

Technopreneurial Physical Education Model Integrating South Sumatran Traditional Games

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ABSTRACT

This study develops a technopreneurship-based physical education model that integrates traditional South Sumatran games to enhance elementary students' physical fitness and critical thinking. Using a development research design with pretest-posttest, the model was implemented in selected schools through planning, implementation, and evaluation phases. Data were collected via observation, performance assessments, and questionnaires. The model includes structured stages: preparation, warm-up, core activities using circuit-based traditional games, and reflective closing sessions. It was validated by experts and tested in the field. **Results show** significant improvements in students' physical fitness and critical thinking abilities, alongside high engagement and participation. **This model** promotes active, culturally grounded learning by revitalizing local heritage within physical education. It offers an effective and practical alternative to conventional methods, aligning with technopreneurship, edupreneurship, culturalpreneurship, and critical thinking entrepreneurship. **The model** supports sustainable educational development by merging physical health, cultural preservation, and 21st-century skills.

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1. INTRODUCTION

In recent years, there has been a growing emphasis on the need for innovation in educational practices across various disciplines, particularly in the field of Physical Education, Sports, and Health (PESH) [1]. As the landscape of education evolves, the integration of culturally relevant practices and innovative teaching strategies has become essential for enhancing student engagement and development [2]. In the context of PESH, this shift requires not only the improvement of physical skills but also the cultivation of cognitive, affective, and social competencies [3, 4]. However, traditional PESH teaching methods often become repetitive and lack cultural relevance, leading to low student engagement and limited opportunities for holistic learning [5, 6].

This research proposes a culturally responsive PESH learning model that integrates traditional South Sumatran games such as engklek, cak ingkling, and gasing to enhance both physical and cognitive development [7, 8]. These games also promote cultural entrepreneurship by preserving local heritage while fostering students' critical thinking, creativity, and social interaction [9, 10]. By integrating digital elements into traditional

games, the approach creates engaging, adaptable, and relevant learning experiences across diverse educational settings [11, 12].

Developed through a Research and Development (R&D) process including needs analysis, design, expert validation, trials, and field testing, the model proved effective in improving students' physical fitness and critical thinking skills [13, 14]. It reflects Vygotsky's social constructivist theory, highlighting the role of social and cultural contexts in effective learning [15]. Traditional games thus serve as tools for collaboration, reflection, and interaction, strengthening social cohesion, confidence, and ownership among students [16, 17].

This study demonstrates that PESH can evolve from a routine subject into an innovative educational experience [18, 19]. The combination of culture, technology, and critical thinking equips students with essential 21st-century skills while reinforcing cultural identity and pride [14, 20]. Furthermore, the model supports global educational priorities by aligning with the Sustainable Development Goals (SDGs) promoting health and well-being SDGs 3, quality education SDGs 4, economic growth and entrepreneurship SDGs 8, and sustainable communities through cultural preservation SDGs 11 [21].

The findings indicate that the proposed model is practical and innovative, demonstrating how cultural and technological integration can enrich education [22, 23]. Successful implementation requires teacher training and community involvement [24]. By integrating physical education with cultural and technological values, the model supports the development of students' physical fitness, critical thinking, and cultural appreciation [25, 26].

2. LITERATURE REVIEW

PSEH is an essential component of the educational process that plays a vital role in developing students' physical, mental, emotional, and social aspects in a holistic manner [27, 28]. It is not limited to teaching motor skills but also serves as a medium for instilling positive character, moral values, and social attitudes [29]. Physical education is a strategic means for building physical competence while simultaneously nurturing values such as cooperation, discipline, and responsibility in students [30, 31]. Similarly, several scholars argue that physical education offers opportunities to develop critical thinking, entrepreneurship, and social skills, not just physical capabilities [32].

