" as well as on the second question item "*What will you do if the ball thrown by a teammate is fast?*"

Table 1. Description of students' analytical thinking skills

No.	Questions	Min.	Max.	Mean	SD	Skew.	Kurt.
1.	In what situation do you catch the ball with both hands?	1.00	4.00	1.917	1.018	.718	-.683
2.	What will you do if the ball thrown by a teammate is fast?	1.00	4.00	1.792	.779	.997	1.410
3.	How do you throw the ball so that your teammates easily catch it?	1.00	4.00	2.792	.779	-.207	-.123
4.	Why do you have to throw a hard ball at a teammate?	1.00	4.00	3.125	.850	-.716	.031
5.	Why does the ball have to be passed to another teammate in team play?	1.00	4.00	3.000	.933	-.351	-1.045
6.	How do you try to catch a ball thrown by a teammate when it is not on target?	1.00	4.00	2.167	.637	. 958	2.375
7.	Why do you need the correct throwing and catching technique in the game?	1.00	4.00	2.333	.761	1.266	1.120
8.	Why are teammates important in team sports to win the game?	1.00	4.00	2.875	.797	-.324	-.099
9.	How do you pass the ball to a teammate who is out of reach?	1.00	4.00	3.167	.761	-.943	1.540

The results of the categorization of analytical thinking skills revealed that the highest percentage is in the "Moderate" category, with a value of 58.34. In contrast, the other two categories, "Good" and "Poor", each present 20.83. Thus it was concluded that the participants had analytical thinking skills and could use them well in PE learning (see Table 2). However, students' thinking required improvement on some items, as in the previous discussion (see Table 1).

Table 2. Students' analytical thinking skills profile

Score range	Predicate	Frequency	Percentage
28–36	Good	5	20.83
19–27	Moderate	14	58.34
9–18	Poor	5	20.83

The learning outcome data in Table 3 informed that all participants have good learning outcomes (100%). The category set by the school shows that during PE learning, students could fulfil good learning performance in developing their cognitive skills, affective skills, and psychomotor performance.

Table 3. Students' learning outcomes profile

Score range	Predicate	Frequency	Percentage
>89	Very good	0	0
77–88	Good	24	100
65–76	Moderate	0	0
<65	Poor	0	0

Linear regression analysis was used to examine the effect of analytical thinking skills on student learning outcomes. The test results proved a linear and significant influence between analytical thinking skills and PE learning outcomes for elementary school students, with a sig. of 0.031 (<0.05) with a value of t = 2.312. Meanwhile, the R Square value indicated that analytical thinking skills contributed 19.6% to student learning outcomes.

Table 4. Regression analysis of analytical thinking skills and student learning outcomes

Model	Unstandardized coefficients	Standardized coefficients	t	Sig.	R Square
Analytical thinking skills	.059	.442	2.312	.031	.196

a. Dependent variable: Learning outcomes

The two research variables showed a positive trend, students have moderate analytical thinking skills (58.34%) and good PE learning outcomes (100%). Furthermore, the regression test results proved a significant linear effect between analytical thinking skills on student learning outcomes ($t = 2.312$, $\alpha = 0.031$) by determining 19.6%.

This study's results support Whittle et al. (2018) justification that students with high thinking skills have high PE learning outcomes. Previous scientific studies have explained that analytical thinking skills make students easy to explore and develop their abilities (Mahyastuti et al., 2020), helping students to construct chronological and valid reasoning and argumentation when uncovering a phenomenon (Darmawan, 2020; Perdana et al., 2019), details when describing facts (Kesorn et al., 2020), as well as helping students solve problems (Suyatman et al., 2021a). That is why analytical thinking is part of logical thinking skills (Beňo et al., 2020) and higher-order thinking (Anderson et al., 2001; Astuti et al., 2021) so teachers need to analyze, evaluate, and even create strategies application of analytical thinking skills to students in PE learning, starting from elementary school.

