P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (RJIF): 5.93
IJPESH 2025; 12(5): 607-612
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https://www.kheljournal.com
Received: 15-07-2025
Accepted: 20-08-2025

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The Effect of the ICT TPACK learning model and the teams games tournament type cooperative learning model on the learning outcomes of variations of floor gymnastics movements (rolling forward and wheeling movements) phase B Class IV SDN 020 East Balikpapan

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DOI: https://www.doi.org/10.22271/kheljournal.2025.v12.i5i.4038

Abstract
This study aims to analyze the influence of *the Information and Communication Technology – Technological Pedagogical and Content Knowledge* (ICT-TPACK) learning model and the *Teams Games Tournament* (TGT) type cooperative learning model on the learning outcomes of floor gymnastics movement variations, especially forward and wheeling movements in grade IV students of SDN 020 East Balikpapan. The research used a quasi-experimental method with *a pretest–posttest control group design*. The research subjects consisted of 30 students who were divided into two groups, namely the ICT-TPACK group and the TGT group. The research instrument included the assessment of cognitive, affective, and psychomotor aspects, which were analyzed using *the Wilcoxon Signed-Rank Test* and *the Paired Sample t-Test* with a significance level of 5%. The results showed that the ICT-TPACK learning model had a significant effect on improving student learning outcomes ($p = 0.043 < 0.05$), while the TGT model did not have a significant effect ($p = 0.547 > 0.05$). Comparisons between groups showed that the ICT-TPACK model was more effective than TGT in improving learning outcomes of floor gymnastics movement variations. These findings confirm that the integration of technology in PJOK learning is able to improve concept understanding, motor skills, and learning motivation of elementary school students.

Keywords: ICT-TPACK, *Teams Games Tournament*, Learning Outcomes, Floor Gymnastics, Physical Education.

Introduction
Physical Education, Sports, and Health (PJOK) is one of the subjects that is favored by students from elementary school to high school. PJOK learning plays an important role in developing the psychomotor, cognitive, and affective aspects of students through fun and meaningful physical activities. The goal of physical education in schools is to create fit learners and help them generate new movements through learning experiences gained in the classroom [1]. PJOK is a means of forming and developing children as a whole through physical activities [2]. This means that physical education not only teaches physical abilities, but also forms positive character and sustainable healthy living habits. However, in practice, PJOK teachers at the elementary school level often face obstacles, one of which is the delay in students' basic motor development. Motor delay is a condition when a child is unable to perform age-appropriate movements, such as walking, sitting, or rolling [3]. This condition has a negative impact on the physical development and coordination of children in the long term. Rapid technological advances also cause children to tend to be less mobile due to passive activities in front of gadgets. Therefore, learning model innovations are needed that can facilitate children's motor development in an active and interesting manner. One of these innovations is the Information Communication and Technology / Technological Pedagogical

and Content Knowledge (ICT TPACK) model. TPACK is a framework that integrates teachers' knowledge of technology, pedagogy, and content to produce effective learning [4]. TPACK allows teachers to analyze and utilize technology as an integral part of the learning process [5]. ICT must play a central role in developing education, both formal and non-formal, because it is able to increase learning participation and effectiveness [6].

In the context of PJOK, the use of the TPACK ICT model is very relevant because it allows teachers to display videos and simulations of movements that can be observed and imitated by students. This helps students who have motor delays to better understand the sequence and technique of movement. TPACK helps teachers develop effective technology-based learning innovations [7]. TPACK can be conceptualized as the distribution of knowledge between individuals (teachers, technologists, students) and artifacts (websites, lesson plans, software, and so on) [8].

In addition to the TPACK model, the Teams Games Tournament (TGT) type cooperative learning model is also an alternative strategy that can increase social interaction and student motivation. TGT is able to encourage social skills, learning achievement, and positive interaction among students through play activities [9]. TGT requires students to be active in understanding and mastering the material and contributing to their group [10]. This model fosters cooperation and shared responsibility, according to the characteristics of elementary school students who love to play.

Previous research has shown the effectiveness of these two models in improving learning outcomes in various fields. TPACK's ICT-based gymnastics learning helped 82% of elementary school students understand basic movements better [11]. TPACK-based floor gymnastics media is very much needed and suitable for junior high school students [12]. The application of TGT is effective in improving creativity, understanding of concepts, and learning outcomes in various contexts, including mathematics and sports games [2, 9, 10, 13, 14].