Physical fitness refers to children's ability to perform daily activities efficiently while maintaining energy reserves and consists of cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, and body composition [33]. Traditional games can naturally enhance these fitness components [34], such as *sambung kaki*, which improves cardiovascular endurance and leg strength, and *tenggoh-tenggohan*, which develops coordination, agility, and balance. Furthermore, physical activity has been shown to positively influence attention and cognitive development among children [35, 36]. School-based physical activity interventions have also been found to improve working memory, fluid intelligence, and classroom engagement [37]. In addition, moderate-to-vigorous physical activity during physical education classes contributes to academic achievement, both directly and through improved attention [38].

The development of a traditional game-based PESH learning model requires a systematic and structured approach to ensure pedagogical validity, practicality, and effectiveness [39, 40]. This approach supports learning that is academically grounded and socially meaningful. Consistent with Vygotsky's constructivist theory, it highlights the importance of social interaction and cultural tools, while participatory methods such as lesson study enhance instructional quality [41]. Moreover, game-based learning has been shown to increase student engagement and motivation [42].

The integration of traditional games aligns with Law Number 20 of 2003 on the National Education System and Law Number 3 of 2005, which emphasize character development, cultural identity, and physical well-being. A PESH learning model based on South Sumatran traditional games provides a culturally relevant approach to improving students' physical fitness and social competence while supporting curriculum objectives and strengthening cultural identity [43]. Furthermore, it contributes to SDGs 3, 4, 8, and 11 through the promotion of health, quality education, essential skills, and cultural preservation.

3. METHODOLOGY

This study adopts the Borg and Gall (R&D) model to create an innovative video-based Physical Education learning model rooted in South Sumatran traditional games [44]. The ten development stages ranging from preliminary research to product dissemination were streamlined to ensure a systematic process that inte-

grates technopreneurship, edupreneurship, culturalpreneurship, and critical thinking preneurship into students' physical learning. The stages of this research and development process are illustrated in Figure 1.

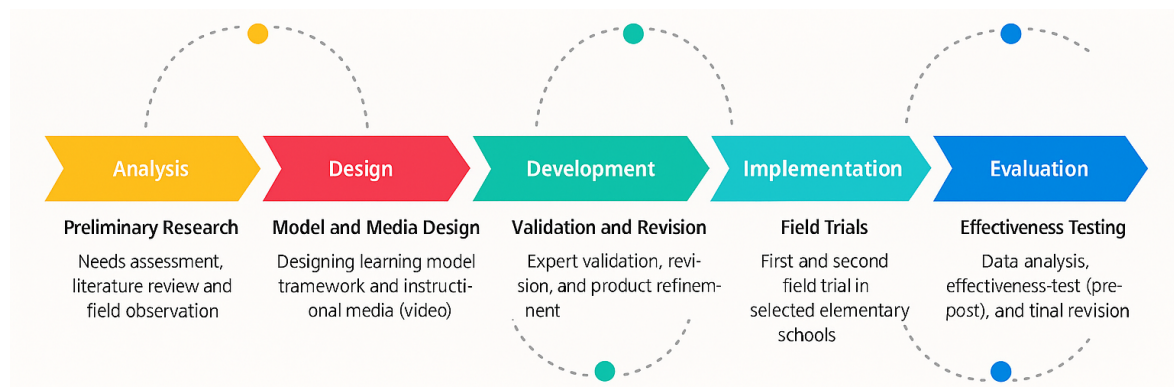


Figure 1. (R&D) stages adapted from Borg and Gall model.

As shown in Figure 1, the research was conducted through five main stages: analysis, design, development, implementation, and evaluation, each contributing to the systematic creation and validation of the learning model.

3.1. Research Subjects

Three participant groups were involved: expert validators in physical education and media design, elementary PESH teachers as evaluators, and students aged 10–12 years as users. This triangulation ensured theoretical, practical, and learner-centered validation focused on improving physical fitness, critical thinking, and cultural appreciation [45, 46].

3.2. Types and Sources of Data

Both qualitative and quantitative data were collected [47]. Qualitative data came from interviews, documentation, and expert feedback, while quantitative data were obtained from questionnaires, observations, and students' pre-test and post-test results. These sources provided comprehensive insights into both feasibility and effectiveness.

