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Unlocking the Full Potential: Non-Linear Physical Education Learning and the Development of Affective-Psychomotor Aspects of Students

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Abstract

This research aims to improve the psychomotor and affective abilities of elementary school students through a nonlinear pedagogical approach. The method used is research and development that combines quantitative and qualitative analysis. From the total number of elementary school teachers spread across the Sampang-Pamekasan area, 53 teachers were selected as samples in this study. Data analysis uses a quantitative descriptive approach, focusing on the use of percentages. The results showed that teachers' understanding of nonlinear pedagogy was achieved with a general average score of 2.705, which showed relatively good performance. However, the lowest score was found on the item "Teacher's Understanding of the LED Approach", with an average score of 3.247, while the understanding of "Cooperative Learning" achieved the highest score, which was 4.325, indicating excellent understanding. These findings show that overall, teachers' understanding of nonlinear pedagogy is still not optimal, underscoring the need for more in-depth training for physical education teachers, as well as strategies to effectively implement nonlinear pedagogy in elementary schools. This research invites new initiatives for teachers to embrace and implement innovative learning strategies that fit the demands of 21st century education while exploring the impact of nonlinear pedagogy on the learning process.

Keywords

Nonlinear pedagogy; physical education; elementary school

INTRODUCTION

Physical education plays a very important role in the physical and affective development of elementary school students (Ha et al., 2024; Mealings & Buchholz, 2024; H. Sun et al., 2017; X. Sun et al., 2024). Physical education aims not only to develop gross motor and fine motor skills but also to introduce important concepts such as teamwork, leadership, and communication skills (Carballo-Fazanes et al., 2023; Iserte et al., 2023; Warbington et al., 2024). However, the learning methods used in physical education are often limited to linear approaches that are less responsive to the needs and uniqueness of each student (DeMatthews et al., 2021; Eberle & Hobrecht, 2021; Pan et al., 2013). In the face of the demands of global development and the need for 21st century skills (Chow et al., 2021; Hidayatullah et al., 2021), physical education can no longer be tied to traditional teaching models. Therefore, the emergence of interest in nonlinear pedagogical teaching models is becoming increasingly relevant, especially in the context of primary education (Chow et al., 2021; Hou et al., 2023; Lee et al., 2014).

Nonlinear teaching offers a more dynamic, flexible, and adaptive approach to teaching (Erarslan, 2023; Galatti et al., 2019). In the context of physical education, this teaching model allows teachers to better consider the individual needs of students and provides greater space for exploration, collaboration, and reflection (Lee et al., 2017). With a focus

on 21st-century skills, such as critical thinking, creativity, communication, and collaboration skills, a nonlinear approach in physical education can open up opportunities to integrate these important aspects into students' physical learning experiences (Chow, 2013; Cote-Laurence et al., 2008). For example, in group play activities, teachers can adopt a nonlinear approach by giving students space to solve problems independently, collaborate with friends, and formulate innovative strategies (Franco & DeLuca, 2019; Hummel et al., 2015; Magen-Nagar et al., 2019).

However, the successful implementation of a nonlinear pedagogical teaching model in physics education is highly dependent on teachers' understanding and skills (Chow et al., 2021; Tri Kaloka et al., 2023). Teachers must be able to understand the basic principles of nonlinear teaching and have skills in designing, managing, and evaluating learning experiences that are relevant to students' needs (Atencio et al., 2014). The main objective of this study was to explore teachers' understanding of nonlinear teaching in the context of physical education for primary school students. By understanding the teacher's perspective, this study aims to identify the challenges, opportunities, and strategies involved in adopting a nonlinear teaching model in physical education.

Through a deeper understanding of teacher perspectives, the study also aims to identify the 21st-century skills needed by teachers to successfully implement non-linear teaching. This can include the ability to organize active classes, plan stimulating activities, direct group discussions, and provide constructive feedback. Thus, this study aims to find out teachers' understanding of nonlinear teaching and identify 21st-century skills from the teacher's perspective.

