



## A mixed methods analysis of needs for developing elementary students' manipulative motor skills

*Análisis de necesidades para el desarrollo de habilidades motoras manipulativas en estudiantes de primaria mediante métodos mixtos*

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### Abstract

**Introduction:** Manipulative motor skills are an important aspect of the motor development of elementary school-aged children.

**Objective:** This study aims to analyze differences in manipulative motor skills between male and female students and identify factors influencing these differences.

**Methodology:** This study used an explanatory sequential design. A total of 27 sixth-grade elementary school students participated. The instruments used were the Test of Gross Motor Development-2 and semi-structured interviews. Quantitative analysis was conducted using an independent two-sample t-test, while qualitative data were analyzed thematically.

**Results:** Male students had significantly higher manipulative skill scores than female students. The qualitative analysis identified three main themes: (1) male students had a higher frequency of practice and interest in ball games; (2) female students experienced physical barriers and less supportive activity preferences; (3) female students demonstrated a more dominant perception of movement difficulties.

**Discussion:** The importance of differentiated learning that takes into account differences in gender, interests, and physical barriers in students. Teachers need to provide support and equitable opportunities so that every student, both boys and girls, can develop their manipulative movement skills optimally and inclusively.

**Conclusions:** Gender influences students' manipulative skills. Developing a physical education learning model based on group and differentiated games is necessary to reasonably and effectively accommodate the differences in movement modalities and the potential of each student.

### Keywords

Manipulative motor skills; gender differences; differentiated learning; elementary school students; motor development.

### Resumen

**Introducción:** Las habilidades motoras manipulativas son un aspecto importante del desarrollo motor en niños y niñas de edad escolar primaria.

**Objetivo:** Este estudio tiene como objetivo analizar las diferencias en las habilidades motoras manipulativas entre estudiantes varones y mujeres, e identificar los factores que influyen en dichas diferencias.

**Metodología:** Se utilizó un diseño secuencial explicativo. Participaron un total de 27 estudiantes de sexto grado de primaria. Los instrumentos utilizados fueron el *Test of Gross Motor Development-2* y entrevistas semiestructuradas. El análisis cuantitativo se realizó mediante una prueba t para muestras independientes, mientras que los datos cualitativos fueron analizados temáticamente.

**Resultados:** Los estudiantes varones obtuvieron puntuaciones significativamente más altas en habilidades manipulativas que las estudiantes mujeres. El análisis cualitativo identificó tres temas principales: (1) los varones tenían una mayor frecuencia de práctica e interés en juegos con balón; (2) las niñas experimentaban barreras físicas y preferencias de actividad menos favorables; (3) las niñas demostraron una percepción más dominante de dificultad en el movimiento.

**Discusión:** Se destaca la importancia de un aprendizaje diferenciado que tenga en cuenta las diferencias de género, intereses y barreras físicas en el alumnado. Es necesario que los docentes brinden apoyo y oportunidades equitativas para que todos los estudiantes, tanto niñas como niños, puedan desarrollar sus habilidades de movimiento manipulativo de manera óptima e inclusiva.

**Conclusiones:** El género influye en las habilidades manipulativas del alumnado. Es necesario desarrollar un modelo de enseñanza en educación física basado en juegos grupales y diferenciados que permita atender de manera justa y eficaz las distintas modalidades de movimiento y el potencial individual de cada estudiante.

### Palabras clave

Habilidades motoras manipulativas; diferencias de género; aprendizaje diferenciado; estudiantes de educación primaria; desarrollo motor.

## Introduction

Manipulative motor skills are part of gross motor skills that involve controlling objects using the hands, feet, or other tools. These movements include activities such as throwing, catching, kicking, hitting, dribbling, and bouncing a ball (Abusleme-Allimant et al., 2023; Anggara et al., 2024; Sutapa et al., 2021; Webster et al., 2019). These skills are crucial in supporting children's physical abilities, particularly in sports and structured play (Dewi & Verawati, 2021; Friskawati et al., 2023; Huggett & Howells, 2024). During elementary school, students are in a phase of rapid motor development. They begin to demonstrate better body coordination and can perform more complex movements. Children at this age also begin to develop the ability to regulate force, direction, and precision in moving objects. The significance of manipulative motor skills is enormous in the context of elementary education. In addition to supporting physical abilities and health, including cardiovascular endurance, upper-body muscle strength and endurance, and flexibility (Chen, Mason, Hammond-Bennett, et al., 2016), these skills also contribute to cognitive and social development. Children who master manipulative skills will be more confident in participating in physical activities, engaging in fair play, making moral decisions, and developing physical self-efficacy (Russo et al., 2025). Therefore, physical education teachers need to provide varied, enjoyable, and developmentally appropriate learning for students.

Problems with manipulative motor skills in elementary school students are quite common and affect their motor development and participation in physical activities. Manipulative motor skills involve the ability to control and move objects, such as throwing, catching, kicking, dribbling, or hitting a ball (Goodway et al., 2019; Koolwijk et al., 2024). However, not all students have the opportunity or ability to master these skills. For example, in China, Chen et al. (2021) demonstrated that the basic manipulative skills competency in soccer and basketball of elementary school students in China needs improvement. In Indonesia, Gumilar et al. (2023) found that kicking emerged as the most developed skill, while throwing was identified as the least proficient. Similarly, Satrianingsih (2024) successfully demonstrated that the majority of elementary school students possess adequate manipulative skills, but kicking requires attention because the percentage of the poor category is the highest. Students with poor manipulative movement skills, such as catching, throwing, kicking, or dribbling the ball, and other manipulative movements in physical activities, can experience several negative impacts. The inability to move manipulatively makes students less likely to participate in physical activities and group games, which ultimately can hinder the development of hand-eye coordination, gross and fine motor control, and body balance (Cohen et al., 2014; Wick et al., 2017; Yang et al., 2025).

