

The effect of learning methods and motor skills on the learning outcomes of basic techniques in volleyball

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Abstract

Plenty of research has investigated various implementations of learning methods in sports and physical education. Unfortunately, the implementation barely involves motor skills, including the absence of grouping the motor skills into levels. Therefore, this research aims to analyze the effect of different learning methods with different motor skill levels on their learning outcomes of basic techniques in volleyball. The research employed a two-way factorial experimental design to divide the learning methods into two: peer tutoring and demonstration. Meanwhile, levels of motor skills were also grouped into high and low. Forty-four junior high school students were randomly recruited to participate in this research. They consisted of Grade 8 male students who took a combined physical education class. They were from three different classes and aged 14.08 ± 0.60 years old. Participants in this research were divided into four groups, receiving treatment for ± 6 weeks. Motor skills data were gathered from the Barrow motor ability test, while data about basic skills in volleyball were taken from the Russel-Lange test (underhand serve, forearm pass, and overhead pass). Then, the data were analyzed using the two-way factorial ANOVA and Tukey post-hoc test. This research found that the peer tutoring method generated better learning outcomes than demonstration ($P < 0.05$). After that, an interaction was documented between both learning methods with the motor skill levels ($P < 0.05$), in which the peer tutoring method was claimed to be better than the demonstration for students with high motor skill levels ($P < 0.05$). Meanwhile, those with low motor levels did not differ significantly from both learning methods ($P > 0.05$). In conclusion, when given a peer teaching method, students with high motor levels will perform better in learning the basic techniques of volleyball. Meanwhile, those with low motor skills can be treated using both methods, although demonstration generates better results. Finally, physical education teachers need to involve students as peers in teaching and group them based on their motor levels.

Keywords: physical education, volleyball, basic techniques, peer tutoring, demonstration, motor skills

Introduction

Physical education aims to promote physical and sports activities as learning outcomes. In this subject, students are directed to do various sports activities (individual or team), allowing them to gain positive values as individuals and team players (Barker et al., 2015a). These positive values are promoted by many sports disciplines, including volleyball – a common sport taught in physical education subject at the junior high school level. According to Roslow Research Group, volleyball learning can facilitate students in developing their motor skills and specific movement patterns in sports (Kim, 2016). These are important in the basic techniques of volleyball (Rifki et al., 2022). Thus, every student must learn them and have learning experiences in actual game situations. Unfortunately, the teaching implemented by physical education teachers is often perceived as a bad experience by most students, negatively affecting their childhood and adolescent physical and sports activities (Allender et al., 2006). Hence, physical education scholars and practitioners have paid serious attention to this (Hastie, 2016; Kim, 2016). In other words, teaching styles implemented in the physical education subject have been identified as an obstacle to supporting students' development in learning the concept and practicing the sports skills, such as psychomotor, cognitive, and affective (Kirk, 2013). Over the years, physical education teaching has shifted from a teacher-centered approach to a student-centered one (Gubacs-Collins, 2015). The latter approach means students can not be left alone (Goodyear & Dudley, 2015). Other reports also suggest various effective teaching models to improve learning outcomes and health (O'Sullivan, 2013), such as student-centre teaching (Haerens et al., 2011; Metzler, 2017), inquiry-based learning (Oliver & Kirk, 2014), and peer tutoring (Barker et al., 2015b). The models that promote the role of students as peers in learning and teaching have attracted the attention of many scholars (Stigmar, 2016). This is also important in the physical education subject as it gives students more roles and responsibilities in teaching (Araújo et al., 2017). Basically, whatever type of teaching method is applied, teachers need to adjust their method to students' situations and characteristics, especially their motor skills. They need to do some combinations and modifications to create new teaching methods to help them achieve the learning outcomes (Cuellar-Moreno, 2016). In addition, prior studies have documented pedagogical practices of sport and physical education through motor skill learning (Orangi et

