Designing an innovative learning model for fundamental throwing and catching skills using the teaching games for understanding (tgfu) approach in elementary education
Diseño de un modelo de aprendizaje innovador para habilidades fundamentales de lanzar y atrapar utilizando el enfoque de juegos de enseñanza para la comprensión (tgfu) en educación primaria

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Abstract. This research focuses on enhancing elementary school students' fundamental throwing and catching skills through an engaging and effective learning model grounded in the Teaching Games for Understanding (TGFU) approach. Traditional physical education methods often fail to engage students, particularly those with underdeveloped motor skills, resulting in lower participation in physical activities. This study aimed to design and validate a TGFU-based learning model specifically for fifth graders, following Borg and Gall's development process, which includes iterative testing and refinement stages. Instruments used to measure throwing and catching skills included performance assessments and observational checklists. The study involved three stages: initial testing with 20 students, main product testing with 100 students, and effectiveness testing with 36 students. Content validation reached 91%, and media expert validation was 85%, with practicality and student engagement questionnaires scoring 92.5% and 95%, respectively, in small-scale trials, and media interest reaching 96% in large-scale trials. Data normality and homogeneity were confirmed through normality ($p > 0.05$) and homogeneity tests ($p > 0.05$), indicating that the data were normally distributed and homogeneous. The paired t-test results (sig. 0.000) demonstrated a significant improvement in students' throwing and catching skills, confirming the effectiveness of the developed learning model. These findings validate the TGFU-based approach as a superior method for engaging students and enhancing their motor skills in physical education.
Keywords: Physical Activity, The Teaching Games for Understanding, Learning Model, Basic Movements, Throwing, Catching.

Resumen. La presente investigación se centra en mejorar las habilidades fundamentales de lanzamiento y recepción de los estudiantes de educación primaria mediante un modelo de aprendizaje innovador y efectivo, basado en el enfoque de Enseñanza de Juegos para la Comprensión (TGfU). Los métodos tradicionales de educación física a menudo no logran involucrar a los estudiantes, especialmente a aquellos con habilidades motoras subdesarrolladas, resultando en una menor participación en actividades físicas. Este estudio tuvo como objetivo diseñar y validar un modelo de aprendizaje basado en TGfU específicamente para estudiantes de quinto grado, siguiendo el proceso de desarrollo de Borg y Gall, que incluye etapas iterativas de prueba y refinamiento. Los instrumentos utilizados para medir las habilidades de lanzamiento y recepción incluyeron evaluaciones de rendimiento y listas de verificación observacional. El estudio se realizó en tres etapas: prueba inicial con 20 estudiantes, prueba del producto principal con 100 estudiantes y prueba de efectividad con 36 estudiantes. La validación de contenido alcanzó el 91% y la validación por expertos en medios fue del 85%, con cuestionarios de practicidad e implicación estudiantil que puntuaron 92.5% y 95% respectivamente en pruebas a pequeña escala, y el interés en los medios alcanzó el 96% en pruebas a gran escala. La normalidad y homogeneidad de los datos fueron confirmadas mediante pruebas de normalidad ($p > 0.05$) y homogeneidad ($p > 0.05$), indicando que los datos estaban distribuidos normalmente y eran homogéneos. Los resultados de la prueba t pareada (sig. 0.000) demostraron una mejora significativa en las habilidades de lanzamiento y recepción de los estudiantes, confirmando la efectividad del modelo de aprendizaje desarrollado. Estos hallazgos validan el enfoque basado en TGfU como un método superior para involucrar a los estudiantes y mejorar sus habilidades motoras en la educación física.
Palabras clave: Actividad física, Los juegos didácticos para la comprensión, Modelo de aprendizaje, Movimientos básicos, Lanzar, Atrapar.

Introduction

Physical activity is not only about activities that expend energy, but also as a medium for developing fundamental movement skills (Newell, 2020; Yani & Sina, 2022). Movement development in childhood is very prominent, especially in locomotor, non-locomotor and manipulative movement abilities. This is confirmed by (Chan et al., 2019; Kurniawan et al., 2022; van Aart et al., 2017) which state that fundamental movement skills are the basis for more advanced skills and include object control, locomotor, and balance skills. Towards adolescence, increasingly complex movements can be mastered with the ability to utilize movement skills according to their needs (Ngadiman et al., 2021). Elementary school age children are in a period of growth and development, therefore special guidance and attention is needed, especially from physical education

teachers who are asked to develop students in teaching basic movement skills (Festiawan et al., 2021; Firmana et al., 2022; Rohmansyah, 2022; Sujarwo & Widayat, 2020) Children's basic movement abilities greatly influence the physical activity they do, this is confirmed by (Sarabzadeh et al., 2019; Tompsett et al., 2017) which states that children with adequate motor skill competency spend significantly more time in moderate-to-vigorous PA than children with insufficient motor skill competency" which states that Children with adequate motor skill competency spend significantly more time in moderate to vigorous physical activity than children with inadequate motor skill competency.