Several previous studies have explored students' manipulative motor skills based on gender. A study by Moreno-Briseño et al. (2010) showed that "throwing accuracy" is one manipulative skill in which boys generally excel compared to girls. A meta-analysis by Zheng et al. (2022) also found that (for children aged 3-6 years) boys tend to be more proficient in object control skills, a component of manipulative motor skills, than girls. In Indonesia, a study by Irwandi et al. (2023) also found that boys scored higher than girls on basic manipulative motor skills after the COVID-19 pandemic. Although boys often excel in manipulative tasks, gender differences in locomotor movements (running, jumping, etc.) are often minor or sometimes insignificant, and sometimes girls even perform better on some balance tasks (Zheng et al., 2022). Several studies show that although boys are generally superior in manipulative skills, many female students also fall into the "sufficient" or "moderate" categories (Irwandi et al., 2023). Limitations of previous studies on manipulative motor skills by gender include a limited age range (e.g., only children aged 3-6), a narrow skill focus, such as examining throwing accuracy, and a failure to consider social, cultural, and environmental factors that may influence the results. Notably, studies in Indonesia, such as those by Irwandi et al. (2023), only covered specific regions and were influenced by the post-pandemic context, thus limiting the generalizability of the results. Many studies have also not thoroughly examined the causes of gender differences in manipulative skills and have not included qualitative data.

The novelty of the research to be conducted lies in the focus on comparing manipulative motor skills between male and female students at the elementary school level. So far, most studies have only focused on improving manipulative skills in general without differentiating based on specific gender. According to Magill's (2011) motor learning theory, the motor learning process is influenced by various factors, including individual characteristics, previous experiences, and learning environment conditions. In this context, gender has the potential to influence children's motor development, both in terms of physical

strength, coordination, and experience in play or sports activities (Biino et al., 2023, 2025; Mülazımoğlu Ballı, 2024). This study aims to fill this gap by providing an in-depth comparative analysis of male and female students' mastery of skills such as the two-hand strike, stationary bounce, catch, kick, and overhead throw. By using a descriptive quantitative approach and instruments in accordance with the principles of gross motor development, followed by a qualitative review, this study is expected to provide a more specific picture of the pattern of manipulative movement mastery based on gender and the factors that underlie it. The findings of this study will not only enrich the scientific literature in the field of physical education but also serve as a basis for designing learning approaches that are more equitable and responsive to the needs of both male and female students. Thus, this study aims to examine gender differences in students' manipulative movement skills explicitly and to explore the factors influencing these differences, which have rarely been the primary focus of previous research.

## Method

This study employed a mixed-methods explanatory sequential design approach. Creswell and Creswell (2018) explain that this design begins with quantitative data collection and analysis, followed by qualitative data collection and analysis to deepen understanding of the quantitative findings. The explanatory sequential research design in this study was implemented in accordance with the six procedural steps formulated by Ivankova et al. (2006): first, quantitative data collection, second, quantitative data analysis, third, connecting the quantitative and qualitative phases, fourth, qualitative data collection, fifth, qualitative data analysis, and finally, integration of the quantitative and qualitative results.

### Quantitative data collection

Researchers collected manipulative motor skills data from 27 sixth-grade students at State Elementary School 57, Banda Aceh, Aceh Province, Indonesia. They consisted of 14 boys ( $M \pm SD$  age =  $11.6 \pm 0.6$ ) and 13 girls ( $M \pm SD$  age =  $11.6 \pm 0.7$ ). The sample was determined using a simple convenience sampling technique, which selects representative sample elements with the main selection criteria related to the ease of obtaining the sample (Mahardika et al., 2024; Schober et al., 2018). In the implementation of the pilot study, the sample was determined using a simple convenience sampling technique, which selects respondents based on ease of access and availability. This technique was chosen because in the preliminary study stage (pilot study), the main objective is not to generalize, but rather to identify research problems for further research design development.

The inclusion criteria in this study were established to ensure that the samples involved had characteristics appropriate to the research objectives, particularly in the context of measuring manipulative motor skills. First, the samples that could be included were children within the relevant developmental age range, namely 10-13 years. Second, the samples must be registered as active students at the elementary school where the study was conducted, so that the learning environment and physical activity experiences of the participants were relatively uniform. Participants were also required to have no history of physical or neurological disorders that could affect motor abilities, such as muscle disorders, paralysis, or body coordination disorders. Third, participants must be able to perform basic physical activities without assistance, such as throwing, catching, or kicking a ball toward a target. They also need to be able to follow instructions or directions given during the motor skills test, to ensure a smooth data collection process. Finally, participants are required to obtain permission from their parents or guardians to participate in the study, as a form of fulfilling the ethical principles of research on children. Before data collection is carried out, researchers explain the purpose, procedures, and participants' rights to participate voluntarily. Participants (with parental consent) are also given full rights to refuse or discontinue participation without any consequences.