The results of this study also clarify doubts about the research report of (Coe et al., 2006; Stevens et al., 2008; Vedøy et al., 2021), as well as Lambert et al. (2022), that purely physical activity-based learning has not provided satisfactory student learning outcomes that are comprehensive for student development. The physical activity that the teacher initiates through play activities and games influences student learning outcomes because the teacher accustoms students to comparing and contrasting two or more things from irrelevant or unimportant parts in play activities and games, determining how elements fit or function in a structure or the reasons why something happens or the procedure for solving a problem in play activities and games, as well as determining, criticizing, or evaluating the viewpoints, biases, values, or intentions that underlie the material in play activities and games. Analytical thinking is an integral part of PE learning. Physical activity designs that encourage students' learning experiences to optimize HOTS have become a new trend in PE learning with the concept of physical literacy (Hobbs et al., 2018) because it rationalizes students' involvement in physical activities (Cornish et al., 2020) by teaching them about how and why it is done (Quennerstedt, 2019), as well as students' attitudes and motivation towards their physical activity (Belton et al., 2022).

The real purpose of education is to prepare students to face real-life problems (Rind, 2022). So does glorifying the physical aspect make teachers forget the essence of educational goals? Of course not, PE learning must be reformed to become a compatible medium for preparing students to survive in real life (life skills). Simple steps can be taken by the teacher, starting with integrating analytical thinking skills in preparing their lesson plans (Kul et al., 2018; Osborne et al., 2016) and followed by learning management that emphasizes students' analytical thinking by comparing and defending experimental results (McDonald, 2012), observing or reviewing learning assignments (Bayu et al., 2022; Blegur et al., 2023), organizing things, dealing with challenging situations, and applying the results of lessons to daily life activities (Chonkaew et al., 2016).

Improving students' analytical thinking skills does not occur automatically, but there is engineering intervention by the teacher in various ways, such as providing data visualization and graphics (Friskawati & Supriadi, 2022; Stamatel, 2015), facilitating students to interact with colleagues from different cultures (Lee, 2017), using student worksheets in learning (Lestari et al., 2021) or through grammatical (Youjun & Xiaomei, 2022). For example, suppose the teacher uses the Scientific Learning Model in a small ball game. In that case, the teacher first divides students into groups with various cultural and gender backgrounds (3-5 people) to encourage cross-cultural interaction. Observing activities are marked by the teacher displaying data of numbers, sentences, videos, pictures, and graphics and guiding students to make observations and differentiate, organize, and attribute data from their observation activities in group discussions. The next step is that the teacher guides and stimulates students to submit questions based on thinking processes and grammatically differentiating, organizing, and attributing about the subject matter. Third, the teacher guides students to conduct experiments/gather information/demonstrate small ball game material in play groups—the fourth step is associating the various successes and failures of students in small ball games. Finally, students communicate their learning outcomes using student worksheets (written and or orally) to their colleagues and the teacher.

The teacher is at the center of transforming student learning through various instructions. Teachers are also the key to students' holistic development, as they are responsible for moderating and transforming theory, skills, and hands-on experience to students inside and outside the classroom (Mesias, 2022). The learning process exemplified in the previous paragraph seeks to elaborate on the

technical implementation of student learning activities that promote and improve analytical thinking skills using the Scientific Learning Model on small ball game material. So during the learning syntax, the teacher needs to provide interventions that direct and guide students to the indicators of analytical thinking skill themselves. Thus, students have a more operational learning experience in processing their analytical thinking in various forms of learning syntax and materials.

Researchers have debated the contribution of PE learning to student learning outcomes. At least Lindner (2002) and Rasberry et al. (2011) reported that physically active students had an insignificant relationship with their academic grades. At the opposite time, there are also not a few studies reporting the contribution of physical activity to student learning outcomes (Bedard et al., 2019; Daly-Smith et al., 2018; Pulido-Gil et al., 2022; Watson et al., 2017). These different conclusions indicate that PE learning has a different orientation regarding measuring and assessing students' cognitive, affective, and psychomotor aspects. Cognitive aspects, for example, what level does the teacher measure and grade during learning? It is an interesting discussion because cognitive learning outcomes have six levels which are then categorized as Lower-Order Thinking Skills (LOTS) and HOTS (Anderson et al., 2001). Is the cognitive aspect adopted by the teacher still related to LOTS (remembering, understanding, and applying), or vice versa, namely analyzing, evaluating, and creating data and information.