Learning physical education in elementary school is the main gateway for children to learn well in basic movement skills (Ketut Yoda et al., 2024; van Aart et al., 2017). Learning basic movements at school must include modifications and developments in the learning model, so that

children can explore and feel happy and interesting in following physical education material for the development of children's physical conditions, especially basic manipulative movements (Lawson, 2021; Pacheco, 2022). Manipulative abilities mostly involve the hands and feet, but other parts of our body can also be used (Sumartiningsih et al., 2022; Susanto et al., 2023). Basic manipulative movement material, namely throwing, catching and kicking an object, is included in the school education curriculum, integrated in the field of physical education and sports studies, and is a basic element found in athletics (Estevan, 2022). Throwing movements are a form of manipulative movement, because the basic movements consist of locomotor, non-locomotor and manipulative movements. Apart from that, to be able to develop the implementation of the teaching and learning process, teachers must first understand and the mastery movement skills in throwing movements, i.e., balance and arm muscle strength (Martins, 2021). Movement errors made by children will result in minor injuries to the hands, thus the need for good basic movement skills and motivation in the learning process. This is confirmed by the findings (Costello, 2020) which state that children's lack of gross motor skills causes children to experience obstacles. The obstacles that occur are because gross motor learning at school has not been carried out optimally, not involving children's physical activities.

Efforts to improve the basic movements of throwing and catching include fun learning through games that students can play. This is in accordance with research (Szymanek-Pilarczyk, 2021) with the results of research in cycle 2 action 2 being 75.15% that the application of frisbee games can increase and improve the basic movement patterns of throwing and catching in elementary school students. In physical education lessons, before entering actual movement practice, the teacher often provides a brief explanation and examples of movements. This is done so that students are better prepared to practice certain movements. The process of learning motor skills is only possible if there is a readiness to learn in children. Readiness to learn involves physical and mental aspects. In connection with this rule, it is very possible for the content of physical education to be adjusted to the child's readiness or maturity (MacEachern et al., 2022).

Research (Johnstone et al., 2017) states that active play is the newest approach for children's low physical activity and basic movement skills in children. Game-based learning is expected to improve student learning outcomes in the basic movements of throwing and catching (Zhao, 2022). This encourages researchers to develop research using the TGFU (Teaching Games for Understanding) approach. According to (Jia, 2021) states that the Teaching Game for Understanding (TGFU) model is game-centered learning and students learn games related to sports using a constructive approach. TGFU is a physical education learning model that uses tactical game elements without eliminating the technique with the aim of active movement to develop skills and knowledge in physical education teaching (Festiawan et al., 2024). This tactical game learning model can use students' interest in a game structure to develop skills and technical knowledge needed for game performance (Yudanto, 2022).

Based on the description above, It is hoped that, by developing this model in accordance with the characteristics of students, it can improve basic manipulative movement skills in throwing and catching.

Materials and Methods

Study Design

The final model of this research is a model for learning basic throwing and catching movements using the Teaching Games for Understanding (TGFU) approach for elementary school students. To produce this product, the development model used in this research refers to the Research and Development (R & D) development model from Borg and Gall. Educational development research is a process used to develop and validate educational products. The results of development research are not only the development of an existing product but also to find knowledge or answers to practical problems. This research is directed at developing appropriate products for schools and other educational institutions with the aim of building something new which is expected to improve the quality of student learning outcomes. The borg and gall model was chosen as a development method with properties suitable for the research to be carried out.

The development of the Borg and Gall model design involves several detailed steps. Initially, a needs analysis is performed through preliminary studies, including field observations, questionnaires, and interviews with teachers, to identify and document issues encountered during the learning process. This is followed by a comprehensive planning phase, where material for a basic throwing and catching movement learning model is prepared. The planning includes dividing responsibilities among the photographer, information technology, and field teams, budgeting for research and product development, and planning the creation of textbooks. The next step involves creating an initial product, which is an application designed to implement the TGfU approach for teaching basic movements in elementary physical education. This product is then subjected to expert evaluation, where feedback is gathered through a justification test and expert review, leading to necessary revisions. Following the expert review, initial field trials are conducted to test the product's feasibility with data analyzed to inform further revisions. If the results of these trials are not satisfactory, additional revisions are made before proceeding to a broader-scale field test of the main product. Data from this main field test are analyzed to assess the product's effectiveness. Subsequent revisions are carried out based on these test results to refine the product. Finally, an effectiveness test is conducted to determine the product's practical value and alignment with learning objectives. The product is then revised based on these tests and

finalized for use by students, teachers, or the wider community, ensuring it meets the intended educational goals.

