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Development and Initial Feasibility of a Digital TGfU-Based EGURA Model

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Abstract

Study purpose. This study aimed to develop and evaluate the validity, practicality, and effectiveness of the EGURA (Exploration, Game, Understanding, Reflection, Action) Game Model based on digital technology through the Teaching Games for Understanding (TGfU) approach and local wisdom to improve junior high school students' physical fitness.

Materials and Methods. This research employed a Research and Development (R&D) approach using the Four-D (4D) model. The model was validated by three experts in instructional media, learning design, and subject matter, followed by a small-group trial involving 15 students and a field trial involving 35 eighth-grade students at SMP Negeri 1 Betung. Model effectiveness was evaluated using a one-group pretest–posttest design. Physical fitness was measured using the Indonesian Physical Fitness Test (TKJI). Data were analyzed using descriptive statistics and a paired sample *t*-test with IBM SPSS Statistics 26.

Results. The EGURA Game Model achieved an expert validation score of 89.29%, indicating that it was highly feasible. The small-group trial showed high practicality with an average score of 85.00%. Students' physical fitness improved significantly after the intervention, with mean scores increasing from 14.60 (pretest) to 21.80 (posttest) (mean difference = 7.20; $t = -32.25$; $p < 0.001$).

Conclusions. The EGURA Game Model is valid, practical, and effective in improving junior high school students' physical fitness. Integrating digital technology, the TGfU approach, and local wisdom provides an innovative and contextual alternative for Physical Education learning that enhances students' participation in physical activity.

Keywords: EGURA Game Model; Digital Technology; TGfU ; Local Wisdom; Physical Fitness.

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Introduction

Physical fitness is a fundamental indicator of students' health, learning readiness, and overall quality of life (Gu et al., 2016; Zheng et al., 2025; Zayed et al., 2024). In Physical Education, Sports, and Health (PESH), improving students' physical fitness is one of the

primary learning objectives because it contributes to physical endurance, concentration, and the development of lifelong active living habits (Asep Akabruddin, 2024). However, the physical fitness level of junior high school students remains a concern. During puberty, physical and psychological changes often reduce students' participation in physical activity (Farooq et al., 2020). This issue is reflected in the 2024 Sports Development Index published by the Ministry of Youth and Sports of the Republic of Indonesia, which reported that 55.5% of the Indonesian population falls into the very low physical fitness category. These findings highlight the urgent need for innovative learning approaches that can promote sustained student engagement in physical activity (Kementerian Pemuda dan Olahraga Republik Indonesia., 2024;Moore et al., 2023;Taemin Ha, Jongho Moon, Hyeonho Yu, 2025).

Game-based learning has been widely recognized as an effective instructional approach for increasing students' physical activity by providing enjoyable, challenging, and contextual learning experiences (Camacho-Sánchez, Rubén, Ana Manzano-León , José Miguel Rodríguez-Ferrer, 2023 ; Mo et al., 2024; Breed, 2024) One of the most widely adopted approaches is Teaching Games for Understanding (TGfU), which places games at the centre of the learning process by simultaneously developing tactical awareness, decision-making skills, and motor competence (Ritonga et al., 2024; Arba-mart et al., 2020;González-valero et al., 2024). Furthermore, integrating local wisdom through traditional games can strengthen students' engagement because learning activities become more closely connected to their cultural environment while simultaneously promoting sportsmanship, teamwork, and cultural preservation (Sudarwo et al., 2023;Handayani et al., 2024).

Advances in digital technology have also created new opportunities to improve the quality of physical education (Lanos et al., 2023; Sari et al., 2026). Digital learning media enable students to access instructional materials, demonstration videos, and activity guidelines more flexibly, allowing physical activity to extend beyond classroom instruction and be performed independently outside school hours (Haqiyah et al., 2021;Lanos et al., 2020;Pulka Ismail, 2023). The integration of digital technology with the TGfU approach and local wisdom-based games is expected to create a more interactive, contextual, and meaningful learning experience that aligns with the characteristics of today's digital generation (Jastrow et al., 2022).