Manipulative motor skills data were collected using the Test of Gross Motor Development-2 (TGMD-2) developed by Ulrich (1985). We focused on only five manipulative motor skills. First, the two-hand strike, with four performance criteria, including "*Hip and spine rotation*." Second, the stationary bounce with three performance criteria, including "*Ball contacts the floor in front of (or to the outside of) the foot on the side of the hand being used*." Third, the catch with four performance criteria, including "*Forward swing of the arm opposite the kicking leg*." Fourth, the kick with four performance criteria, including "*The trunk is inclined backward during ball contact*." Fifth, the overhead throw with four performance criteria,

including "Following-through beyond the ball release diagonally across the body toward the side opposite the throwing arm." Each student was allowed to perform the movement experiment twice, receiving a score for each performance criterion, with the highest score being 1 and the lowest 0. Thus, each indicator or performance criterion received a score of 2 if the student successfully met the performance criteria, otherwise 0 if it was not met.

### Quantitative data analysis

Data analysis was conducted in two stages. First, descriptive analysis was used to describe the profile of students' manipulative motor skills, including the mean, standard deviation, minimum, and maximum scores. Second, to test whether there were significant differences between male and female students' manipulative skills, a two-group independent test was used.

Table 1. Tests of normality and homogeneity

		Kolmogorov-Smirnov <sup>a</sup>		Shapiro-Wilk		Test of homogeneity	
		Statistic	Sig.	Statistic	Sig.	Levene	Sig.
Manipulative motor skills	Male	0.169	0.200*	0.927	0.307	2.793	0.108
	Female	0.144	0.200*	0.980	0.981		

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

a. Lilliefors Significance Correction

Before statistical testing was conducted, the data were tested for normality using the Shapiro-Wilk test. Where the data were normally distributed and the assumption of homogeneity of variance was met through the Levene test (sig. >0.05) (see Table 1), both for the manipulative motor skills variable, the independent samples t-test was used. This analysis technique was chosen to identify whether there were statistically significant differences in manipulative motor skills between male and female students. If the significance value was smaller than alpha (<0.05), then there were significant differences in manipulative motor skills between male and female students, and vice versa. The data collection and analysis process used the assistance of Google Forms, Microsoft Excel, and SPSS version 29.

### Connecting quantitative and qualitative phases

After the quantitative data analysis was completed, this research entered the connecting phase, which connects the quantitative and qualitative phases in an explanatory sequential mixed methods design. The purpose of this phase is to bridge the quantitative findings with the qualitative data collection process so that both phases complement each other and form a more comprehensive understanding of the research problem.

Based on the results of the quantitative analysis using the Test of Gross Motor Development-2 (TGMD-2) instrument, differences in manipulative motor skill scores were found between male and female students. This finding served as the basis for designing the qualitative phase. The researchers then purposively selected interview participants, selecting several students with high and low scores from each gender group.

The quantitative results were also used as the basis for developing an interview guide. Questions were designed to delve deeper into factors that may influence students' manipulative skills, such as play experience, parental support, participation in sports activities, and students' perceptions of physical activity. Thus, the qualitative data obtained in the subsequent phase can provide a more comprehensive explanation of the previously obtained quantitative findings.

### Qualitative data collection

This phase aimed to delve deeper into the factors underlying the quantitative findings, particularly those related to differences in manipulative skills between male and female students. The qualitative data collection technique used in this study was semi-structured interviews. The interview guide was developed based on the quantitative findings and focused on exploring students' experiences, habits, and perceptions regarding motor activities, both in and outside of school.

Six interview participants were purposively selected from the quantitative analysis, considering the diversity of manipulative skill scores, both high and low, as well as gender representation. The number of



six participants was based on the principle of data saturation. The interview process was carried out until the information obtained from the participants began to be repetitive and no longer yielded significant new findings. In this way, the researcher ensured that the data collected was sufficiently rich and representative to describe the phenomenon under study, without having to increase the number of participants excessively.

There were three males: MSAF (male/12 years old), MAH (male/12 years old), and MA (male/12 years old). The three females were: ANL (female/11 years old), MJ (female/13 years old), ZGM (female/12 years old), and ZAI (female/12 years old). It was done so that the qualitative data obtained could provide a more comprehensive explanation of the variations emerging in the quantitative data. Interviews were conducted in person using a flexible approach, while still referring to a predetermined list of questions. Here are some sample interview questions: First, do you enjoy learning sports (physical education) like throwing, kicking, or catching a ball? Why? Please tell us. Second, which movements do you find easiest and which are most difficult? For example: throwing a ball overhead, kicking, or hitting a ball. Can you explain why? Third, when you are learning these movements in physical education class, what does the teacher usually do to help you? Fourth, have you ever felt confused or struggled when having to perform a particular movement? What do you usually do when that happens? Fifth, do you think learning movements like kicking or catching a ball is important? Why are they important or not important?

During the interviews, the researcher also noted non-verbal expressions and responses deemed relevant to strengthen data interpretation. All interviews were recorded and transcribed for further analysis using a thematic approach.

### ***Qualitative data analysis***

The qualitative data analysis in this study was conducted using a thematic analysis approach based on six systematic stages adapted from Naeem et al. (2023). This approach was chosen because it is able to provide a clear structure and allows researchers to develop a conceptual model based on empirical data obtained from interviews with the help of the N-Vivo15 application.

The first stage was transcription, familiarization with the data, and selection of quotations, where all interview data was transcribed verbatim. The researcher read the transcripts thoroughly to gain a deeper understanding of the content and began to identify important quotations related to the research focus. The second stage was keyword selection, where the researcher identified important terms or phrases that frequently appeared or were deemed relevant to students' manipulative skills. These keywords formed the basis for the coding process. The third stage was coding meaningful data fragments. Data fragments with similar meanings were assigned code labels that reflected the substance of their content.