al., 2021). Therefore, it is important for researchers and practitioners to understand and investigate how sport basic techniques are taught in physical education. Recent studies increasingly investigate the implementation of sport and physical education. For example, Khairuddin et al. (2022) examine the relationship between physical fitness and learning approach (command and assignment), which is based on the level of motor skills among students in elementary schools. Another research focuses on studying physical education teacher actions (roles) in student-centered learning (Goodyear & Dudley, 2015). Another example is research that links physical education and the art of teaching (Quennerstedt, 2019). It studies transformative learning and teaching in physical education and sports pedagogy. In addition to empirical research, a meta-analysis is conducted to review an initial empirical model from practical factors of peer tutoring on academic achievement (Leung, 2015). Another meta-analysis discusses the effect of peer tutoring in martial arts education that focuses on social and psychomotor skill development (Ayvazo & Aljadeff-Abergel, 2019). Prior research also indicates teaching practices through content knowledge in volleyball (Kim, 2016). The research focuses on developing teachers' content knowledge to change their teaching practice. This change is reported to impact their volleyball learning in high schools. Another research discusses the effect of different teaching strategies on volleyball learning outcomes (Sgrò et al., 2020). The study involves high school students with two treatment groups: a tactical game model approach (experimental group) and a technique-oriented approach (control group). A model-based approach is also adopted to teach physical education (Casey & MacPhail, 2018). The study describes cooperative learning, tactical games, and sports education involving male students in two different age groups. More recently, researchers have taken a pedagogical approach related to how students acquire performance skills in sports. It connects sports coaching, physical education, and motor learning to improve pedagogical practices (Moon, 2022). To the best of our knowledge, very few studies investigate the application of different learning methods based on the motor level to the learning outcomes of basic volleyball techniques in physical education. For that reason, this research aims to analyze different learning methods which are based on motor levels toward the learning outcomes of basic techniques in volleyball. These learning methods are peer tutoring and demonstration. Meanwhile, the level of motor skills is divided into high and low. The analysis of these factors is expected to provide benefits for implementing learning methods based on motor levels in physical education and sports in schools.

Methods

Design and participants This research is a factorial experiment with a two-way ANOVA design. In this research, learning methods (A) consisted of peer tutoring (A1) and demonstration (A2). Meanwhile, the motor skills (B) were divided into high (B1) and low (B2). The research used four treatment groups: peer tutoring for participants with high and low motor levels (A1B1 and A1B2) and demonstration learning methods for participants with high and low motor levels (A2B1 and A2B2). This design is illustrated in Table 1. This research involved 44 students at a public junior high school in Indonesia. They were recruited randomly. The participants consisted of Grade 8 male students from three different classes. During the research, they took a combined physical education class, voluntarily participated, and were willing to comply with the research's conditions (14.08 ± 0.60 years, 149.33 ± 3.84 cm, 45.61 ± 2.38 kg, and BMI 20.48 ± 1.17).

Procedure Groups in this research were divided based on the motor skill pretest data. The data was used to categorize the students into the two-way factorial experimental designs (A1B1, A2B1, A1B2, and A2B2). Motor test results were sorted from maximum to minimum value. The upper motor data (numbers 1 to 22) were categorized as high motor level ($n=22$), while the lower motor data (numbers 23-44) were categorized as low motor level ($n=22$). Then, groups for treatment with peer tutoring and demonstration learning methods were divided using the ordinal pairing method based on high and low motor levels. Thus, this study had four treatment groups, each with 11 participants (see Figure 1 and Table 1).

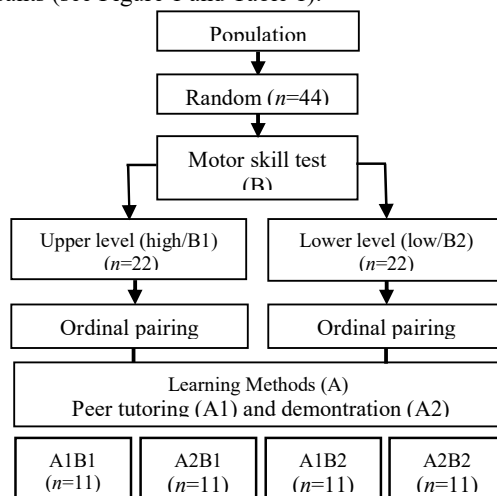


Figure 1. Procedures for dividing group

Table 1. Two-way factorial ANOVA design and number of participants for each group

Motor skill level (B)	Learning Methods (A)				Total (n)
	Peer tutoring (A1)	n	Demonstration (A2)	n	
High (B1)	A1B1	11	A2B1	11	22
Low (B2)	A1B2	11	A2B2	11	22
Total	A1	22	A2	22	44

Dependent variable: Basic techniques in volleyball.