A preliminary needs assessment conducted at SMP Negeri 1 Betung involving 35 eighth-grade students and two Physical Education teachers revealed that Physical Education instruction was still predominantly based on repetitive technical drills, resulting in the underutilisation of game-based activities. During classroom observations, 29 students (82.9%) demonstrated greater enthusiasm when participating in game-based activities than in repetitive technical exercises, while 30 students (85.7%) expressed greater interest in lessons supported by digital learning media, such as instructional videos and digital game guides. In addition, 28 students (80.0%) reported that they had never experienced Physical Education lessons integrating traditional games into the curriculum. Interviews with the teachers further revealed the absence of a learning model that systematically combines digital technology, the TGfU approach, and local wisdom within a single instructional framework to improve students' physical fitness. These findings indicate the need for a more interactive, contextual, and student-centred learning model capable of increasing students' engagement in physical activity while improving their physical fitness.

Based on these findings, this study developed the EGURA (Exploration, Game, Understanding, Reflection, and Action) Game Model, which integrates digital technology, the Teaching Games for Understanding (TGfU) approach, and local wisdom. The model consists of five sequential learning stages Exploration, Game, Understanding, Reflection, and Action designed to enhance not only students' motor skills but also their tactical understanding, decision-making ability, and active participation in physical activities. Digital technology enables students to access learning materials, instructional videos, and game guidelines

independently, while local wisdom-based traditional games provide contextual learning experiences that promote sportsmanship, cooperation, and cultural preservation.

Although numerous studies have investigated TGfU, traditional games, and digital technology in physical education, most have examined these components separately. To date, studies that systematically integrate digital technology, the TGfU approach, and local wisdom into a comprehensive learning model to improve junior high school students' physical fitness remain limited. Therefore, this study aimed to develop a Digital Technology-Based EGURA Game Model through the TGfU Approach and Local Wisdom as an innovative Physical Education learning model for improving junior high school students' physical fitness. The developed model is expected to provide an innovative, contextual, and effective alternative for enhancing students' physical activity participation and physical fitness.