The fourth stage was theme development, where similar codes were grouped into initial themes. These themes were then analyzed in more depth to identify the connections, differences, and patterns that emerged among participants. Next, in the fifth stage, conceptualization through the interpretation of keywords, codes, and themes, the researcher interprets how the relationships between themes and codes shape an understanding of the phenomenon being studied, in this case, the factors influencing students' manipulative motor skills. The final stage involves developing the conceptual model, which formulates a comprehensive overview of the thematic analysis results as relationships between themes. This model then serves as a framework for understanding the main findings of the research.

Through this approach, qualitative data analysis not only produces descriptive themes but also builds a deeper theoretical understanding of the phenomenon being studied.

### ***Integration of the quantitative and qualitative results***

The integration of quantitative and qualitative results in this study was conducted to gain a more comprehensive understanding of elementary school students' manipulative motor skills. This approach aligns with an explanatory sequential mixed-methods design, where qualitative data is used to explain, expand, or deepen quantitative findings.

Quantitative results obtained through measurements using the Test of Gross Motor Development-2 (TGMD-2) indicated differences in manipulative skill scores between male and female students. Male

students' average scores tended to be higher than female students'. This finding suggests possible differences in experiences, habits, or environmental support in motor skill development.

To further understand these findings, qualitative data were obtained through interviews with some male and female students from the high and low-scoring groups. These interviews revealed that male students generally have more opportunities for active outdoor play, involvement in sports, and greater support from their environment (such as parents and peers) for physical activity. Conversely, some female students reported having less access to activities involving manipulative motor skills or feeling less confident in doing them.

The integration of these two results suggests that differences in scores between groups are influenced not only by biological or gender factors, but also by social, environmental, and psychological influences that shape children's motor experiences. Thus, the qualitative data successfully provides context and explanation that enrich the interpretation of the quantitative results.

## Results

### Quantitative results

This study analyzed student performance based on several technical criteria for manipulative motor skills, such as the two-hand strike, stationary bounce, catch, kick, and overhand throw. Data are presented as the frequency of achievement per level (0 = not achieved, 1 = partially achieved, 2 = fully achieved in both treatments) and the average score for each group.

First, regarding the two-hand strike skill indicator, based on the performance criterion "dominant hand grips bat above non-dominant hand," all participants in the second group (100%) demonstrated correct technique (score 2.0). In contrast, in the first group, only 92.9% demonstrated perfect technique, with the remainder at an average level (7.1%). The average score for the second group was higher (2.0) than that of the first group (1.9) (see Table 2).

Second, regarding the stationary bounce movement skill indicator in the performance criterion "pushes ball with fingers (not a slap)," the first group demonstrated better achievement with  $M \pm SD = 1.4 \pm 0.8$  compared to the second group, which only achieved  $M \pm SD = 0.4 \pm 0.7$ . It indicates that most students in the first group were more capable of performing this technique correctly (see Table 2).

Third, regarding the catch movement skill indicator in the performance criterion "elbows bend to absorb force," the first group's average score was  $M \pm SD = 1.9 \pm 0.3$ . Meanwhile, the second group's score was lower, with  $M \pm SD = 1.6 \pm 0.7$ . It indicates that the first group was more consistent in using force absorption techniques when catching the ball (see Table 2).

Fourth, regarding the kick movement skill indicator in the performance criterion "forward swing of the arm opposite the kicking leg," there was a striking difference between the two groups. The first group ( $M \pm SD = 0.9 \pm 0.9$ ) had better technique than the second group ( $M \pm SD = 0.5 \pm 0.7$ ). The performance criteria for the "rapid continuous approach" also showed a difference, with the first group achieving  $M \pm SD = 0.8 \pm 0.6$  compared to the second group, which only achieved  $M \pm SD = 1.2 \pm 0.6$  (see Table 2).

Last, regarding the overhand throw skill indicator, interestingly, on the performance criteria for "weight is transferred by stepping with the foot opposite the throwing hand," the second group showed a higher average score of  $M \pm SD = 1.5 \pm 0.8$  compared to the first group ( $M \pm SD = 0.8 \pm 0.8$ ), indicating that the second group performed a better weight transfer technique during throwing. However, on the performance criteria for "follow-through," both groups scored low, with the second group scoring 0.0, indicating that no students performed this technique flawlessly (see Table 2).

Table 2. Description of students' manipulative motor skills

No	Manipulative motor skills (and performance criteria)	Value (male, n=14)				Value (female, n=13)			
		0	1	2	M $\pm$ SD	0	1	2	M $\pm$ SD
1	Two-hand strike								
	a. Dominate hand grips bat above nondominant hand	1 (7.1%)	0 (0%)	13 (92.9%)	1.9 $\pm$ 0.5	0 (0%)	0 (0%)	13 (100%)	2.0 $\pm$ 0.0