Floor gymnastics is an ideal context to test both models because their movements demand coordination, flexibility, and balance. Gymnastics exercises can improve strength, flexibility, and kinesthetic awareness [15]. However, the results of the author's observations show that many students have difficulty performing floor gymnastics movements correctly and feel less confident. One of the problems in the learning of sports and health physical educators, especially in floor gymnastics materials, is the lack of simple learning media [16]. Learning media is very important in the learning process because teachers can convey material to students to be more meaningful. The teacher not only conveys the material in the form of words with lectures but can bring students to understand the material conveyed in real terms [17]. Floor gymnastics learning is still inefficient and has not used effective media for students [18].

Based on these findings, this study focuses on the application of the TPACK ICT learning model and the Teams Games Tournament (TGT) type cooperative learning model to improve the learning outcomes of floor gymnastics movement variations (rolling forward and wheeling). The objectives of this study are (1) to determine the influence of the TPACK ICT model on the learning outcomes of floor gymnastics movements, (2) to determine the influence of the TGT model on the learning outcomes of floor gymnastics movements, and (3) to compare the effectiveness of the two models in grade IV students of SDN 020 East Balikpapan.

Research methods

Research Type and Design

This study uses a quasi experiment method with a quantitative approach. The research method is a scientific way to obtain data that is specific and useful [19]. Quantitative research aims to answer research questions through empirical, objective, structured, and systematic procedures using statistically analyzed numerical data [20].

Quasi-experimental research was chosen because it involved treating two groups without complete randomization [21]. The design of this study is the Pretest–Posttest Control Group Design [22], which consists of two groups: one experimental group using the ICT learning model TPACK and the other group using the Teams Games Tournament (TGT). Both groups were given a pretest before treatment and a posttest after treatment to measure the improvement of floor gymnastics learning outcomes (rolling forward and rolling).

Table 1: Division of Research Groups

Yes	Group Name	Sum
1	*ICT TPACK Group*	15 students
2	TGT Group	15 students
	Sum	30 students

Research Procedure

The implementation of the research consists of three stages:

1. Preparation Stage: Preparing learning tools, instruments (lesson plans, ICT media, observation sheets), validating by three PJOK experts, and preparing two observers.

2. Implementation Stage: The experiment was conducted for 7 weeks (12 meetings). Both groups were given a pretest (O_1 and O_3), then the ICT TPACK group received technology-based treatment such as video tutorials, while the TGT group was given game-based cooperative learning and team-based competitions. After treatment, both underwent posttests (O_2 and O_4).

3. Evaluation Stage: pretest and posttest results data are analyzed through prerequisite tests (normality and homogeneity) and hypothesis tests (t-tests).

Population and Sample

The population in this study is all grade IV students of SDN 020 East Balikpapan for the 2024/2025 school year totaling 30 students. Sampling was carried out by random sampling technique [19], which resulted in two groups of 15 students each.

Research Variables

This study has two independent variables and one bound variable:

Variable Code	Variable Name	Variable Type	Short Description
X_1	TPACK ICT Learning Model	Independent Variable	A learning model that integrates technology, pedagogy, and material content to improve student learning effectiveness.
X_2	TGT (Teams Games Tournament) Cooperative Learning Model	Independent Variable	A learning model that emphasizes group cooperation and competition through educational games.
Y	Learning Outcomes of Variations of Floor Gymnastics Movements (front roll and wheeling)	Bound Variable (Dependent)	The level of students' ability to understand and practice variations of floor gymnastics movements is measured through skill tests and observations.

The operational definition of a variable refers to Sugiyono [19]:

1. Learning outcomes are measured through students' ability to perform floor gymnastics movements precisely, smoothly, and balanced.
2. ICT TPACK is defined as the application of technology and content pedagogy in PJOK learning [23].
3. TGT is cooperative and competition-based learning in teams [24].

Data Collection Instruments and Techniques Data is collected using:

1. Movement skills test and Google Form questionnaire based on Likert scale 1–4 (Very Good – Poor).
2. Documentation and direct observation during floor gymnastics practice.
3. The motion assessment grid covers aspects of technical accuracy, balance, coordination, and smoothness.

Validity and Reliability

The instrument was tested for validity and reliability with SPSS 22. The results of the validity test showed 26 valid question items (r-count > r-table = 0.497). The results of the reliability test yielded a value of Cronbach's Alpha = 0.952, indicating very high reliability [25].