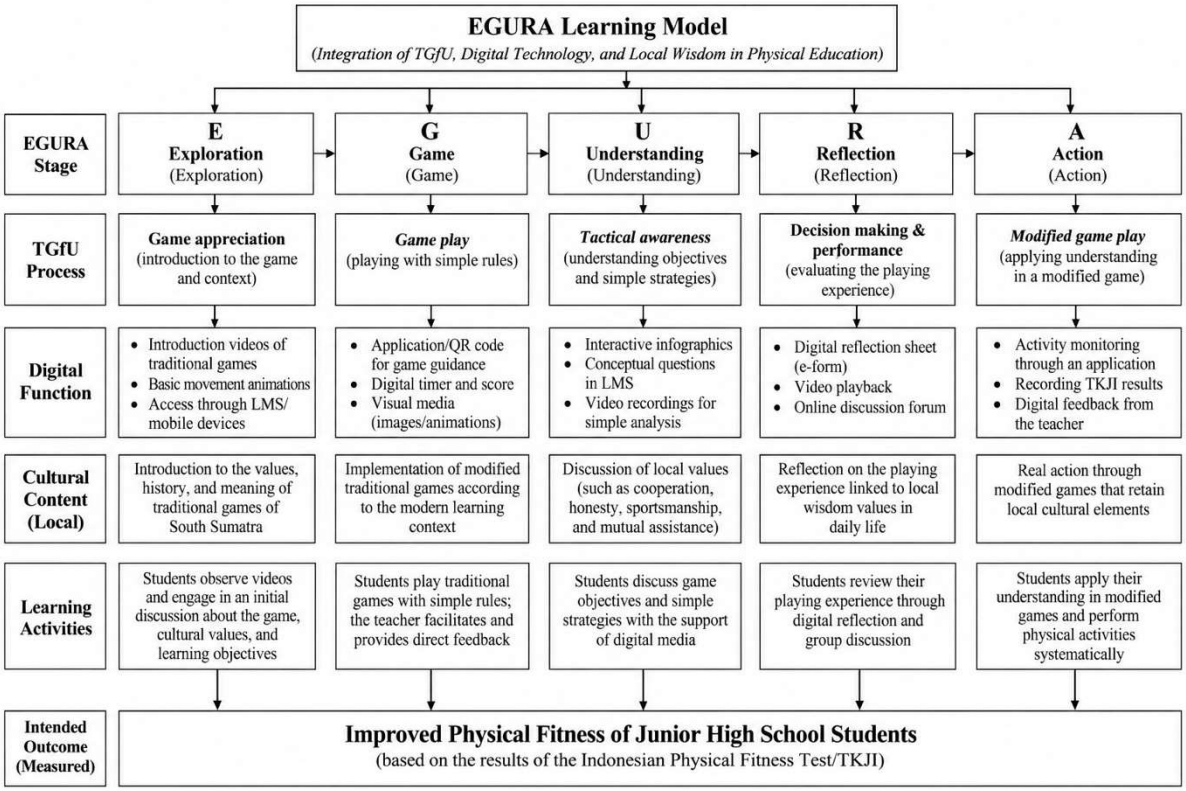


Figure 1. Conceptual Mapping of the EGURA Model: Integration of TGfU Processes, Digital Functions, Cultural Content, Learning Activities, and Intended Outcomes

EGURA (Exploration–Game–Understanding–Reflection–Action) is positioned as a contextual learning model developed through the adaptation and modification of the instructional sequence of Teaching Games for Understanding (TGfU), integrating digital technology and local wisdom through traditional games from South Sumatra. EGURA is neither a wholly new pedagogical theory nor simply a digitally supported package of traditional games. Rather, it offers a systematic five-stage learning structure in which digital technology is used functionally across the exploration, game, understanding, reflection, and action stages. The novelty of the model lies in the integrated configuration of a modified TGfU instructional sequence, traditional games as a cultural context, and digital support as an integral component of the learning process, rather than in the creation of each component independently.

The empirical claims of this study are limited to outcomes directly measured in the research, particularly the initial feasibility of the model based on expert validation and/or the preliminary trial reported in the study. Accordingly, the study does not claim improvements in

motor skills, physical literacy, participation, engagement, or tactical decision-making when these outcomes were not assessed using appropriate instruments. Compared with existing TGfU-based, traditional game-based, and digitally supported physical education interventions, EGURA's contribution lies in integrating these three approaches into a coherent, locally contextualized instructional sequence and establishing its initial feasibility as a foundation for further empirical testing.

Materials and methods

Research Design

This study employed a Research and Development (R&D) methodology using the Four-D (4D) development model proposed The Four-D model consists of four stages: Define, Design, Develop, and Disseminate (Indaryanti et al., 2025; Sihombing, 2024). This model was selected because it provides a systematic framework for developing learning products that are valid, practical, and effective.

The Define stage involved conducting a needs analysis through interviews with Physical Education, Sports, and Health (PESH) teachers and administering questionnaires to both teachers and students to identify instructional problems and determine the need for developing the learning model. The Design stage focused on preparing the initial prototype of the learning model, including the instructional syntax, game-based learning activities, teaching materials, supporting digital media, and assessment instruments. During the Develop stage, the prototype was evaluated by three experts in instructional media, learning design, and subject matter, followed by product revision based on their recommendations. The effectiveness of the developed model was then evaluated using a one-group pretest–posttest design to determine changes in students' learning outcomes by comparing their performance before and after the intervention (Creswell, J. W., & Creswell, 2017; Pasaribu et al., 2026). Finally, the Disseminate stage involved implementing the validated and effective learning model in Physical Education classes as an alternative instructional model for use in schools.

Study participants

Participants involved in the development phase included the validators, namely a physical education expert, an instructional media expert, and a physical education, sports, and health teacher, who evaluated the validity of the developed learning model. Following expert validation, a small-group trial was conducted to assess the practicality of the model prior to large-scale implementation. The trial involved 15 eighth-grade students from State Junior High School 1 Betung, selected as representatives from classes VIII.A, VIII.B, and VIII.C, with five students from each class.