3.3. Data Collection Technique

Data collection combined interviews, classroom observations, questionnaires, and testing [48]. Interviews explored learning needs and cultural relevance, while observations and questionnaires evaluated media usability. Pre-tests and post-tests measured the model's impact on students' fitness and understanding of cultural values [49].

3.4. Data Analysis Technique

This study employs both qualitative and quantitative data analysis methods. The qualitative analysis follows the Miles and Huberman model, consisting of data collection, data reduction, data display, and conclusion drawing, allowing information from interviews, documentation, and observations to be organized into meaningful themes that support product development. Meanwhile, the quantitative analysis uses descriptive statistics to interpret expert validation and teacher response data through a Likert scale, which is categorized into levels such as "Very Feasible" and "Feasible" [50]. Student responses are analyzed using percentage calculations to determine the proportion of positive feedback toward the video. The formula used is: The percentage (P) is calculated using the formula $P = N / F \times 100\%$, where P represents the percentage, F is the number of students who answered "Yes", and N is the total number of students.

To measure the effectiveness of the media, statistical tests are conducted using pre-test and post-test data. Prior to hypothesis testing, a normality test is performed using the Shapiro-Wilk test, and a homogeneity test using the Levene Test. Then, a t-test is conducted, using either a paired sample t-test (to compare pre-tests and post-test results within the same group) or an independent sample t-test (to compare the experimental and

control groups). All statistical analyses are carried out using SPSS version 25.0, with a significance level of $\alpha = 0.05$.

4. RESULTS AND DISCUSSION

4.1. Validity and Practicability of the Learning Model

Learning that emphasizes physical fitness is a major focus of this study. Therefore, innovation in the learning process is needed to improve students' physical fitness. The first step was validating the developed learning model and learning tools. Validation was conducted by three experts in the field of PESH, and their evaluations were used to assess the feasibility and appropriateness of the model before implementation.

Table 1. The model was valid, practical, and improved students' fitness.

No	Statement	Validator Value		
		IS	ERS	H
1	Supporting Theory			
	This learning model development theory refers to existing model development theories.	4	4	4
	Physical fitness is developed based on relevant theories.	4	4	4
2	Syntax			
	The syntax contains logical phases of activity and can be used by teachers.	3	3	3
	The phases in syntax contain a logical sequence.	3	3	3
	There are phases in the syntax that include activities involving students carrying out movements in the game.	4	3	3
	There are phases in the syntax that minimize the number of students who do not understand the rules of the game.	3	3	3
3	Social System			
	The phases in syntax contain the roles of teachers and learners.	3	3	3
	The pattern of the relationship between teacher and student shows the role of the teacher as a guide and facilitator.	3	3	3
	The pattern of teacher and student relationships shows student-centered learning.	3	3	3
	The relationship pattern between teachers and students in learning can be situated by the teacher.	4	3	3
	The pattern of the relationship between teachers and students can be realized based on the syntax of the learning model.			
4	Reaction Principle			
	Teacher behavior in learning is stated clearly.	4	3	3
	The teacher’s behavior at the preparation stage is clearly stated.	3	4	4
	The teacher’s behavior at the initial activity stage is stated clearly.	3	3	3
	Teacher behavior at the core activity stage is stated clearly and can be carried out by the teacher.	3	3	3
	The teacher’s behavior at the closing activity stage is stated clearly and can be carried out by the teacher.	3	3	3
5	Support System	4	4	4
	RPP shows learning activities.	4	4	4
	RPP can be implemented by teachers.	4	4	4
	The RPP shows learning activities that enable students to train their physical fitness.	4	4	4
	Modules are developed based on CP.	3	3	3