METHOD

The participants in this study were 53 physical education and sports teachers (Penjas) from elementary schools in Sampang-Pamekasan. The study uses the R&D method, which involves 10 different processes: Research and data collection, planning, initial product, initial trials, revision of main product, main field testing, revision of operational product, operational product, revision of final product, and result of developing disinfection product. The research data was collected using questionnaires through interviews and document analysis. The questionnaire was used to explore the needs and understanding of elementary school teachers about physical education teaching, especially in the context of nonlinear teaching pedagogy. Interviews were conducted to obtain information about the implementation of teaching in elementary schools. Meanwhile, document studies are used to evaluate documents related to teaching in elementary schools, such as curriculum, time allocation, and learning facilities.

Data analysis is carried out using a quantitative descriptive approach, where percentages are used as a method to analyze data. The determination of the quality of the instrument used is carried out by proving the validity of the content and estimating the reliability. Proving the validity of the content using the Aiken content validity method (Retnawati, 2016). The goal is to evaluate the level of agreement between raters on each item in the research instrument (Newman et al., 2013; Retnawati, 2016). Reliability estimation uses Cronbach's Alpha (α) which aims to evaluate the reliability of an instrument (McNeish, 2018; Tavakol & Dennick, 2011). Cronbach's Alpha values range from 0-1, where higher values indicate a better level of reliability (Heo et al., 2022).

RESULT AND DISCUSSION

Results

In this study, a questionnaire was distributed to a sample consisting of 53 physical education teachers in elementary schools. The distributed questionnaire generates relevant data for each question asked. This study uses the Likert scale as a measurement method. The selection of the Likert scale is based on the clarity of the interval between the response rate and the categorization of the data that follows the logic standard, making it suitable for the analysis conducted (Stratton, 2018). The Likert scale used has values ranging from 1 to 5, thus allowing this study to quantitatively measure respondents' attitudes or perceptions (Norman, 2010).

Next, the study categorized the averages of each question to get a deeper picture of the distribution and central tendencies of the responses received. The results of the analysis showed that the sample of elementary school physical education teachers had a minimum score of 2.78 and a maximum of 5.00, as can be seen in Table 1. These results provide an overview of the variation in respondents' perceptions and attitudes towards the topic studied.

Table 1. Teachers' understanding of nonlinear pedagogy

	N	Min	Max	Mean	SD	Description
The teacher's understanding of nonlinear pedagogy	53	2.78	5.00	2.75	.290	Very good
Valid N (Listwise)	53					

Table 1 shows data on teachers' understanding of nonlinear pedagogy. The table shows 53 respondents rating their understanding using a scale of 1 to 5. The minimum score reported was 2.78, which indicates that no teacher gave a low rating to their understanding of nonlinear pedagogy. Meanwhile, the maximum score is 5.00, which indicates that some teachers feel that they understand nonlinear pedagogy.

The average value was 2.75 with a standard deviation (SD) of 0.290. An average score that is almost equal to the minimum score can indicate that the majority of respondents are giving a biased assessment towards the minimum score. This may indicate that, overall, teachers feel that they only have a "good enough" understanding of nonlinear pedagogy. However, it should be noted that lower average scores on the middle scale may indicate that the understanding of these teachers is generally at a moderate level, not high (Chyung et al., 2017). The relatively small standard deviation suggests that respondents' responses do not vary significantly, which means their perceptions of their understanding tend to be uniform (Lipovetsky & Conklin, 2018).

Table 2. Teacher's Understanding of Teaching Games for Understanding (TGfU)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	2	3.8	3.8	3.8
	D	5	9.4	9.4	13.2
	NT	10	18.9	18.9	32.1
	A	18	34.0	34.0	66.0

SA	18	34.0	34.0	100
Total	53	100	100	

Table 2 shows data on the level of teachers' understanding of the concept of Teaching Games for Understanding (TGfU). The table shows that answers are displayed in five categories: Strongly Disagree (SD), Disagree (D), Neutral (NT), Agree (A), and Strongly Agree (SA), with frequency and percentages for each category. The data showed that out of 53 teachers, the number who felt 'Strongly Agreed' and 'Agreed' with their understanding of TGfU was the same, with 18 people or 34% for each category, which cumulatively accounted for 68% of the total respondents. Meanwhile, 10 teachers (18.9%) gave a 'Neutral' response, which can mean that they may not be sure or do not have enough information to make a definitive assessment of their understanding of TGfU. This group is important because they may need additional information or practical experience to form a more convincing opinion. There were also 7 teachers (13.2%) who stated 'Disagree' or 'Strongly Disagree' with their understanding of TGfU, indicating that there is a small number of teachers who do not feel that they understand the concept well. This can be an area that needs to be addressed in professional development to improve the understanding and application of TGfU in teaching practice.