Subsequently, the effectiveness of the model was examined with 35 students from class VIII.D at State Junior High School 1 Betung. Class VIII.D was selected based on the findings of the initial needs analysis, which involved students from this class and indicated a need for the developed physical education learning model. In addition, the class was selected because its student characteristics were aligned with the intended target population of the model and allowed the intervention to be implemented comprehensively within a single intact class. Thus, class VIII.D was selected purposively based on its relevance to the objectives and needs of the study rather than solely for convenience. All participants were approximately 13–14 years old and completed the entire physical education learning program throughout the study.

Study organization

The study was conducted during the Develop stage of the Four-D (4D) development model, which included expert validation, product revision, and effectiveness testing of the Digital Technology-Based EGURA Game Model through the Teaching Games for

Understanding (TGfU) Approach and Local Wisdom. The feasibility of the EGURA game model was evaluated using a validation instrument developed to assess the appropriateness and quality of the developed learning model. The instrument consisted of seven evaluation aspects: content appropriateness, clarity of the learning syntax, integration of the Teaching Games for Understanding (TGfU) approach, integration of digital technology, suitability of the game activities, safety of implementation, and implementation feasibility. Each aspect was assessed using a percentage-based feasibility scale, with the results categorized according to the predetermined feasibility criteria.

The effectiveness of the model was evaluated using a one-group pretest–posttest design, a pre-experimental design that compares participants' performance before and after the intervention within the same group (Creswell, J. W., & Creswell, 2017). The study was conducted over 16 learning sessions, consisting of one pretest session, fourteen intervention sessions, and one posttest session. Students' physical fitness was assessed using the Indonesian Physical Fitness Test (TKJI) during both the pretest and posttest as a standardized instrument for measuring the physical fitness of junior high school students (Departemen Pendidikan Nasional, 2010). The TKJI test used was the TKJI for the 13–15-year-old age group:

Table 1. TKJI Fitness Test for the 13–15-Year Age Group

No.	Component	Test Procedure	Unit
1	Speed	50-meter sprint	seconds
2	Arm and shoulder muscular strength/endurance	Pull-up (boys)/flexed-arm hang (girls)	repetitions/seconds
3	Abdominal muscular strength/endurance	Sit-up	repetitions/60 seconds
4	Leg muscular explosive power	Vertical jump	cm
5	Cardiorespiratory endurance	1,000-meter run (boys)/800meter run (girls)	minutes/seconds

During the intervention, students participated in learning activities using the EGURA Game Model, which integrates the Teaching Games for Understanding (TGfU) approach, digital technology, and local wisdom-based games through five sequential stages: Exploration, Game, Understanding, Reflection, and Action. The effectiveness of the developed model was determined by comparing the TKJI scores obtained from the pretest and posttest.

Statistical analysis

Data were analysed using IBM SPSS Statistics version 26. Descriptive statistics were used to summarise the pretest and posttest results, including the mean, standard deviation, minimum value, and maximum value. Before hypothesis testing, the normality of the data was assessed using the Shapiro–Wilk test, which is recommended for small sample sizes ($n < 50$) because of its greater statistical power compared with other normality tests (Field, 2018).

If the data were normally distributed ($p > 0.05$), differences between the pretest and posttest scores were analysed using a paired-samples *t*-test. Otherwise, if the data were not normally distributed ($p < 0.05$), the Wilcoxon signed-rank test was employed as a non-parametric alternative for paired data. All statistical analyses were conducted using a significance level of $\alpha = 0.05$. In addition to statistical significance, effect size was calculated to determine the magnitude of the intervention's effect on improving students' physical fitness, thereby providing a more comprehensive interpretation of the findings beyond *p*-values alone (Lakens, 2013).

Results

Define Stage

The Define stage was the initial phase of the Four-D (4D) development model, aimed at identifying learning needs, students' characteristics, current instructional conditions, and the challenges encountered by teachers in Physical Education, Sports, and Health classes. The needs analysis was conducted through classroom observations, teacher interviews, and student questionnaires at State Junior High School 1 Betung. Observations involving 35 eighth-grade students and two Physical Education, Sports, and Health teachers revealed that classroom instruction was still predominantly based on drill-oriented activities, resulting in the limited use of game-based learning. Consequently, students' engagement during lessons remained relatively low because the learning activities tended to be monotonous and provided limited opportunities for tactical thinking and active interaction.