No	Statement	Validator Value		
		IS	ERS	H
6	Impact of Instructions and Impact of Herding	3	3	3
	Learning activities show that students construct knowledge based on experience.	3	3	3
	Student learning activities direct students to understand learning and practice cooperation.	3	3	3
	Student learning activities show sufficient movement for students.	4	4	4
	Student learning activities show the existence of a social and cultural teaching process, in this case traditional games.	3	3	3
	Implementation of Learning			
7	Learning activities are planned to improve physical fitness.	4	4	4
	Learning activities are clearly planned.	4	4	4
	The module can be implemented by the teacher.	4	4	4
	The role of teachers in helping students as guides and facilitators.	4	4	4
	Learning takes place in a student-centered manner.	4	4	4
	Learning activities provide opportunities for students to learn individually.	4	4	4
	Learning activities provide opportunities for students to learn together in groups.	4	4	4
	Average value	3.5	3.4	3.4

Based on the validation results in Table 1, the traditional game-based Physical Education, Sports, and Health Learning Model is declared valid and suitable for use in the learning process. Furthermore, Table 2 presents the assessment of learning innovations included in the model to enhance physical fitness, showing consistent validation scores that indicate the model's practicality and effectiveness in classroom implementation.

Table 2. Assessment Results

INNOVATION APPEARANCE	MODULE 1			MODULE 2			MODULE 3			MODULE 4		
Validators	IS	ER	H	IS	ER	H	IS	ER	H	IS	ER	H
Classroom management minimizes students who do not understand the rules of the game and the benefits of the game.	3	3	4	3	3	3	3	3	4	3	4	4
There are variations in movements/movement tasks demonstrated by the teacher.	4	4	4	3	4	4	2	3	3	2	4	4
In independent learning, students are given assignments independently and the teacher acts as a facilitator.	3	3	3	3	3	3	3	3	3	3	3	3
In independent learning, learning provides Physical Fitness learning	4	4	4	4	4	4	4	4	4	3	3	3
There are assessment evaluations, self-assessment and peer observation.	4	4	3	3	4	4	3	4	4	3	3	3
Amount	18	18	18	16	18	18	15	18	18	15	15	15
Average	4	4	4	3	4	4	3	4	4	3	3	3

Note: (4 = very high), (3 = high), (2 = low), (1 = very low)

Based on Table 2 and expert validation, the PESH module integrating South Sumatran traditional games is valid and effective for improving students' physical fitness. The incorporated expert suggestions and 70% allocation for core activities support its alignment with the Merdeka Curriculum and readiness for implementation.

4.2. Effectiveness of the Learning Model

The effectiveness of the South Sumatran Traditional Game-Based Physical Education model was tested in two stages: the first in three schools (SDN 112, SDN 19, SDN 9 Palembang) and the second in five schools (SDN 45, SDN 91, SDN 78 Palembang). The detailed results are presented below:

4.2.1. First Trial

The first trial was conducted at SDN 112 and SDN 19 Palembang over a six-week period, from the second week of June 2024 to the fourth week of July 2024, to test the initial implementation of the model.

- Formative Class Evaluation (CFE)

Table 3 shows improved student responses across meetings, especially in the "Will" and "Method" components, indicating increased motivation and engagement.

Table 3. FCE Results in the First Stage Trial

School	Components	Meeting 1	Meeting 2	Meeting 3	Meeting 4
SDN 112	Results	2.87	2.89	2.89	2.89
	Will	2.80	2.82	2.84	2.88
	Method	2.32	2.32	2.44	2.48
	Cooperation	2.60	2.64	2.72	2.72
	Mean	2.65	2.67	2.72	2.74
	Criteria	Good	Good	Good	Good
	Results	2.68	2.68	2.68	2.76
SDN 19	Will	2.95	2.95	2.95	2.95
	Method	1.92	2.06	2.21	2.23
	Cooperation	2.98	2.98	2.98	2.98
	Mean	2.63	2.67	2.70	2.73
	Criteria	Good	Good	Good	Good

The first stage collected data on the model's effectiveness through the FCE. As shown in Table 3, 16.6% of students rated it "very good" and 83.3% "good," indicating that the learning model was well-received and effectively met students' needs during the first trial.