2	b. Nondominant side of body faces the tosser (feet parallel)	0 (0%)	0 (0%)	14 (100%)	2.0±0.0	0 (0%)	0 (0%)	13 (100%)	2.0±0.0
	c. Hip and spine rotation	5 (35.7%)	1 (7.1%)	8 (57.1%)	1.2±1.0	9 (69.2%)	2 (15.4%)	2 (15.4%)	0.5±0.8
	d. Weight is transferred by stepping with front foot	6 (42.9%)	0 (0%)	8 (57.1%)	1.1±1.0	9 (69.2%)	3 (23.1%)	1 (7.7%)	0.4±0.7
	Stationary bounce								
3	a. Contact ball with one hand at about hip height	4 (28.6%)	2 (14.3%)	8 (57.1%)	1.3±0.9	3 (23.1%)	6 (46.2%)	4 (30.8%)	1.1±0.8
	b. Pushes ball with fingers (not a slap)	3 (21.4%)	3 (21.4%)	8 (57.1%)	1.4±0.8	9 (69.2%)	3 (23.1%)	1 (7.7%)	0.4±0.7
	c. Ball contacts floor in front of (or to the outside of) foot on the side of the hand being used	3 (21.4%)	2 (14.3%)	9 (64.3%)	1.4±0.9	7 (53.8%)	3 (23.1%)	3 (23.1%)	0.7±0.9
	Catch								
4	a. Preparation phase where elbows are flexed and hands are in front of body	0 (0%)	3 (21.4%)	11 (78.6%)	1.8±0.4	1 (7.7%)	2 (15.4%)	10 (76.9%)	1.7±0.6
	b. Arms extend in preparation for ball contact	0 (0%)	1 (7.1%)	13 (92.9%)	1.9±0.3	1 (7.7%)	3 (23.1%)	9 (69.2%)	1.6±0.7
	c. Ball is caught and controlled by hands only	0 (0%)	2 (14.3%)	12 (85.7%)	1.9±0.4	0 (0%)	3 (32.1%)	10 (76.9%)	1.8±0.4
	d. Elbows bend to absorb force	0 (0%)	1 (7.1%)	13 (92.9%)	1.9±0.3	1 (7.7%)	3 (23.1%)	9 (69.2%)	1.6±0.7
5	Kick								
	a. Rapid continuous approach to the ball	0 (0%)	3 (21.4%)	11 (78.6%)	1.8±0.4	1 (7.7%)	8 (61.5%)	4 (30.8%)	1.2±0.6
	b. The trunk is inclined backward during ball contact	5 (35.7%)	5 (35.7%)	4 (28.6%)	0.9±0.8	5 (38.5%)	5 (38.5%)	3 (23.1%)	0.8±0.8
	c. Forward swing of the arm opposite kicking leg	6 (42.9%)	4 (28.6%)	4 (28.6%)	0.9±0.9	8 (61.5%)	4 (30.8%)	1 (7.7%)	0.5±0.7
5	d. Following-through by hopping on nonkicking foot	7 (50.0%)	3 (21.4%)	4 (28.6%)	0.8±0.9	6 (46.2%)	5 (38.5%)	2 (15.4%)	0.7±0.8
	Overhead throw								
	a. A downward arc of the throwing arm initiates the windup	0 (0%)	3 (21.4%)	11 (78.6%)	1.8±0.4	0 (0%)	3 (23.1%)	10 (76.9%)	1.8±0.4
	b. Rotation of hip and shoulder to a point where the nondominant side faces an imaginary target	4 (28.6%)	3 (21.4%)	7 (50.0%)	1.2±0.9	4 (30.8%)	5 (38.5%)	4 (30.8%)	1.0±0.8
5	c. Weight is transferred by stepping with the foot opposite the throwing hand	6 (42.9%)	5 (35.7%)	3 (21.4%)	0.8±0.8	2 (15.4%)	2 (15.4%)	9 (69.2%)	1.5±0.8
	d. Following-through beyond ball release diagonally across body toward side opposite throwing arm	13 (92.9%)	1 (7.1%)	0 (0%)	0.1±0.3	13 (100%)	0 (0%)	0 (0%)	0.0±0.0

An independent samples t-test was then conducted to determine differences in manipulative movement skills between the two groups of students based on each skill item in the TGMD test. The analysis revealed significant differences in several indicators.

For the two-hand strike skill, the mean score for the first group (males) was 6.2 (SD = 1.7), higher than the mean score for the second group (females), which was 4.8 (SD = 1.3). The t-value was 2.372, and the p-value was 0.026 (<0.05), indicating a significant difference. Similar results were found for the stationary bounce skill indicator (t = 2.434; p = 0.022) and the kick skill indicator (t = 2.078; p = 0.048), each of which showed significant differences between the groups.

Conversely, the catch and overhead throw skill indicators did not show significant differences between the two groups. The p-value for the catch skill indicator was 0.174, and for the overhead throw skill indicator was 0.436, both >0.05 (see Table 3).

Overall, the total manipulative skill scores showed a significant difference between the groups, with a t-value of 3.470 and a p-value of 0.002 (<0.05). It indicates a significant difference in general manipulative skill ability between the two groups tested.

Table 3. Results of independent samples t-test of manipulative motor skills

No	Manipulative motor skills	Group statistics (M±SD)		Independent samples t-test		Decision
		Male (n=14)	Female (n=13)	t-value	Two sided p	
1	Two-hand strike	6.2±1.7	4.8±1.3	2.372	0.026 (<0.05)	Significant
2	Stationary bounce	4.1±2.3	2.2±1.7	2.434	0.022 (<0.05)	Significant
3	Catch	7.5±1.1	6.7±1.8	1.398	0.174 (>0.05)	Not significant
4	Kick	4.4±1.5	3.2±1.3	2.078	0.048 (<0.05)	Significant
5	Overhead throw	3.9±1.6	4.3±1.3	-0.792	0.436 (>0.05)	Not significant

Total	26.0±3.9	21.2±3.2	3.470	0.002 (<0.05)	Significant
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## Qualitative results

Based on the analysis of interviews with male and female students, several factors can explain why male students have better manipulative motor skills than female students, as indicated by the previous quantitative results. The explanations can be broken down as follows:

### Higher Frequency and Interest in Ball Games (Males)

Male students often use their time outside of class to play soccer, either with friends or family members. This activity provides a highly beneficial form of additional exercise, as it helps them practice and strengthen motor skills such as kicking, catching, and throwing. It significantly impacts their TGMD scores, particularly in manipulative skills like kicking and two-hand strikes. These physical activities and experiences also foster teamwork, improve physical fitness, and foster a spirit of sportsmanship from an early age.