Table 2. Results of the Student Needs Analysis Questionnaire for Physical Education Learning

No.	Statement	Students (n)	Percentage (%)
1	Students were more enthusiastic when teachers implemented game-based learning activities than repetitive technical drills.	29	82,9
2	Students showed greater interest when learning was supported by digital technology, such as instructional videos, QR code-based game guides, and other interactive digital media.	30	85,7
3	Students reported that they had never experienced Physical Education lessons integrating traditional games into the learning process.	28	80,0

Note: Total respondents = 35 students.

The interview results with the two PESH teachers supported these findings. The teachers reported that no instructional model had yet been developed to systematically integrate the Teaching Games for Understanding (TGfU) approach, digital technology, and local wisdom into a single learning framework for improving students' physical fitness. They also expressed the need for a learning model that is practical, engaging, aligned with students' characteristics, and capable of increasing students' physical activity during lessons. Based on the needs analysis, it was concluded that an innovative learning model integrating game-based activities, digital technology, and local culture is required to create more active, enjoyable, and contextual learning experiences while improving students' physical fitness. These findings served as the basis for developing the Digital Technology-Based EGURA Game Model through the Teaching Games for Understanding (TGfU) Approach and Local Wisdom.

Design Stage

Based on the findings of the needs analysis, the researchers designed the EGURA Game Model, which integrates the Teaching Games for Understanding (TGfU) approach, digital technology, and traditional games derived from the local wisdom of South Sumatra. The model was developed as an alternative Physical Education learning approach to enhance students' physical activity while simultaneously promoting tactical thinking and decision-making skills. The EGURA Game Model consists of five sequential learning stages:

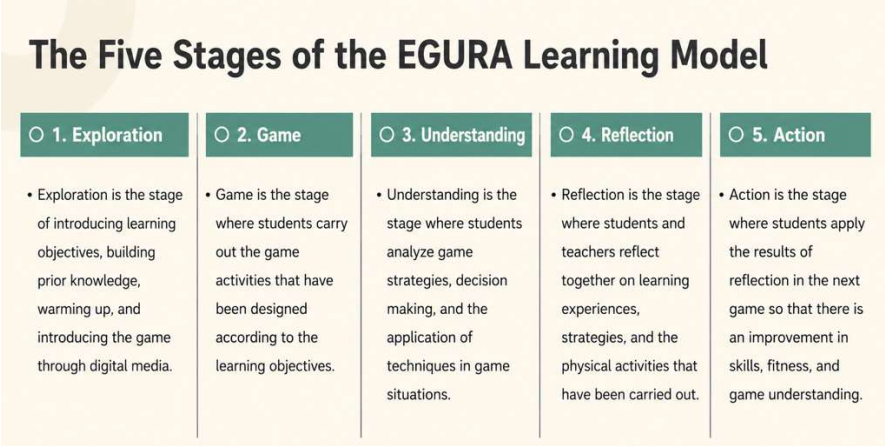


Figure 2. EGURA Learning Syntax

In addition to developing the learning syntax, this stage also produced supporting learning materials, including a teacher's guidebook, game implementation guidelines, QR code-based instructional videos, assessment instruments, and student activity observation sheets. Six game models were developed by modifying physical activity games and integrating the cultural values of South Sumatra.

Table 3. Developed EGURA Game Models

No.	Game Model	Description
1	EGURA Musi Exploration	Represents an adventure along the Musi River through various physical challenges and game strategies.
2	EGURA Sriwijaya Treasure Hunt	Inspired by the glory of the Sriwijaya Kingdom, symbolising exploration and the search for historical treasures.
3	EGURA Musi Guardian Mission	Represents the resilience of communities living along the Musi River in overcoming various physical challenges.
4	EGURA Kuto Besak Fortress Battle	Inspired by Kuto Besak Fortress as a symbol of defence, strategy, and teamwork.
5	EGURA Sriwijaya Expedition	Represents an expedition across the former Sriwijaya Kingdom through game-based physical fitness activities.
6	EGURA Great Ampera Challenge	Inspired by the Ampera Bridge as a symbol of strength, determination, and the pride of the people of South Sumatra.