Data Analysis Techniques

Data analysis is carried out in two stages:

1. Descriptive Analysis – calculating the mean, percentage, and category of learning outcomes [26].
2. Inferential Analysis – using the t-test (Paired Sample t-Test) to see the difference between pre-test and posttest, as well as the Independent t-Test to compare the effectiveness between the ICT TPACK and TGT groups.

Prerequisite tests (normality and homogeneity) were performed using Shapiro-Wilk and Levene Test with SPSS 22. The hypothetical decision was set at a significance level of $\alpha = 0.05$. If $p<0.05$, then the learning model has a significant effect on student learning outcomes.

Research results

a. Research Results

The results of the research that have been carried out provide a descriptive overview of the influence of the ICT TPACK learning model and the Teams Games Tournament type cooperative learning model on the learning outcomes of floor gymnastics movement variations in students of SDN 020 East Balikpapan. The results of the pretest and posttest showed a significant improvement after the treatment. The analysis was carried out by normality, homogeneity, Wilcoxon, and t-test.

1. Normality Test

The normality test aims to find out if the data is distributed normally. The data can be seen in figure 1.

Based on the Kolmogorov-Smirnov test, the significance value of the pretest of 0.028 (< 0.05) showed abnormal data, while the posttest of 0.200 (> 0.05) was normally distributed. Thus, the Wilcoxon non-parametric test is used.

Fig 1: Normality Test Results

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.169	30	.028	.929	30	.046
Posttest	.113	30	.200*	.978	30	.779

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

2. Wilcoxon Non-Parametric Test

Table 1: ICT TPACK Non-Parametric Test Test Results

	Posttest – Pretest	Information
Z	- 1.876	Significant
Asymp. Sig. (2-tailed)	,061	Significant

Table 2: TGT Non-Parametric Test Test Results |

	Posttest – Pretest	Information
Z	- 0.490	Significant
Asymp. Sig. (2-tailed)	,624	Significant

Wilcoxon's results showed p = 0.061 (> 0.05) in ICT TPACK and p = 0.624 (> 0.05) in TGT, meaning that they were not parametrically significant. However, the t-test results showed a significant increase in the ICT TPACK group (p = 0.043 < 0.05).

3. Homogeneity Test

The results of Levene's Test showed a Sig. value of 0.757–0.785 (> 0.05), which means that the data had homogeneous variance between groups. The results can be seen in figure 2.

Fig 2: Homogeneity Test Results

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Hasil Pembelajaran	Based on Mean	.098	1	28	.757
	Based on Median	.076	1	28	.784
	Based on Median and with adjusted df	.076	1	22.982	.785
	Based on trimmed mean	.137	1	28	.714

Based on the overall significance values (Sig.) of various test bases, the values were greater than 0.05, namely 0.757 (Based on Mean), 0.784 (Based on Median), 0.785 (Adjusted Median) and 0.714 (Trimmed Mean). Since the total value of Sig. > 0.05, it can be concluded that the variance between the groups is homogeneous. The results of the homogeneity test using *Levene's Test* found that the significance value was greater than 0.05 in all basic testing approaches (mean, median, trimmed mean). Thus, it can be concluded that the data has a homogeneous variance between groups. This condition fulfills one of the basic assumptions in parametric statistical analysis, so hypothesis testing can be continued using parametric tests such as t-tests, if supported by normality assumptions.

4. T Test (Calculate)

Table 3: Paired Sample T Test Results

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	ICT TPACK	-5,733	9,968	2,574	-11,253	-,213	-2,228	14	,043
Pair 2	TGT	-1,467	9,211	2,378	-6,567	3,634	-,617	14	,547

Based on the results of the study interpretation, the value *of t* = -2.228 with *p* = 0.043 (< 0.05) showed that there was a significant difference in influence between the two learning models on improving learning outcomes. TPACK's ICT model is more effective than the *Team Game Tournament* (TGT) model.