- Physical Fitness

Table 4 presents students' post-test physical fitness results.

Table 4. Physical Fitness Data in the First Phase Trial

Indikator KJ		IMT/ BMI		Sit & Reach		Sit-Up		Trunk- Lift		PACER 20-M Run	
		Average	Std. Dev	Average	Std. Dev	Average	Std. Dev	Average	Std. Dev	Average	Std. Dev
Pre- test	SDN 112	15.82	3.49	29.26	3.06	16.16	2.93	26.36	1.93	13.92	5.45
	SDN 19	16.37	2.95	26.31	3.59	11.80	2.01	22.54	2.84	15.76	6.44

	Indikator KJ	IMT/ BMI		Sit & Reach		Sit-Up		Trunk- Lift		PACER 20-M Run	
		<i>Average</i>	<i>Std. Dev</i>	<i>Average</i>	<i>Std. Dev</i>	<i>Average</i>	<i>Std. Dev</i>	<i>Average</i>	<i>Std. Dev</i>	<i>Average</i>	<i>Std. Dev</i>
<i>Post- test</i>	SDN 112	15.66	3.44	30.96	3.08	17.16	2.58	28.04	1.97	19.56	10.21
	SDN 19	16.18	2.97	28.73	3.53	13.02	1.93	24.80	3.31	19.37	7.63

Table 4 shows that both SDN 112 and SDN 19 experienced improvements across all physical fitness indicators after applying the PESH learning model. Table 5 shows that in each class in each school there is a significant increase in the physical fitness of students. The increase is as follows:

Table 5. Improvement of Physical Fitness in the First Phase Trial

School name	IMT	Sit and Reach	Sit Ups	Trunk Lift	PACER 20-M
SDN 112	1.01%	5.81%	6.19%	6.37%	40.52%
SDN 19	1.11%	9.21%	10.34%	10.00%	22.90%

Table 5 shows overall improvement in all physical fitness components, especially in the PACER 20M test. The results of the Paired Sample T-test in Table 6 for the total score of each component of the physical fitness test show that in general there is a significant difference from before and after the application of the innovative learning model, except for the BMI component at SDN Talunkidul I [$t = -0.570$; $p = 0.572$ (<0.05)].

Table 6. Paired Sample t-test of Physical Fitness in the First Stage Trial

School	Post-Pre	T	p-value	Information
SDN 112	IMT	4.766	0.000	Significant
	Sit and Reach	7.667	0.000	Significant
	Sit Ups	6.124	0.000	Significant
	Trunk Lift	5.738	0.000	Significant
	PACER 20-M	3.868	0.001	Significant
SDN 19	IMT	2.319	0.024	Significant
	Sit and Reach	6.948	0.000	Significant
	Sit Ups	9.528	0.000	Significant
	Trunk Lift	14.123	0.000	Significant
	PACER 20-M	6.397	0.000	Significant

Table 6 shows significant improvements in all physical fitness indicators at SDN 112 and SDN 19, with p-values < 0.05 confirming statistical significance across all components. The positive changes observed in both schools suggest that the intervention contributed effectively to improving students' physical fitness across multiple fitness components during the first-stage trial.

- Revised of First Trial

The Formative Class Evaluation (FCE) showed that the learning scenario focused on improving physical fitness was generally rated "good," with some aspects rated "very good." However, the "method" component received lower ratings (1–3), leading to improvements such as applying the scientific approach (5M), fostering independent knowledge discovery, and enhancing language skills for communication and

logical thinking. Overall, the innovative model remains consistent with its goal of improving students' physical fitness by emphasizing both conceptual understanding and practical skills.

4.2.2. Second Trial

After revising the model based on students' physical fitness results before and after implementing the traditional South Sumatran game-based PESH model, a second-stage trial will be conducted to further evaluate its effectiveness. This trial will involve five elementary schools: SDN 112 Palembang, SDN 19 Palembang, SDN 45 Palembang, SDN 91 Palembang, and SDN 78 Palembang.