Study Participant

The main research subjects in the basic throwing and catching movement learning model for fifth grade elementary school students in Sungai Rumbai Dharmasyara Village, Indonesia with the following details: 1) 20 students in the initial field trial; 2) 100 students in the main product field test; 3) 36 students will be involved in the effectiveness test.

Study Procedures

The research and development steps in this research include: 1) Preliminary study stage; 2) Model development planning stage; and 3) Validation, evaluation and model revision stages. The procedure for developing a model for learning basic throwing and catching movements for elementary school children follows the product development steps according to the Borg and Gall pattern. The following is an explanation of the ten stages of the model developed by Borg and Gall:

1. Research and information collecting (collecting information and research results). This first step includes needs analysis, literature study, small-scale research and required reporting standards. To carry out a needs analysis there are several criteria related to the urgency of product development itself, as well as the availability of competent human resources and sufficient time to develop. The literature study is carried out for a temporary introduction to the product to be developed and this is carried out to collect research findings and other information related to the planned product development. Meanwhile, small-scale research needs to be carried out so that researchers know several things about the product to be developed.

2. Planning (drawing up a research plan). Develop a research plan, including the abilities needed to carry out research, formulation of objectives to be achieved with the research, research design or steps, and the possibility of testing in a limited environment.

3. Develop preliminary form of product (initial product development). namely developing the initial form of the product that will be produced. Included in this step is preparing supporting components, preparing guidelines and manuals, and evaluating the suitability of supporting tools.

4. Preliminary field testing (initial trial). Carrying out initial stage trials, carried out on 1-3 schools using 6-12 subjects. Collecting information/data using observation, interviews and questionnaires, and continuing with data analysis.

5. Main product revision (revising initial trial results). Namely making improvements to the initial product produced based on the results of initial trials. It is very possible for this improvement to be carried out more than once, according to the results shown in limited trials, so that a main product (model) draft is obtained that is ready to be tested more widely.

6. Main field testing (main trial). Conducted on 5-15 schools, with 30-100 subjects.

7. Operational product revision, namely making improvements/refinements to the results of wider trials, so that the product developed is an operational model design that is ready to be validated;

8. Operational field testing (operational trials). Conducted on 10-30 schools, involving 40-200 subjects), data was collected through interviews, observations and questionnaires.

9. Final product revision (final product revision). This step is a refinement of the product being developed based on suggestions in field trials.

10. Dissemination and implementation (dissemination and implementation). Namely reporting and disseminating products through scientific meetings and journals, collaborating with publishers to disseminate products for commercial use, and monitoring distribution and quality control.

This developmental research produced a learning model designed to improve elementary school students' basic throwing and catching skills through the Teaching Games for Understanding (TGFU) approach. The specific outcomes of this research include: (1) the development of a learning model that integrates the TGFU approach for teaching basic throwing and catching movements, and (2) the creation of a textbook to support instruction in these fundamental motor skills using the TGFU methodology.

Result

The results obtained from research and development procedures. This research was used to produce a product in the form of media developed by researchers adapted to Competency Standards and basic competencies in the fifth grade of elementary school. By using media, students will not only listen to explanations from the teacher but students will also be more active. The steps taken by the researcher are presented in table 1.

Table 1.
Development of a Basic Movement Learning Model for Throwing and Catching Using the Borg and Gall Model.

No.	Step Activities	Research Activities	Description
1	Needs Analysis	Preliminary studies	Analyze the teacher's teaching style
			Analyze students' learning styles
			Analyze the basic movement skills of throwing and catching in fifth grade elementary school students
			Analyze the learning model given by the teacher to students
			Analyze existing learning resources
			Analyze the need to develop a learning model for the basic movement of throwing and catching