Learning activities must ensure students' survival skills and success in real life. Teachers must select and predict what skills are future demands and needs and immediately integrate them into their student's learning experiences, such as focusing their teaching on analytical, evaluation, or creating thinking skills (Suhardi et al., 2023). These skills must be a parameter for assessing student learning outcomes, including analytical thinking skills. According to Sternberg (2006), success is achieved through a balance of three aspects of intelligence, namely analytical, practical, and creative skills. Sternberg (2006) further added that apart from successfully analyzing their ideas and the ideas of others, successful people are also able to create their ideas while convincing others about the value of their ideas. For example, in the world of work, as when a staff member tries to convince the boss of the value of his plans; in the world of personal relationships, such as when a child tries to convince a parent to do what he or she wants; and in the school world, as when a student writes an essay arguing a point of view.

Even though elementary school students are still euphoric with playing and playing activities, analytical thinking can be a parameter in assessing their learning outcomes. Hence, the teacher deliberately has to integrate students' analytical thinking into various playing activities and games. For example, the study by Huincahue et al. (2021) explains that students with an analytical style benefit more in learning mathematics because teacher evaluation and assessment activities emphasize higher analytical mathematical thinking. It means the teacher adopts analytical thinking to assess learning outcomes to stimulate students to use their analytical thinking during learning. A recent study by Phuseengoen & Singhchainara (2022) has made significant progress, as it succeeded in promoting analytical thinking skills using the concept of "STEM" (Science, Technology, Engineering, and Mathematics) through physical and sports activities.

Analytical thinking is only sometimes presented in a complex and profound way for elementary school students. Teachers can operationalize simply through various analytical questions to students during learning (Blegur et al., 2023; Kao, 2016). As a critical note for teachers, PE learning uses physical activity to prepare students for life in the future ("through" the body, not "for" the body). So all the demands of life in the future (including analytical thinking) must be the basis of the teacher when planning, implementing, assessing, and evaluating their student's learning experience and success. Ignoring students' analytical thinking learning in elementary schools will impact low thinking skills when they become university students (Friskawati & Supriadi, 2022; Ghazivakili et al., 2014). If we review Martin's (2010) research, innovation success is balancing original analytical thinking and intuition. Nuntamanop et al. (2013) classify analytical thinking skills as one of seven "strategic thinking competencies." In conclusion, analytical thinking is a future skill that helps students survive and be successful, so it is necessary to intensify its internalization in PE learning from an early age.

CONCLUSION

The results of this study provide empirical evidence that integrating analytical thinking in learning experiences and mastery of movement skills contributes to students' physical education learning outcomes. Teachers need to ensure that when students are involved in learning and mastering movement

skills, students also operate thinking skills that differentiate, organize, and attribute their decisions when using their movement skill preferences in play experiences and games during learning. At the same time, the evaluation of student learning outcomes should ideally also be based on analytical thinking itself (besides assessing the mastery of movement skills and psychosocial activities) so that there is coherence between the use of analytical processes in various student learning activities while at the same time making the analytical process a parameter for assessing student learning outcomes because it is following the mandate of the Indonesian education curriculum.

Considering that analytical thinking is essential for students in improving learning outcomes and promoting students to survive in real life. Further investigations need to use analytical thinking instruments from different theories, indicators, and test models, add samples to the test, and compile test results, learn independently to ensure a more incredible determination of the contribution of analytical thinking to improving student learning outcomes. In addition, investigating the contribution of analytical thinking to the choices of students' movement behavior in PE learning is very important to ensure that the various choices of students' movements are not just spontaneous and mechanistic actions but through a high-order thinking process so that the decisions students choose during problem-oriented learning as well as planning actions more effective and efficient way to achieve goals.

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