For example, MSAF (male, 12 years old), stated that he really enjoys activities like throwing, kicking, and catching the ball because he can run around while playing and interacting with his friends. He also mentioned his love for soccer and other games like baseball, as well as his habit of playing soccer outside of school with his friends.

Similarly, another student, MAH (male, 12 years old), also stated that he enjoys physical activities because they are exciting and fun, especially when done with friends. He emphasized that games like soccer allow freedom of movement and provide a fun experience. MAH (male, 12 years old) also admitted to frequently playing soccer outside of school. For more details, see the reference code below.

"I really enjoy movements like throwing, kicking, and catching a ball, because I can run around chasing and kicking the ball with my friends. I really enjoy games, especially soccer. I often play soccer with my friends outside of school. I also enjoy throwing and catching games like baseball." (MSAF/male/12 years old).

"I like it because the movements are fun and exciting to do with friends. You can move freely, and it is really fun. I prefer playing soccer, and I also play soccer often outside of school." (MAH/male/12 years old).

"I really enjoy physical education because it is so much fun. Movements like throwing, kicking, and catching a ball are often done with my younger siblings at home. Activities like throwing, kicking, and catching a ball improve your health, promote teamwork, and are fun to do with friends." (MA/male/12 years old).

Based on the interview results above, it is clear that male students show a high level of interest in physical activity, particularly games involving gross motor skills such as throwing, catching, kicking, and running. Both students explicitly stated that they really enjoy playing ball games, especially soccer, both at school and outside of school hours. From these two statements, it can be concluded that physical activity involving games, especially ball games, is a form of activity that students at this age highly seek.

Besides providing physical enjoyment, these games also play a vital role in fostering social interaction among peers. The sense of togetherness and a pleasant atmosphere are key motivators for participating in physical activities. It demonstrates that in physical education learning, it is crucial to include activities that incorporate elements of group play, are fun, and encourage freedom of movement to align with the interests and developmental needs of children their age.

### Physical Preferences and Barriers in Female Students

Unlike male students, female students tend to prefer movements that do not involve hard contact or excessive force, such as throwing and catching. For example, ZGM (female/12 years old) explained that she does not like kicking a ball because it hurts her feet. It suggests a physical barrier and negative perceptions of certain manipulative movements, which can lower the quality of their performance in the TGMD assessment. Consider the female students' views or opinions about whether learning movements like kicking or catching a ball is important.



"Both are important. To play soccer, you must master the kicking motion. Kicking practice also strengthens your leg muscles. However, I do not particularly enjoy kicking. I really enjoy catching the ball. We often practice throwing and catching with our friends during recess or when the teacher is absent. Throwing and catching exercises can improve arm strength. It also helps develop teamwork and self-confidence." (ZGM/female/12 years old).

"It does not really matter, because we can still play in other ways even if we cannot kick or catch the ball." (ZAI/female/12 years old).

According to ZGM (female/12 years old), both movements are equally important. She explained that in soccer, kicking skills are a fundamental skill that must be mastered. Kicking exercises can also strengthen leg muscles. However, ZGM (female/12 years old) admitted that she does not enjoy kicking. She is more interested in catching the ball, especially in the throwing and catching activities she often does with her friends at school, both during recess and when the teacher is not in class. For her, throwing and catching exercises not only build arm strength but also foster self-confidence and the ability to work together in a group.

Unlike ZGM, ZAI (female, 12 years old) has a simpler view. She believes that kicking and catching a ball are not particularly important. She believes that playing can still be done in various ways, even if someone is unable to perform both movements. For her, the enjoyment of playing does not always depend on a particular technique. This difference of opinion shows that each child has a unique perspective on sports activities. Some emphasize the importance of technique and physical benefits, while others emphasize flexibility and the enjoyment of playing.

#### Perception of Movement Difficulties in Female Students

Some female students expressed that movements such as hitting and kicking a ball felt more challenging than those of male students. They often experienced difficulty performing them and tended to ask more questions to understand the correct technique. The resulting confusion and lack of confidence can affect the fluency of performing motor skills during the test, thus impacting the overall movement evaluation results. When asked if they had ever experienced feeling confused or struggling when having to perform certain movements, what did they usually do when this happened? Students' answers are as shown in the reference code below.

"Once, when we felt confused, we asked the teacher to explain it again so that we understood the correct way." (ANL/female/11 years old).

"I once felt confused, but chose to try asking the teacher about the movements that were difficult to do, and the teacher provided an understanding of the complicated movements so that they would be easier to do." (MJ/female/13 years old).

"I have tried again and again until I can do it. If I am still having trouble, I ask a friend for help. If I am still having trouble, I ask a teacher for help." (ZGM/female/12 years old).

"Sometimes I get confused when a movement is complex. If that happens, I usually watch a friend first, or ask a teacher, then I try again slowly until I get it." (ZAI/female/12 years old).

Female students shared their experiences when they encountered difficulties performing specific movements during physical education. ANL (female, 11 years old) admitted to feeling confused and usually immediately asking the teacher for further explanation. MJ (female, 13 years old) shared a similar sentiment, stating that when she encountered difficulties, she preferred to ask the teacher to gain a better understanding of the complex movements.

ZGM (female, 12 years old) demonstrated a slightly different approach. She tried to do it herself first. If she still had difficulty, she would ask a friend for help, and if that still did not work, then she would ask the teacher for help. Meanwhile, ZAI (female, 12 years old) admitted that she usually felt confused when a movement was complex. In such situations, she preferred to observe a friend first, then ask the teacher, and then try again slowly until she succeeded.