Table 2 shows that although most teachers feel that they understand TGfU, there is still room for improvement in teacher education regarding this approach. Because TGfU is an approach that focuses on developing students' understanding of games and strategies in the context of physical education, teachers need to have a strong understanding of these concepts in order to implement them effectively in their teaching.

Table 3. Teacher's Understanding of the LED Approach

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	3	5.7	5.7	5.7
	D	9	17.0	17.0	22.6
	NT	22	41.5	41.5	64.2
	A	9	17.0	17.0	81.8
	SA	10	18.9	18.9	100
	Total	53	100	100	

Table 3 shows that teachers' understanding of the LED (Light Emitting Diode) approach varies. The frequency distribution of the existing answers shows that the Neutral (NT) category has the highest percentage at 41.5%, which indicates that most teachers have not yet decided their opinion on the understanding of the LED approach or may not be very familiar with the concept. Meanwhile, 9 teachers (17%) agreed (A) and 10 teachers (18.9%) strongly agreed (SA), indicating that they understood the approach. Nearly one-third of the total respondents felt that they understood the approach enough or very well. On the other hand, there were 12 respondents (22.6%) who stated that they disagreed (D) or strongly disagreed (SD) about their understanding of this approach. This suggests that there is still a group of teachers who may need more support to understand the concept of the LED approach effectively.

Table 3 shows that although there is a group of teachers who understand the LED approach, the majority are still in a neutral or unsure position, and there are also some teachers who do not feel understood. This requires special attention in professional development and increased resources or training related to the use of LED technology in educational practice.

Table 4. Teachers' Understanding of Physical Education Pedagogy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	5	9.4	9.4	9.4
	NT	9	17.0	17.0	26.4
	A	16	30.2	30.2	56.6
	SA	23	43.4	43.4	100
	Total	53	100	100	

Table 4 shows that teachers' understanding of sports education pedagogy is quite good. Of the total 53 teachers who were respondents, 23 (43.4%) teachers showed positive understanding, stating 'Strongly Agree' (SA), and 16 teachers (30.2%) stated 'Agree' (A). This indicates that about three-quarters of the total respondents have a positive view of their understanding of sports education pedagogy. Meanwhile, only 9 respondents (17%) felt 'Neutral' (NT), which may reflect uncertainty or the need for more information before being able to express a stance. This group may need additional support to develop a deeper understanding of PEpedagogy. In addition, a small number of teachers, namely 5 respondents (9.4%), stated 'Disagree' (TS), which indicates that there are a small number of teachers who feel that they do not understand the concept of physical education pedagogy well. The causes can be various, including a lack of resources,

A small number of teachers feel that they have little understanding of the pedagogy of the service teacher, the majority feel that they are sufficiently to be very competent in this field. This is a positive indicator for the teaching of social workers, but there is still room for improvement through professional development and improvement of the social service curriculum to support teachers who are still hesitant or lack understanding.

Table 5. Teachers' Understanding of Cooperative Learning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	1	1.9	1.9	1.9
	NT	1	1.9	1.9	3.8
	A	13	24.5	24.5	28.3
	SA	38	71.7	71.7	100
	Total	53	100	100	

Table 5 shows the distribution of teachers' perceptions of their understanding of cooperative learning. Of the 53 respondents, the majority, namely 38 teachers (71.7%), stated that they strongly agreed (SA) that they understood cooperative learning. This shows that most teachers are quite familiar with this concept. A total of 13 teachers (24.5%) agreed (A), adding a significant percentage for those who were positive about the

understanding of cooperative learning. Cumulatively, 96.2% of respondents had a positive response to their understanding of cooperative learning.