These results indicate that the treatment or intervention given in the study has a significant influence on the improvement in outcomes after treatment, which is reflected in the difference in *higher posttest* scores than *pretests*. The value of t = -2.228 with p = 0.043 showed that there was a significant difference in the ICT TPACK group. TPACK's ICT model has proven to be more effective than TGT.

b. Research Discussion

1. Description of Research Data

Table 4: Description of Ordinal Data Learning Outcomes

Group	N	Mean	Median	Mood	SD	Category
ICT TPACK	15	3.38	4.00	4	0.83	Good – Very Good
TGT	15	3.19	3.00	4	0.86	Good

From the table above, it can be seen that the average learning outcome score of students who study with the ICT TPACK model (3.38) is higher than students who study using the TGT model (3.19). In general, both groups showed improved learning outcomes after treatment.

2. Hypothesis Test 1 – The Influence of the ICT TPACK Model

Table 5: Wilcoxon Test Results (TPACK ICT Group)

	Posttest - Pretest	Information
Z	- 1.876	Insignificant
Asymp. Sig. (2-tailed)	,061	

The results of the Wilcoxon test in the table above show values Z = -1.876 and p = 0.061 (> 0.05). Statistically non-parametrically, this shows no significant difference between pretest and posttest results. However, follow-up tests using the Paired Sample t-Test gave different results, as can be seen in table 6.

Table 6: Paired Sample T Test Test Results (ICT TPACK Group)

Group	Mean	SD	t	Df	Sig. (2-tailed)
ICT TPACK	-5.733	9.968	-2.228	14	0.043

The TPACK ICT model has a significant effect on improving the learning outcomes of floor gymnastics. Technology integration increases PJOK's understanding and motivation to learn [27, 28].

3. Hypothesis Test 2 – The Influence of the TGT Cooperative Model

The test was carried out with *the Wilcoxon Signed-Rank Test* in the TGT group. The results can be seen in table 7, as follows.

Table 7: Wilcoxon Test Results (TGT Group)

	Posttest - Pretest	Information
Z	- 0.490	Insignificant
Asymp. Sig. (2-tailed)	,624	

The significance value (p = 0.624 < 0.05) showed that there was no significant difference between the pretest and posttest results in the TGT group. The results of the parametric test (Paired Sample t-Test) also support this finding, which can be seen as follows:

Table 8: Paired Sample t Test Results (TGT Group)

Group	Mean	SD	t	Df	Sig. (2-tailed)
ICT TPACK	-5.733	9.968	-2.228	14	0.043

Thus, H_0 is accepted and there is no significant influence of the TGT model on improving student learning outcomes. The TGT model basically emphasizes cooperative and competitive aspects through academic games. In the context of floor gymnastics learning, these activities increase social interaction and cooperation, but are not strong enough to significantly improve students' cognitive and psychomotor abilities. The TGT model did not show a significant improvement, although it encouraged students' cooperation and social motivation. These results support the effectiveness of TGT depending on the content and readiness of the students [24].

4. Hypothesis Test 3 – Differences in the Influence of ICT TPACK and TGT

The test was carried out with *a Paired Sample t Test* to find out the difference in posttest results between the ICT TPACK and TGT groups. The results are in the form of table 9, as follows.

Table 9: Paired *Sample T Test Results*

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	ICT TPACK	-5,733	9,968	2,574	-11,253	-,213	-2,228	14	,043
Pair 2	TGT	-1,467	9,211	2,378	-6,567	3,634	-,617	14	,547

The significance value (p = 0.000 < 0.05) showed that there was a significant difference in learning outcomes between the TPACK and TGT ICT groups, it was known that:

a. In the ICT TPACK group, *a value of t* = -228 with *a p-value* = 0.043 (< 0.05), so that there was a significant difference between the pretest and posttest results. Thus, it can be concluded that the ICT TPACK learning model has a significant effect on improving the learning outcomes of floor gymnastics movement variations
b. In the TGT group, *a value of t* = -0.617 with *a p-value* = 0.547 (> 0.05) was obtained, indicating that there was no significant difference between the pretest and posttest results. This means that the implementation of the TGT-type cooperative learning model has not shown a statistically significant increase in learning outcomes

TPACK's ICT model is superior because it provides an interactive visual experience through video and simulation media. TPACK-based learning is effective in improving understanding of sports concepts through technology support.