- Formative Class Evaluation

After revisions in the first stage, the PESH learning model based on South Sumatran Traditional Games (Sumsel Flyfit) was further tested. The model's effectiveness was evaluated through students' responses summarized in the FCE, which indicated high enthusiasm and active participation. The results are presented in Table 7.

Table 7. FCE Results in the Second Stage Trial (continued)

School	Components	Meeting 1	Meeting 2	Meeting 3	Meeting 4
SDN 112	Results	2.742	2.742	2.783	2.8
	Will	2.95	2.95	2.95	2.95
	Method	1.988	2.088	2.1	2.325
	Cooperation	2.975	2.975	3	3
	Mean	2.66	2.69	2.71	2.77
	Criteria	Good	Good	Good	Good
SDN 19	Results	2.717	2.737	2.778	2.798
	Will	2.939	2.939	2.939	2.939
	Method	2.045	2.227	2.318	2.53
	Cooperation	2.97	2.97	2.97	2.97
	Mean	2.67	2.72	2.75	2.81
	Criteria	Good	Good	Good	Very Good
SDN 45	Results	2.738	2.817	2.921	2.937
	Will	2.952	2.952	2.952	2.952
	Method	1.964	1.988	2.167	2.405
	Cooperation	2.976	2.976	3	3
	Mean	2.66	2.74	2.79	2.85
	Criteria	Good	Good	Good	Good
SDN 78	Results	2.778	2.889	2.889	2.981
	Will	2.944	2.944	2.944	2.944
	Method	2.319	2.347	2.458	2.528
	Cooperation	2.972	2.972	2.972	3
	Mean	2.75	2.79	2.82	2.86
	Criteria	Good	Very Good	Very Good	Very Good

Based on Table 7, in general, according to the opinion of the learners, the effectiveness of the learning model is good (40% excellent category and 60% good category). These results indicate that the model was well accepted by students and supported active participation during the learning process. Students also demonstrated high enthusiasm and engagement throughout the implementation of the learning activities.

- Fitness

In the second phase of the trial, data on students' physical fitness before and after the implementation of the PESH learning model based on traditional South Sumatra games were obtained. The physical fitness results of Grade IV students after the implementation are presented in Table 8 below.

Table 8. Physical Fitness Data in the Second Stage Trial

	Indikator KJ	IMT/ BMI		Sit & Reach		Sit-Up		Trunk-Lift		PACER 20-M Run	
		Average	Std. Dev	Average	Std. Dev	Average	Std. Dev	Average	Std. Dev	Average	Std. Dev
Pre- Test	SDN 112 Palembang	16.05	3.06	25.70	4.62	13.58	4.75	31.63	2.84	17.85	10.71
	SDN 19 Palembang	16.61	2.65	29.21	4.52	16.32	4.95	37.52	4.90	19.23	8.48
	SDN 45 Palembang	16.40	3.04	27.12	3.47	11.55	2.04	24.95	3.65	12.76	3.43
	SDN 91 Palembang	15.11	3.06	26.75	3.06	10.50	3.52	27.08	3.82	13.86	5.34
	SDN 78 Palembang	16.27	3.59	26.13	3.67	14.31	3.48	35.75	3.89	14.50	4.42
Post- Test	SDN 112 Palembang	16.18	3.10	27.43	4.40	15.10	3.40	33.18	2.61	21.03	11.23
	SDN 19 Palembang	16.63	2.73	30.79	4.37	17.87	4.81	38.16	4.65	22.26	8.66
	SDN 45 Palembang	16.35	2.99	27.90	3.68	20.61	4.83	26.09	2.95	14.19	3.81
	SDN 91 Palembang	14.95	2.95	28.03	4.60	12.71	4.33	28.08	2.36	16.44	9.51
	SDN 78 Palembang	16.47	3.49	26.94	3.64	16.08	3.90	35.94	3.90	17.36	5.77

Note: Average = Mean score; Std. Dev = Standard Deviation

Table 8 shows that each school experienced improvements in most students' physical fitness components, except for BMI at SDN 112 Palembang, SDN 19 Palembang, and SDN 78 Palembang, which showed slight decreases. Table 9 further presents the percentage improvements across the assessed components, including BMI (IMT), flexibility (Sit and Reach), muscular strength (Sit-Up), trunk strength (Trunk Lift), and cardiorespiratory endurance (PACER 20-M).