Meanwhile, only a small percentage of teachers felt unsure of their understanding, with only one teacher (1.9%) choosing Neutral (NT), and another teacher (1.9%) stating that they disagreed (D) that they understood cooperative learning. This indicates that almost all teachers have a good understanding of cooperative learning, with only 3.8% indicating uncertainty or disagreement. These findings may indicate that teachers' experiences in cooperative learning may be quite effective, but attention still needs to be paid to a small number of teachers who are still hesitant or disagreeable. In the context of education, this is important because cooperative learning is a strategy that is often considered to improve student learning performance through cooperation and interaction between students (Fernández-Ferrer & Espinoza, 2022; Ghufron et al., 2023; Yaduvanshi & Singh, 2019).

Table 6. Teacher Readiness and Consent in Teaching Nonlinear Pedagogy

Indicator	Items	Score	%
Teacher readiness and approval in teaching nonlinear pedagogy	5	20	83.33
	6	20	83.33
	7	20	83.33
	8	20	83.33
	9	22	91.67
	10	20	83.33
	11	20	83.33
	12	23	95.83
	13	24	100
	14	20	83.33
	15	20	83.33
Rate %			86.7 %

Table 6 illustrates the readiness and agreement of teachers in teaching nonlinear pedagogy. From the indicators displayed, the score obtained ranged from 20 to 24, with the percentage of each item ranging from 83.33% to 100%. Item 13, which scored perfectly, shows that there are certain indicators that indicate that teachers are fully prepared and agree with this non-linear pedagogical approach. Overall, the approval and readiness rate was 86.7%, reflecting a high level.

The data in Table 6 show that there is a significant level of agreement and readiness among teachers to implement nonlinear pedagogy, which can include a variety of teaching methods that do not follow traditional linear structures. However, there are variations in scores that show that while the overall approval rate is high, there is still room for improvement in certain aspects. Items with lower scores can serve as focal points for further professional development for teachers, such as providing additional training or discussing practical applications of this nonlinear pedagogy in the classroom. In addition, it is also necessary to pay attention to how this readiness is realized in actual teaching practice, because a high level of agreement does not always mean effectiveness in implementation. In today's educational context that increasingly emphasizes flexibility

and innovation in teaching methods, these findings can be a positive indication of teachers' adaptation and acceptance of new and more dynamic teaching paradigms.

Discussion

Physical education has long been an important component of the holistic development of students in school, where the main goal is not only to improve physical health but also to facilitate their affective, emotional, and psychomotor growth (Liu & Lipowski, 2021). Effective physical education can enrich students' learning experiences by integrating these aspects thoroughly (Werner et al, 2019). However, conventional approaches that are still frequently used are sometimes not enough to achieve optimal outcomes in student-centered teaching (Chow & Atencio, 2014). In this regard, nonlinear pedagogy offers an alternative method that emphasizes play and creative use of space to make physics learning more engaging (Moy et al., 2019).

Nonlinear pedagogy, which prioritizes learning through exploration and discovery, has been shown to increase positive interaction between students and facilitate collaboration (Chow, 2013). This approach supports the principles of positive psychology by meeting students' intrinsic needs for autonomy, competence, and connectedness. This is in line with research showing that effective physical education involves the development of communication and collaboration skills, skills that are critical in preparing students to face the challenges of the 21st century (Ezzedini, 2017; Noel & Liu, 2016; Szabo et al., 2020).

In contrast, traditional linear approaches often encourage students' dependence on teacher instruction and can limit interaction between peers, as various studies have found (Chow, 2013; Chow & Atencio, 2014). This top-down method can also inadvertently encourage other people's blaming behavior, which inhibits self-learning and the assumption of responsibility (Chow & Atencio, 2014). According to Körner and Staller (2018), focusing on skills in socially valued contexts can lead to fear of negative judgment, which can hinder students' learning and self-development.