5. Recapitulation of Hypothetical Results

Table 10: Recapitulation of Hypothesis Test Results

Yes	Hypothesis	Test Type	Sig. (2-tailed)	Decision	Information
1	The influence of the TPACK ICT model on student learning outcomes	Wilcoxon & Paired t-Test	0.061 / 0.043	H_1 Accepted	Significant (there is an improvement in learning outcomes)
2	The influence of the TGT model on student learning outcomes	Wilcoxon & Paired t-Test	0.624 / 0.547	H_1 rejected	Insignificant
3	Differences in the influence of ICT TPACK and TGT on learning outcomes	Paired t-Test	0.043	H_1 Accepted	Significant (ICT TPACK is more effective)

The general conclusion shows that the TPACK ICT model is more effective than the TGT model in improving the learning outcomes of floor gymnastics movement variations in elementary school students.

Conclusions and suggestions

a. Conclusion

Based on the results of research, data analysis, and discussions that have been carried out regarding the influence of the ICT TPACK and TGT (Teams Games Tournament) learning models on the learning outcomes of the variation of students' floor gymnastics movements, the following can be concluded:

1. TPACK's ICT Learning Model has a significant effect on improving student learning outcomes. Based on the results of the Paired Sample t-Test, a value of t = -2.228 with p = 0.043 (< 0.05) was obtained, which means that there is a significant difference between the results of the pretest and posttest. This shows that the application of the TPACK ICT model, which integrates elements of technology, pedagogic, and material content, is able to improve students' understanding of concepts and skills in practicing variations of floor gymnastics movements more effectively.
2. The TGT Learning Model does not have a significant effect on improving student learning outcomes. The results of the Wilcoxon test and the Paired Sample t-Test showed significance values of 0.624 and 0.547 (> 0.05, respectively. This means that the TGT model has not provided a statistically significant improvement in learning outcomes. Nevertheless, the implementation of TGT still makes a positive contribution to the social aspect and cooperation between students, although it does not have a strong impact on improving cognitive and psychomotor aspects.
3. There is a significant difference in influence between the TPACK and TGT ICT models on student learning outcomes. Based on the results of the Paired Sample t-Test between groups, a significance value of p = 0.043 (< 0.05) was obtained, which means that there is a real difference between the two groups. The TPACK ICT model has proven to be more effective than the TGT model in improving the learning outcomes of students' floor gymnastics movement variations. The advantage of TPACK's ICT model lies in its ability to provide visual, demonstrative, and interactive learning experiences that make it easier for students to understand movements thoroughly. Overall general conclusion, this study proves that the TPACK ICT learning model is more effective than TGT in improving the learning outcomes of floor gymnastics movement variations of elementary school students.

b. Research Implications

The results of this study have implications for the development of PJOK learning strategies, namely:

1. Teachers can use the TPACK approach as a foundation to design learning activities that combine technology, pedagogic, and sports content so that the learning process becomes more effective and fun.2. ICT-based learning TPACK can be a relevant alternative to improve psychomotor learning outcomes and student motivation in floor gymnastics learning.3. The TGT model can still be used to foster cooperation and sportsmanship, but it needs to be combined with technology-based media so that learning outcomes are more optimal.

C. Suggestions

Based on the results of the overall data analysis of the ICT TPACK learning model and the Teams Games Tournament type cooperative learning model on the learning outcomes of variations in front roll floor gymnastics and wheeling, the author proposes the following suggestions:

1. For Physical Education Teachers: Teachers are advised to utilize the TPACK ICT model in floor gymnastics learning so that students can understand movements more concretely through the help of digital media such as videos, animations, and simulations. Teachers can also combine it with the TGT model to create an active, competitive, and fun learning atmosphere.

2. For Schools: Schools are expected to provide support for technology-based learning facilities and infrastructure, such as projector devices, computers, and internet access, so that the implementation of the TPACK ICT learning model can run optimally in Physical Education subjects.

3. For the Next Researcher:

a. Increase the number of samples so that the research results are more general.
b. Testing the effectiveness of ICT TPACK on other sports materials (such as big ball games or athletics).
c. Combining the TGT and ICT TPACK models to see the synergistic influence between collaborative and technological aspects in improving learning outcomes.

4. For Students: Students are expected to be able to take advantage of technology-based learning with a positive and responsible attitude, as well as continue to increase cooperation and competitive spirit in every Physical Education learning activity.

This study shows that innovations in technology-based and collaborative learning models are able to improve the quality of the process and student learning outcomes in floor gymnastics learning. Therefore, the application of learning models that are adaptive to technological developments and student characteristics is an important key in creating effective, interesting, and meaningful Physical Education learning in elementary schools.

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