These responses reflect a typical learning approach pattern found among most female students: being more cautious, relying on help from others (teacher or friends), and tending to choose a gradual process in understanding the movements. This pattern may be one reason why female students' manipulative

motor skills are often lower than those of male students. Social factors such as gender norms, shyness, or a lack of confidence in trying new movements also influence their active participation in physical activity. It highlights the importance of learning approaches that support female students' courage and independence in developing their motor skills.

#### Teacher Motivation and Role are the Same, but Responses are Different

The teacher's role in learning is to ensure that students can express their physical experiences energetically, including ensuring that students receive educational services and motivation to learn. Both male and female students stated that teachers often demonstrate movements first, but male students appear more confident and exploratory in trying them themselves. In contrast, female students rely more on teachers or peers when experiencing difficulties. It can affect the speed at which they master new skills. More details can be found in the following reference code:

"The teacher usually gives an example first on how to do it, then we do it after the teacher explains it. The teacher constantly monitors what we do so that if there are any incorrect movements, they can immediately correct them." (MSAF/male/12 years old).

"The teacher provides examples before performing movements, such as serving and smashing in volleyball. Afterward, if the movement is incorrect, the teacher corrects it." (MAH/male/12 years old).

"The teacher provides more guidance in carrying out movements by giving examples, then trying to do it. If the movement is not correct, the teacher corrects it so that the movement becomes correct." (MJ/female/12 years old).

"Usually, the gym teacher demonstrates the movements first, then tells us to do what they demonstrated. If we make a mistake, the teacher usually corrects it or shows us the correct method." (ZAI/female/12 years old).

The results of the interviews conducted in this study align with the quantitative data obtained. It was found that male students have better manipulative motor skills than female students. It is due to several main factors. First, male students tend to have more practice and experience outside of class, particularly through soccer activities that involve various manipulative movements. Furthermore, their interest in ball games is also higher, so they are more motivated to practice and hone these skills. Another contributing factor is male students' greater confidence in performing manipulative movements, allowing them to be more daring and free to explore. Conversely, male students face fewer physical and psychological barriers in engaging in these activities.

Conversely, female students tend to experience several challenges that limit their mastery of manipulative motor skills. They often perceive manipulative activities as challenging, feel physically uncomfortable when performing certain movements, and have less exposure to competitive or physically demanding games. These conditions result in the development of manipulative motor skills in female students being more limited than in male students. Thus, the differences in these factors explain why the manipulative skills between male and female students show significant differences.

## Discussion

The results of this study indicate a significant difference in manipulative motor skills between male and female students at the elementary school level. Quantitative analysis revealed that the total score of male students' manipulative motor skills was higher than that of female students ( $t = 3.470$ ,  $p = 0.002$ ), confirming that gender is a variable that influences overall manipulative skill mastery. This finding is consistent with Magill's (2011) motor learning theory, which states that individual characteristics, previous experiences, and learning environment conditions influence the motor learning process. In this case, gender differences can affect children's motor development through factors such as physical strength, coordination, and experience in play or sports (Biino et al., 2023, 2025; Mülazımoğlu Ballı, 2024). Although the overall difference was significant, a more detailed analysis showed that female students had slightly higher scores on the overhead throw skill indicator ( $M \pm SD = 4.3 \pm 1.3$ ). It indicates that gender differences are not absolute in all aspects of manipulative skills, but can be specific to certain types of movement.

These findings align with various previous studies. Moreno-Briseño et al. (2010) showed that throwing accuracy, a form of manipulative skill, is generally better in boys. Similarly, Zheng et al. (2022) in their meta-analysis showed that boys aged 3–6 years are more proficient in object control skills, which include skills such as throwing, catching, and kicking a ball, all of which fall under the manipulative movement category. In the national context (Indonesia), Irwandi et al. (2023) also found that after the COVID-19 pandemic, male students had higher scores on basic manipulative skills than female students. These studies reinforce the finding that boys tend to be more active and skilled in physical activities involving object manipulation. One reason is boys' higher exposure to ball games, both in and out of school.

However, what is interesting about this study is that in one skill indicator, namely the overhead throw, female students actually recorded a higher average score ( $M \pm SD = 4.3 \pm 1.3 > 3.9 \pm 1.6$ ), although it was not statistically significant. This finding provides an important nuance in looking at gender differences, that not all aspects of manipulative skills are mastered better by males. Chen, Mason, Hypnar, et al. (2016) support this by showing that female students can experience significant improvements in overhead throw and soccer skills when given appropriate training. This fact indicates that women have potential that can be developed in the area of manipulative skills, depending on the training context, environmental support, and personal motivation. In this context, differences in performance are not solely due to biological factors, but also social and environmental factors.

Qualitative findings support the quantitative results and provide deeper insights into the causes of these differences. First, male students tend to have a higher frequency of practice and interest in ball games, which strengthens their manipulative motor skills, which is also in line with the findings of Field and Temple (2017) and He et al. (2024), who proved that higher participation intensity in certain sports activities leads to better motor skills than those who do not. Second, female students face physical barriers and activity preferences that limit their opportunities to practice manipulative skills optimally (Zheng et al., 2022), so they require additional instruction to improve their manipulative motor skills (Robinson et al., 2017). Third, the perception of movement difficulties that are more dominant in female students affects their motivation and confidence in performing manipulative activities, which is in line with the findings of Clark et al. (2018) that girls are more likely to underestimate their object/ball abilities than boys. Based on these findings, the differences in manipulative motor skills between male and female students are not only related to biological factors, such as strength and coordination, but are also influenced by psychosocial factors, interests, and training experience.