The Design stage resulted in the initial prototype of the EGURA Game Model together with its supporting instructional materials, which were subsequently prepared for the development stage.

Develop Stage

The Develop stage aimed to produce a valid learning model before implementation. The developed product consisted of the EGURA learning syntax, a teacher's guidebook, QR code-based digital learning media, instructional materials, and six local wisdom-based game models. The model was validated by three experts in instructional media, learning design, and subject matter. The validation covered the appropriateness of the learning content, clarity of the instructional syntax, integration of the Teaching Games for Understanding (TGfU) approach, integration of digital technology, suitability of the games for students' characteristics, safety, and implementation feasibility.

The expert validation results indicated that all six EGURA game models achieved the Very Feasible category, with percentage scores ranging from 88.57% to 93.57% and an

overall average score of 90.89%. The highest validation score was obtained by EGURA Sriwijaya Expedition (93.57%), followed by EGURA Musi Guardian Mission (92.14%), EGURA Musi Exploration (91.07%), EGURA Great Ampera Challenge (90.71%), EGURA Kuto Besak Fortress Battle (89.29%), and EGURA Sriwijaya Treasure Hunt (88.57%). These results indicate that all six game models met the expert feasibility criteria and were considered valid for implementation. Suggestions provided by the validators, particularly regarding improvements to the game instructions, assessment indicators, and the visual appearance of the digital learning media, were incorporated into the product revision. Consequently, the six EGURA game models were considered valid, feasible, and suitable for subsequent implementation and field testing.

Table 4. Expert Validation Results of the 6 EGURA Game Model

No.	Game Model	Percentage (%)	Category
1	EGURA Musi Exploration	91.07	Very Feasible
2	EGURA Sriwijaya Treasure Hunt	88.57	Very Feasible
3	EGURA Musi Guardian Mission	92.14	Very Feasible
4	EGURA Kuto Besak Fortress Battle	89.29	Very Feasible
5	EGURA Sriwijaya Expedition	93.57	Very Feasible
6	EGURA Great Ampera Challenge	90.71	Very Feasible

Following expert validation, a small-group trial was conducted to evaluate the practicality of the model before large-scale implementation. The trial involved 15 eighth-grade students from State Junior High School 1 Betung.

Table 5. Practicality Test Results of the EGURA Game Model

Indicator	Percentage (%)	Category
Ease of use	85.71	Very Practical
Learning comfort	82.14	Very Practical
Benefits for physical fitness	84.28	Very Practical
Learning attractiveness and motivation	87.85	Very Practical
Average	85.00	Very Practical

The small-group trial demonstrated that all indicators were classified as Very Practical, with an average practicality score of 85.00%. Therefore, the EGURA Game Model was considered suitable for field implementation.

Dissemination Stage

The field implementation involved 35 eighth-grade students from State Junior High School 1 Betung, selected using the total sampling technique. The study was conducted over 16 instructional sessions, consisting of one pretest session, fourteen intervention sessions using the EGURA Game Model, and one posttest session. Students' physical fitness was assessed using the Indonesian Physical Fitness Test (TKJI) before and after the intervention. Descriptive statistical analysis indicated a substantial improvement in students' physical fitness after participating in the EGURA learning programme. The mean physical fitness score increased from 14.60 in the pretest to 21.80 in the posttest, representing an average improvement of 7.20 points.

Table 6. Descriptive Statistics of the Pretest and Posttest Results

Measurement	n	Mean
Pretest	35	14.60
Posttest	35	21.80

To determine the effectiveness of the developed model, the data were analysed using a paired-samples *t*-test.

Table 7. Paired-Samples *t*-Test Results

Variable	Mean Difference	*t*	*df*	Sig. (2-tailed)
Pretest–Posttest Physical Fitness	-7.20	-32.25	34	0.0000001

The paired-samples *t*-test revealed a mean difference of -7.20, indicating that the posttest scores were substantially higher than the pretest scores. The analysis yielded t = -32.25, df = 34, and p = 0.0000001, which was well below the significance level of 0.05. Therefore, the null hypothesis was rejected, indicating that the implementation of the Digital Technology-Based EGURA Game Model through the Teaching Games for Understanding (TGfU) Approach and Local Wisdom had a statistically significant effect on improving the physical fitness of eighth-grade students at State Junior High School 1 Betung. The average improvement of 7.20 points demonstrates that the developed model effectively enhanced students' physical activity, classroom engagement, and overall physical fitness. Accordingly, the EGURA Game Model can be considered both practical and effective for use in junior high school Physical Education.