Table 9. Physical Fitness Improvement in the Second Stage Trial

School	IMT	Sit and Reach	Sit-Up	Trunk Lift	PACER 20-M
SDN 112 Palembang	-0.82%	6.71%	11.23%	4.90%	21.15%
SDN 19 Palembang	-0.08%	5.40%	9.49%	1.72%	15.77%
SDN 45 Palembang	0.29%	2.83%	12.89%	6.43%	10.93%
SDN 91 Palembang	1.08%	4.78%	20.90%	3.69%	18.64%
SDN 78 Palembang	-1.26%	3.14%	12.43%	0.54%	19.73%

Table 9 shows improvements in most physical fitness components across all schools, with the greatest gains in sit-up and PACER 20-M performance, while BMI slightly declined in several schools. Table 10 indicates significant differences between pre-tests and post-tests implementation scores of the South Sumatra traditional games-based PESH learning model, except for BMI in all schools, sit and reach at SDN 45 Palembang [$t = 1.988$; $p = 0.054$ (>0.05)], and trunk lift at SDN 78 Palembang [$t = 1.745$; $p = 0.090$ (>0.05)].

Table 10. Paired Sample t-test of Physical Fitness in the Second Stage Trial

School	Post-pre	T	p-value	Information
SDN 112	IMT	-1.107	0.275	Not Significant
	Sit and Reach	13.241	0.000	Significant
	Sit Ups	2.641	0.012	Significant
	Trunk Lift	7.658	0.000	Significant
	PACER 20-M	5.07	0.000	Significant
SDN 19	IMT	-0.038	0.97	Not Significant
	Sit and Reach	11.315	0.000	Significant
	Sit Ups	2.965	0.006	Significant
	Trunk Lift	2.808	0.009	Significant
	PACER 20-M	3.255	0.003	Significant
SDN 45	IMT	2.023	0.05	Not Significant
	Sit and Reach	1.983	0.054	Not Significant
	Sit Ups	6.308	0.000	Significant
	Trunk Lift	7.121	0.000	Significant
	PACER 20-M	8.714	0.000	Significant
SDN 91	IMT	1.95	0.059	Not Significant
	Sit and Reach	4.82	0.000	Significant
	Sit Ups	4.761	0.000	Significant
	Trunk Lift	4.743	0.000	Significant
	PACER 20-M	3.039	0.004	Significant
SDN 78	IMT	-1.056	0.141	Not Significant
	Sit and Reach	4.542	0.000	Significant
	Sit Ups	2.783	0.000	Significant
	Trunk Lift	1.174	0.089	Not Significant
	PACER 20-M	3.653	0.02	Significant

- Revised of Second Trial

The revised second trial produced an effective Physical Education (PESH) learning model based on traditional South Sumatran games that improved students' physical fitness. The model was developed through five stages: analysis, design, development, implementation, and evaluation, and features a learning syntax consisting of preliminary (P-A-L-T-P), core (T-M-F-P), and closing (P-R-E-A-L) activities designed to enhance movement skills, critical thinking, and understanding of physical strategies.

In the first trial at SDN 112 and SDN 19 Palembang, students showed significant gains in PACER, sit-up, and trunk-lift performance. SDN 112 improved by 40.52% The Traditional Games technopreneurship-based Physical Education, Sports, and Health (PJOK) Learning Model of South Sumatra has been validated and tested to assess its effectiveness in improving the physical fitness of elementary school students. Based on the validation results carried out by three competent validators in the field of PJOK, this model is declared valid and suitable for use. The validation covered various aspects such as supporting theories, learning syntax, social systems, reaction principles, and support systems. Overall, the model showed good results, with an average score of 3.5 for the syntax indicators and 4 for the other indicators. These results indicate that the learning model can be implemented effectively in the PJOK learning process at the elementary school level.