Not only that, this study is supported by the study of Dinkel and Snyder (2020), which showed that boys had higher scores in manipulative intensity, indicating more active and enthusiastic involvement in physical activities involving object control. However, on the other hand, Hurtado-Almonacid et al. (2024) found that both boys and girls showed low levels of physical activity overall, with over 55% of respondents falling into the very poor, poor, or low average categories. It indicates that the problem of low manipulative skills is not only related to gender, but also related to low participation in physical activity in general. Although many studies show male dominance in manipulative skills, this research also shows that girls can achieve good performance in certain indicators if given appropriate opportunities and learning approaches. In this regard, gender differences should not be viewed as absolute determinants, but rather as a reflection of the complexity of social, cultural, and educational factors at play.

Movement skills learning strategies in elementary schools should consider individual needs and gender differences, for example, by increasing practice opportunities for female students and providing activities that suit their interests and abilities. Physical education teachers can implement differentiated learning to address the diversity in students' abilities, interests, and learning styles, particularly in the context of manipulative movement skills. The rationale is that differentiated learning allows teachers to tailor teaching strategies based on students' dominant modalities and individual potential. In this context, teachers can map students based on their initial manipulative abilities, interests in movement types, and emotional responses to physical activity (Blegur & Hardiansyah, 2024; Langelan et al., 2024; Razali et al., 2024; Tomlinson, 2014).

By identifying that male students have better manipulative skills than female students, this study provides insight into factors that influence children's motor development based on gender, complementing previous studies (Dinkel & Snyder, 2020; Gidley Larson et al., 2007; Junaid & Fellowes, 2006; Zheng et al., 2022). These findings can provide a basis for teachers to design more inclusive and responsive learning methods that not only adapt to the average abilities of students but also consider the needs and

barriers experienced by female students. Furthermore, this research makes an important contribution to addressing the gender gap in manipulative movement skill mastery. By identifying the physical and psychological barriers and perceived difficulties experienced by female students, learning interventions can be directed at increasing motivation, confidence, and practice opportunities for female students. It will help create a more equitable learning environment and support optimal motor skill development for all students. The findings of this study are also relevant for developing more effective physical education policies, particularly in designing curricula and physical activities that are gender-appropriate for students. Thus, this research not only contributes to scientific knowledge but also offers practical implications for improving the quality of physical education at the elementary school level.

The results of this study have several practical applications that are very useful in the context of physical education learning in elementary schools. First, teachers can design more adaptive and gender-based learning programs, paying special attention to the development of female students' manipulative movement skills. For example, movement learning can focus on increasing self-confidence and reducing physical and psychological barriers experienced by female students, such as by providing a variety of fun and less competitive activities. Second, teachers can encourage increased participation of female students in physical activity through a motivating and inclusive approach by incorporating engaging ball games and adjusting the difficulty level to suit their abilities. It will help female students gain more experience so that their manipulative skills can develop optimally. Third, schools can develop physical education curricula that are more responsive to the different needs of male and female students (differentiated learning) by incorporating a variety of activities that stimulate balanced motor development. In addition, schools can also provide training for teachers on the importance of understanding gender differences in motor development and how to overcome barriers faced by students. By applying these steps, it is hoped that students' manipulative movement skills, especially female students, will significantly improve, thus supporting better physical and psychosocial development in the future. It will also help create a more inclusive and equitable learning environment for all students.

Future research offers ample opportunities to develop and deepen the understanding of students' manipulative motor skills based on gender. One important direction is to conduct intervention research focused on developing more effective and inclusive group game-based learning models and strategies, particularly for improving manipulative motor skills in female students. This research context could test various training methods, learning media, and psychological approaches designed to reduce the physical barriers and perceived difficulties experienced by female students. Future research could expand its scope by including other variables that influence the development of manipulative skills, such as social environmental factors, family support, and the role of technology in motor learning. A longitudinal approach could also be used to examine the continuous development of manipulative motor skills from elementary school to higher levels, thus identifying developmental patterns and long-term influencing factors. Consideration of different cultural and regional contexts will help to understand how sociocultural differences influence motor skill development and gender differences. It will provide a more comprehensive and relevant picture, both locally and globally. Finally, the use of technology such as digital movement measurement tools, interactive learning applications, and gamification in physical learning is also an interesting prospect for research, to increase motivation and effectiveness of manipulative movement skills training for all students without exception.

## Conclusions

This study demonstrated significant differences in manipulative movement skills between male and female elementary school students. Quantitative results showed that male students had significantly higher total manipulative skill scores than female students ( $t = 3.470$ ;  $p = 0.002$ ). It confirms that gender plays a significant role in influencing overall manipulative skill mastery. However, for specific indicators such as the overhead throw, female students actually showed slightly higher scores, although the difference was not significant. Qualitative findings from interviews enriched the understanding of the quantitative results by identifying three main factors explaining these differences. First, male students had a higher frequency of practice and interest in ball games, which directly supported the development of their manipulative skills. Second, female students experienced physical challenges and activity preferences that limited their ability to perform manipulative activities optimally. Third, the perception of



movement difficulties, which was more dominant in female students, also influenced their motivation and opportunities to practice these skills. Ultimately, gender differences are not only biological but also influenced by social and psychological factors that impact the development of manipulative movement skills. Therefore, group learning models and strategies that still pay attention to the needs and conditions of each student are very important to support the development of their potential optimally and inclusively.

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