2	Planning	Research Process Planning	Design a basic learning model for throwing and catching movements for fifth grade elementary school students Form a research support team Make a budget plan needed for the research process Make a research schedule
3	Creation of Initial Products	Preliminary Product Creation of a Basic Movement Learning Model for Throwing and Catching for elementary school students	Create an initial product, draft 1, learning model for basic throwing and catching movements for fifth grade elementary school students Initial product draft 1 is validated by expert judgment Revision of initial product draft 1 after validation by expert judgment Create an initial product draft 2
4	Initial Field Trials	Small Scale Trials	The initial product draft 2 was tested on a small group of 20 subjects from two schools Subjects were given an instrument of satisfaction with the basic movement learning model of throwing and catching for fifth grade elementary school students Observers together with experts carry out practical tests to assess the application of the basic movement learning model of throwing and catching in fifth grade elementary school students
5	Product Revision	Product Revisions After Small Group Trials	The product is revised based on initial field trial results Create a model product for learning the basic movements of throwing and catching for fifth grade elementary school students, draft 3 Draft product 3 is ready to be tested to the next stage
6	Key Product Field Tests	Large Scale Trials	Draft product 3 was tested on a large-scale group of 100 subjects from five schools Subjects were given an instrument of satisfaction with the basic throwing and catch movement learning model for fifth grade elementary school students Observers and experts carry out practical tests to assess the application of the basic throwing and catch movement learning model for fifth grade elementary school students
7	Product Revision	Product Revision after Large Scale Trials	The product is revised based on the results of field trials of the main product Create a model product for learning basic throwing and catching movements for fifth grade elementary school students, draft 4 Draft product 4 is ready to be tested to the next stage
8	Main Trial / Effectiveness Test (Field Testing)	Product Effectiveness Test	Subjects were divided into two groups consisting of an experimental group and a control group Both groups were given a free test first to determine their initial abilities. The experimental group was given treatment with a learning model for basic throwing and catching movements for fifth grade elementary school students using draft 4 products The control group carries out learning as usual. The control group and experimental group carried out a post test Observers and experts carry out practical tests to assess the application of the basic movement learning model for throwing and catching in fifth grade elementary school students
9	Product Revision	Product Revision After Effectiveness Testing	Products are revised based on effectiveness test results Create a model product for learning the basic movements of throwing and catching for fifth grade elementary school students, draft 5
10	Final Product	Products that are ready to be marketed	Draft product 5 is the final product or final product ready for dissemination.

The results of the learning media expert validation after revision of the media value were 47 with a percentage of 85%. The assessment results from learning material experts after revision of the media score were 59 with a percentage of 91%. The assessment results given by learning experts showed a score of 55 with a percentage of 90%. During the validation process by media experts, material experts and practicality experts, researchers included a questionnaire complete with comments and suggestions used to assess the media being developed. Assessments take the form of suggestions or comments from media experts, researchers redesign learning media to make it more interesting. The researcher made improvements to the material, namely making the material clearer by using Indonesian which is better understood by fifth grade elementary school students as study participants. Based on the assessment that has been carried out after being revised by learning media experts, material experts and practicality experts, the media developed is declared suitable for use because the media is interesting, safe to use and can motivate students. The media developed by researchers received a positive response with a percentage of 95% which was indicated by a yes answer and received a negative response with a percentage of 5% because there were some students who were less interested in physical activity. The results of this student's questionnaire used the Guttman scale which consists of yes or no answers. Based on several shortcomings in the small group trial, the researcher made revisions according to the advice of learning experts, namely providing variations in the media display to make it more attractive to fifth grade elementary school students. A large group trial involving 100 students and 80 students will be involved in the effectiveness test. Based on the assessment of large group trials, the media developed received a positive response of 96% and a negative response of 4%. The effectiveness test produced a value of 95%. If seen from the percentage of positive responses from students, the media developed is declared valid for use as learning media in Physical Education subjects, especially for the fifth grade of elementary school.

This study examined the effectiveness of interactive learning media in improving learning outcomes of manipulative movements through a series of statistical tests. For ease of mention in data analysis, the group innovative learning model using the Teaching Games for Understanding (TGFU) Approach was given the initials "A" and the group using conventional model used the initials "B". The normality test results showed that the data were normally distributed, while the variance homogeneity test showed similar results. The paired-sample t-test showed a significant increase in learning outcomes between the pre-test and post-test of method A greater than method B, confirming that

the use of interactive media is effective in improving manipulative movement skills in elementary school students.

Table 2.
Normality Test

No	Group	N	Asym. Sig (p-value)	Note
1	Pretest Group A	18	.534	Normal
2	Postest Group A	18	.441	Normal
3	Pretest Group B	18	.192	Normal
4	Postest Group B	18	.131	Normal

Table 2 presents the results of the normality test for both pretest and posttest data across two groups. The p-values indicate that the data in all groups are normally distributed: Pretest Group A had a p-value of 0.534, Posttest Group A had a p-value of 0.441, Pretest Group B had a p-value of 0.192, and Posttest Group B had a p-value of 0.131. Since all p-values are greater than the significance level of 0.05, the data for both pretest and posttest in each group meet the criteria for normal distribution.