Having divided the groups into the two-way factorial design, the learning methods of peer tutoring and demonstration were applied in order to find out the learning outcomes of the basic techniques in volleyball. These learning methods were implemented for ± 6 weeks, with three meetings a week. The meetings were arranged following the class schedule for the combined physical education subject. During the process, the learning began with opening for ± 10 minutes, main for ± 70 minutes (learning materials about the underhand serve, forearm pass, and overhead pass), and closing for ± 10 minutes.

The implementation of both learning methods was aimed at gaining learning outcomes of the basic techniques in volleyball. The difference was in the roles of the students and the teachers. In the peer tutoring method, the peers played a role as a tutor. Meanwhile, in the demonstration method, this role was played by the teachers. Regarding the main activity, the learning materials about the basic techniques in volleyball (underhand serve, forearm pass, and overhead pass) were delivered variedly (individually or in team). The materials were also sorted from easy to difficult, following the first to the last meetings.

Instrument

To obtain students' motoric skill data, this research employed the Barrow motor ability test (Fraser, 1966). This test involved the zig-zag run, standing broad jump, and medicine ball put. Meanwhile, the basic techniques in volleyball were measured using the Russel-Lange test, covering underhand serve, forearm pass, and overhead pass. Each participant must perform underhand serve ten times, with a maximum score of 50 and a minimum score of 10 (see Figure 2.a). After that, the forearm and overhead passes were done by bouncing the ball to the wall (target) for 30 seconds (see Figure 2.b). The accumulative score from these three tests (underhand serve, forearm pass, and overhead pass) was summed and averaged to obtain the learning outcomes of the basic techniques in volleyball.

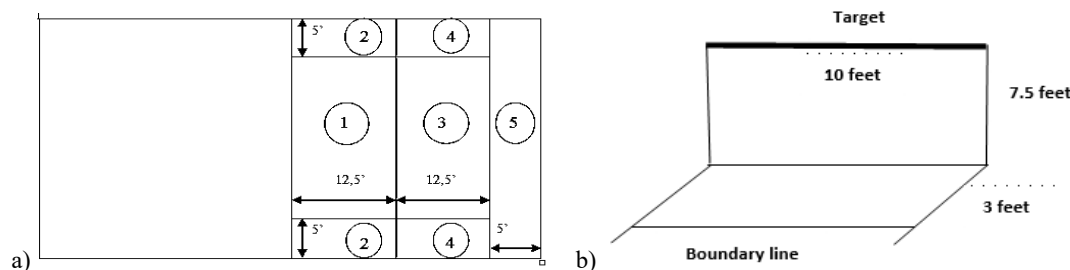


Figure 2. (a) Underarm serving test, (b) Forearm and overhead passing tests.

Data analysis

The characteristics of each treatment group were analyzed using descriptive statistics. Testing of analysis requirements was carried out based on standard residual values (normality) and Levene's test (homogeneity). Following that, the research performed the two-way factorial ANOVA and Tukey's follow-up test to analyze the difference of effects or treatment group that has a significant effect. These analysis were carried out using the SPSS software version 26.

Result

Overall, the learning outcomes of the basic techniques in volleyball in group A1B1 were better than the other groups, with a value of 18.06 ± 0.89 , as presented in Table 2 and Figure 3. Meanwhile, the scores for other research groups were different by 15.55 ± 1.38 (A1B2), 15.73 ± 1.47 (A2B1), 15.91 ± 1.35 (B2), 16.00 ± 1.37 (A2), 16.27 ± 1.27 (A2B2), 16.80 ± 1.71 (A1), and 16.89 ± 1.69 (B1). Then, Table 3 and Figure 4 illustrate the results of testing the analysis requirements where the data meets the criteria for hypothesis testing ($P > 0.05$).

Table 2. Data description from each group

Groups	n	Basic Techniques	Min	Max	<i>M ± SD</i>	
					Per technique	Overall
A1	22	Underhand serve	19.00	29.00	23.77 ± 3.26	16.80 ± 1.71
		Forearm pass	10.00	15.00	12.86 ± 1.39	