With a nonlinear approach, the teacher becomes a facilitator who allows students to explore and discover through outcome-oriented activities and the use of analogies. This approach encourages creativity and imagination (Hopper, 2010) and can help students develop critical and creative thinking, which is much needed in this rapidly changing world. Creativity and innovation arise when students engage with each other's actions and ideas, which often results in new behaviors and effective problem-solving. Nonlinear pedagogy also encourages greater peer contact and improves students' ability to collaborate, thereby reducing conflict (Chow & Atencio, 2014; Tan et al., 2012). Since the teacher's job is to guide and not direct, there is also an opportunity for students to give feedback to each other. The nonlinear pedagogical method, which encourages learning through inquiry, problem-solving, and creative thinking, encourages positive relationships between teachers and students to develop with each other and jointly create new functional movement solutions (Dupri et al., 2021; Erdem & Adiguzel, 2019).

This technique allows students to meet internal (i.e., autonomy, competence, and interconnectedness) and external (i.e., performance-related) constraints (Chow, 2013). The increased connectedness and cooperation shown by NP groups, as expressed in interview sessions, can result in improved interaction management and interpersonal

awareness (Chow & Atencio, 2014; Tan et al., 2012), which lead to improved communication and collaboration skills, which are an important part of the 21st century competencies of the Ministry of Education.

Because teachers in the Linear Pedagogy (LP) approach are required to guide students to do activities correctly, teachers state that students often wait for instruction (Chow, 2013; Lee et al., 2014). Teachers say that the top-down strategy of LP is ineffective, as it creates distance between teachers and students, resulting in limited contact between students. In addition, teachers and students state that the LP strategy is associated with students blaming others and engaging in conflict. This is similar to the previous theme, where students delegate the blame for their success or failure to others to avoid being held accountable. The problem with skill-focused learning settings is that skills must be performed in a social evaluative context, which can lead to fear of unfavorable evaluation by others, avoidance, or self-harming actions (Körner & Staller, 2018; Machado et al., 2019).

The teacher instructs the NP with exploration. This includes outcome-oriented considerations such as "eyes on the ball" or "ball throw", and using analogies such as "bounce" to maintain rhythm when hitting the ball repeatedly. The way students acquire knowledge seems to affect their cognitive abilities during group activities (Haataja et al., 2019; Renshaw, 2012). The emphasis on inquiry and the use of analogies encourages the development of students' creative imaginations, as they develop their analogies using fictional events and characters as a means to engage in longer discussions. In the context of competitive gaming, NP treatment requires focusing on outcomes and using analogies to gain an advantage. This statement illustrates that the NP technique allows exploration within the boundaries of the tasks assigned by the teacher, allowing students to solve problems, show creativity, and develop new strategies to win the game. Creativity and innovation are most likely to emerge when students are engaged, respond to other students' actions and ideas, and develop new behaviors (Hopper, 2010). The NP method is relevant to the development of creative and critical thinking, which is the main competence of the 21st century. This method is relevant to the development of creative and critical thinking, one of the basic competencies of the 21st century (Casado-Robles et al., 2022; Humphries, 2014).

CONCLUSION

A descriptive analysis of teachers' understanding of nonlinear pedagogy shows that there is variation in the understanding of concepts that are important for students' motor and affective development, with generally good scores, but there are certain areas that need improvement. High average scores in understanding cooperative learning indicate acceptance of this concept, but lower scores in understanding the LED Approach indicate the need for further professional development. In the context of primary school education, a nonlinear pedagogical approach plays a role in providing a richer experience for students, with an emphasis on the motivation and skills necessary to maintain a lifetime of physical activity.

Implicitly, future research should explore more deeply how teacher training can be optimized to include a broader and deeper understanding of different, including nonlinear pedagogical approaches. There needs to be a study of the direct impact of the use of

nonlinear pedagogy on student learning outcomes and the sustainability of their motivation in the long term. In addition, the suggestion for further research is to conduct longitudinal studies that assess how knowledge and skills gained through nonlinear pedagogy impact students' physical health and emotional well-being in the long term. This research can also be complemented by qualitative studies to understand students' perceptions and experiences more deeply about this learning. Finally, it is critical to integrate interdisciplinary research involving experts in the fields of education, psychology, and sports medicine to develop holistic and inclusive learning strategies that can be widely adopted in schools.

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