Table 3.
Homogenity Test

No	Group	N	Asym. Sig (p-value)	Note
1	Pretest Group A.B	36	0.302	Homogeneous
2	Postest Group A.B	36	0.294	Homogeneous

Table 3 shows the results of the homogeneity test for the pretest and posttest data. The p-values for both Pretest Group AB and Posttest Group AB are above the significance level of 0.05, with values of 0.302 and 0.294, respectively. These p-values indicate that the variances of the data in both groups are homogeneous. Thus, the data for both pretest and posttest meet the criteria for homogeneity of variances.

Table 4.
Paired sample T-Test

No	Group	t	Asym. Sig (p-value)
1	Pretest – Posttest Group A	5.342	0.000
2	Pretest – Posttest Group B	1.199	0.050

Table 4 displays the results of the paired sample t-test for both groups. For Group A, the t-value is 5.342 with a p-value of 0.000, indicating a significant difference between pretest and posttest measurements. In contrast, Group B has a t-value of 1.199 with a p-value of 0.050, which is just at the threshold of significance. The results suggest that there is a significant change in Group A, while Group B shows a marginally significant difference between pretest and posttest.

Discussion

The study effectively developed and evaluated a basic movement learning model for throwing and catching using the Borg and Gall model, tailored for fifth-grade elementary school students. The results indicated that the media created based on this model significantly enhanced learning outcomes. The validation process showed high ratings from media, material, and practicality experts, with scores of 85%, 91%, and 90% respectively. These high percentages reflect the quality and relevance of the learning media developed. The positive feedback from students, with 95% indicating satisfaction, underscores the effectiveness and appeal of the interactive learning media. This is corroborated by the statistical analysis, which demonstrated a significant improvement in learning outcomes for the experimental group using the new model compared to the control group using conventional methods.

The normality and homogeneity tests confirmed the reliability of the data, showing normal distribution and homogeneous variances across the groups. The paired sample t-test results revealed a substantial difference in learning outcomes for Group A, with a t-value of 5.342 and a p-value of 0.000, indicating a highly significant improvement. In contrast, Group B showed a less pronounced change with a t-value of 1.199 and a p-value of 0.050, which is marginally significant. This indicates that the new model was more effective than traditional methods in enhancing students' manipulative movement skills.

Comparing these results with previous studies, such as those by (Domínguez, 2022; Houghton, 2022), which explored various teaching methods and their effectiveness, this study provides a novel approach by integrating the Teaching Games for Understanding (TGfU) model specifically for basic throwing and catching movements. Previous research often focused on generic or less specific teaching strategies, whereas this study's focus on a targeted learning model offers a more refined approach to improving physical education outcomes.

The innovation in this study lies in its application of the TGfU approach to basic movement skills and the use of interactive media to engage students more actively. Previous research, like that of (Burgess et al., 2018) demonstrated the effectiveness of different types of physical therapy but did not delve deeply into the use of interactive learning media for elementary education. This study extends the current understanding by showing that interactive, model-based learning can significantly improve specific physical skills in young students, filling a gap in the literature. One of the key advantages of this study over previous research is its comprehensive development process, which includes expert validation, small and large-scale field trials, and rigorous effectiveness testing. This thorough approach ensures that the final product is well-tested and refined based on multiple stages of feedback, setting a higher standard for educational media development. By demonstrating a 95% effectiveness rate and high student satisfaction, this study establishes a robust framework for developing and implementing effective learning media in physical education.

Conclusion

This research can provide scientific contributions, knowledge and experience in physical education learning, especially material on basic throwing and catching manipulative movements. The final product of this development research can simplify and expedite the learning process, for students to simplify and speed up the

learning process, especially mastering the basic movement skills of throwing and catching, so that multi-directional learning interactions can be realized and support the achievement of learning objectives. Skill development for elementary school students is basic manipulative movements, one of which is throwing and catching. Learning basic movements from an early age is a form of developing movement skills to the next stage because basic movements are the foundation for the next special movements. Every student has the ability to develop basic movement skills in each phase. The development of basic movements, especially manipulative throwing and catching movements, can be done optimally with directed and continuous learning. Students who have good basic movement skills will find it easy to practice more complicated movements at the next stage. The learning model for the basic movements of throwing and catching is adapted to the characteristics of the child's age and stage of development in an effort to improve the basic movement skills of throwing and catching. Based on the analysis of the development of the learning model for the basic movement of throwing and catching, students' needs, as well as the conditions for implementing the learning carried out and the results of the development of the basic movement learning model for improving the basic movement skills of throwing and catching elementary school students which was developed and validated within a limited scope at the 09 Sungai Rumbai Dharmasyara State Elementary School, Indonesia.

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