Discussion

The findings of this study demonstrate that the Digital Technology-Based EGURA Game Model through the Teaching Games for Understanding (TGfU) approach and local wisdom meets the criteria of validity, practicality, and effectiveness. The model achieved an expert validation score of 89.29%, indicating that it was highly feasible, while the practicality test yielded an average score of 85.00%, categorising it as highly practical. Furthermore, the effectiveness test revealed a statistically significant improvement in students' physical fitness following the implementation of the model, as indicated by the paired-samples *t*-test ($t = -32.25$, $p < 0.001$). These findings suggest that the EGURA Game Model provides an effective instructional approach for enhancing students' participation in physical activities and improving their physical fitness.

The results are consistent with previous studies reporting that the Teaching Games for Understanding (TGfU) approach enhances students' motivation, tactical understanding, and engagement in Physical Education by promoting active participation in game-based learning environments (Alcala & Garijo, 2017) Likewise, previous research has shown that integrating traditional games and local wisdom into Physical Education can improve students' physical activity levels, motor skills, and physical fitness while simultaneously fostering cultural awareness and social values (Kusuma et al., 2021; Nurhikmah et al., 2022) The findings indicate that the integration of traditional games and local wisdom can enhance students' physical activity, motor skills, and physical fitness. The use of digital technology through mobile learning-based instructional media also supports more interactive, flexible learning that is aligned with the characteristics of learners in the digital era. In contrast to previous studies that have generally examined TGfU, traditional games, or digital technology separately, the present study integrates these three elements within a unified learning model., the use of digital technology through mobile learning and interactive instructional media has been shown to support more flexible, engaging, and student-centred learning experiences that align with the characteristics of today's digital generation

Unlike previous studies, which have generally examined TGfU, traditional games, or digital technology as separate instructional components (Sumarno et al., 2022), the present study integrates these three elements into a single instructional framework, namely the EGURA (Exploration, Game, Understanding, Reflection, and Action) Game Model. The novelty of this

study lies in the development of six local wisdom-based game models, supported by digital technology, to improve students' motor competence, physical fitness, and physical literacy in an integrated manner. Therefore, the EGURA Game Model offers an innovative, contextual, and effective alternative for Physical Education instruction, particularly for improving the physical fitness of junior high school students.

Conclusions

This study successfully developed the EGURA Game Model based on digital technology through the Teaching Games for Understanding (TGfU) approach and local wisdom to improve junior high school students' motor skills and physical fitness. The developed model met the criteria of validity, practicality, and effectiveness, as demonstrated by expert validation results (89.29%; very feasible), small-group practicality testing (85.00%; very practical), and field testing, which showed a significant improvement in students' physical fitness ($p < 0.05$). These findings indicate that integrating TGfU, digital technology, and local wisdom into a single learning model provides an effective and contextual approach to increasing students' participation in physical activity and improving their physical fitness. Therefore, the EGURA Game Model can be used as an alternative learning model for Physical Education in junior high schools.

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Ethical approval

The study was conducted in accordance with applicable research ethics principles and regulations. Permission to conduct the study was obtained from the Banyuasin District Education Office, South Sumatra (Letter No. 420/706/DISDIKBUD-SEKRT/2026), as well as from the participating school. Written informed consent was obtained from the students and their parents or legal guardians. Participation was voluntary, and all participants had the right to decline or withdraw from the study at any time without any consequences. Compliance with the relevant research ethics principles was verified by the Institute for Community Service, Universitas PGRI Palembang, prior to the commencement of the study.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. The research was conducted objectively, and the funding source had no role in the study design, data collection, data analysis, interpretation of the results, manuscript preparation, or the decision to publish the findings.

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