In the first trial phase conducted at two elementary schools, SDN 112 Palembang and SDN 19 Palembang, through Formative Class Evaluation (FCE), the model received positive feedback from students. Most students rated the learning model as effective in enhancing their physical fitness. Data showed significant improvement in physical fitness test results, particularly in the PACER (20-meter run), sit-up, and trunk-lift com-

ponents. Physical improvement at SDN 112 was recorded at 40.52% for the PACER component and 6.37% for trunk-lift, while SDN 19 showed a 22.90% improvement in PACER and 10.00% in trunk-lift.

In the second trial involving five elementary schools, the model was well received by students, with 40% of schools rating it as "very good" and 60% as "good." Improvements in physical fitness indicators, particularly sit-up, trunk-lift, and PACER performance, confirmed its effectiveness. The model can therefore be implemented more broadly with minor revisions and alignment to the Merdeka Curriculum.

5. MANAGERIAL IMPLICATION

School leaders and education managers should integrate technopreneurship principles into PESH programs through digital-based traditional game media to promote innovation, creativity, and entrepreneurship while preserving local cultural values. Such integration can enrich learning experiences by combining physical activity, technology, and cultural heritage in a meaningful and engaging way.

To support successful implementation, continuous training should be provided for PESH teachers in educational technology, digital media development, and culturally responsive pedagogy. These competencies are important for applying the developed model effectively in line with the Merdeka Curriculum. Regular professional development can also help teachers adapt learning activities to students' needs and emerging educational trends.

In addition, adequate institutional support and learning resources are needed to ensure the sustainability and wider adoption of the model in schools. Schools should provide access to digital learning facilities and encourage collaboration among teachers, communities, and local stakeholders. Such support can strengthen the implementation process, enhance the quality of technology-integrated learning, and promote the preservation of local cultural heritage. Furthermore, the model can contribute to the development of students' physical, digital, entrepreneurial, and cultural competencies, supporting a more holistic and meaningful learning experience.

6. CONCLUSION

This study concluded that the PESH learning model, which incorporates traditional South Sumatran games, effectively improves both critical thinking skills and physical fitness among elementary school students. The model was implemented through a structured approach, including teacher preparation, introductory activities PALTP, core activities TMFP, and closing activities PREAL, focusing on movement tasks, circuit learning, peer observation, and authentic assessments. Trials conducted in selected schools demonstrated significant improvements in both cognitive and physical aspects, confirming the model's effectiveness.

For future research, it is recommended that PESH teachers adopt this model, particularly for fourth-grade students, and utilize the critical thinking assessment instruments developed in this study. Researchers are also encouraged to replicate or extend this model using the physical fitness tests applied in this research. Parents should be involved through parenting programs to reinforce physical fitness practices at home. Furthermore, further research should delve into cognitive functions, such as critical thinking, within the context of PESH, as this area remains underexplored.

In addition, education policymakers and school administrators should consider institutionalizing this technopreneurship-based PESH model within the broader school management system. Integrating technology, entrepreneurship, and cultural heritage into the curriculum can strengthen student engagement, teacher innovation, and community participation while supporting the achievement of SDGs 3 (Good Health and Well-Being), SDGs 4 (Quality Education), SDGs 8 (Decent Work and Economic Growth), and SDGs 11 (Sustainable Cities and Communities).

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: BH; Methodology: HS; Software: NN; Validation: DW and BP; Formal Analysis: BH and NN; Investigation: JS; Resources: HS; Data Curation: BP; Writing Original Draft Preparation: DW and BP; Writing Review and Editing: HS and JS; Visualization: NN; All authors, BH, HS, NN, DW, BP, JS have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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