		Overhead pass	11.00	15.00	13.77 ± 1.23	
A2	22	Underhand serve	19.00	26.00	22.64 ± 2.19	
		Forearm pass	9.00	15.00	12.09 ± 1.85	16.00 ± 1.37
		Overhead pass	11.00	16.00	13.27 ± 1.32	
B1	22	Underhand serve	19.00	29.00	24.23 ± 2.91	
		Forearm pass	9.00	15.00	12.73 ± 2.00	16.89 ± 1.69
		Overhead pass	11.00	15.00	13.73 ± 1.12	
B2	22	Underhand serve	19.00	25.00	22.18 ± 2.34	
		Forearm pass	10.00	14.00	12.23 ± 1.23	15.91 ± 1.35
		Overhead pass	11.00	16.00	13.32 ± 1.43	
A1B1	11	Underhand serve	22.00	29.00	26.09 ± 2.02	
		Forearm pass	12.00	15.00	13.64 ± 1.03	18.06 ± 0.89
		Overhead pass	13.00	15.00	14.45 ± 0.82	
A2B1	11	Underhand serve	19.00	26.00	22.36 ± 2.46	
		Forearm pass	9.00	15.00	11.82 ± 2.36	15.73 ± 1.47
		Overhead pass	11.00	14.00	13.00 ± 0.89	
A1B2	11	Underhand serve	19.00	25.00	21.45 ± 2.54	
		Forearm pass	10.00	14.00	12.09 ± 1.30	15.55 ± 1.38
		Overhead pass	11.00	15.00	13.09 ± 1.22	
A2B2	11	Underhand serve	19.00	25.00	22.91 ± 1.97	
		Forearm pass	10.00	14.00	12.36 ± 1.21	16.27 ± 1.27
		Overhead pass	11.00	16.00	13.55 ± 1.63	

Dependent variable: Basic techniques in volleyball.

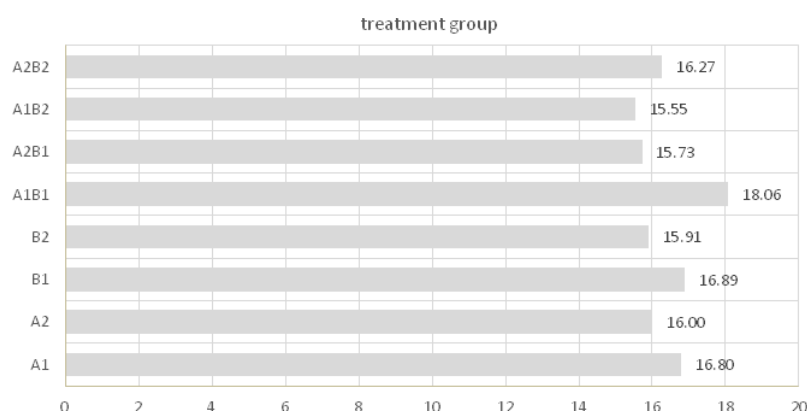
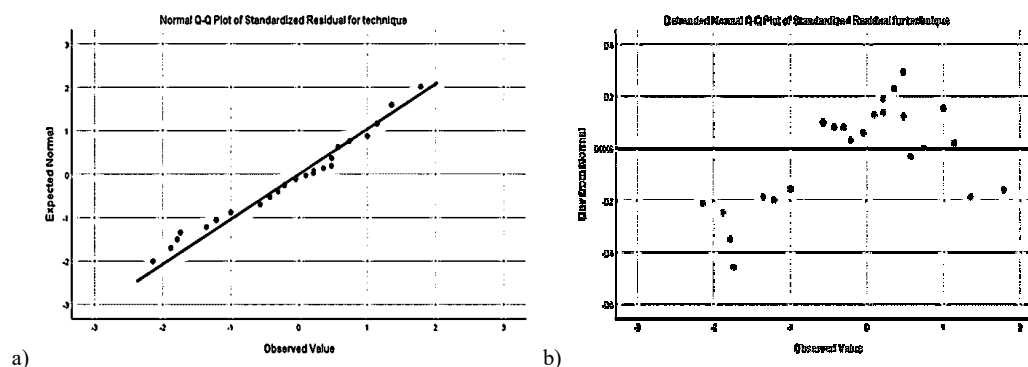


Figure 3. Average learning outcomes of basic techniques in volleyball for each group

Table 3. Testing requirements analysis

Normality				Homogeneity			
Source	Statistic	df	P	Source	df1	df2	P
Kolmogorov-Smirnov	0.120	44	0.118	Levene's	3	40	0.157
Shapiro-Wilk	0.966	44	0.214				

The data were normally distributed and homogeneous ($P > 0.05$).



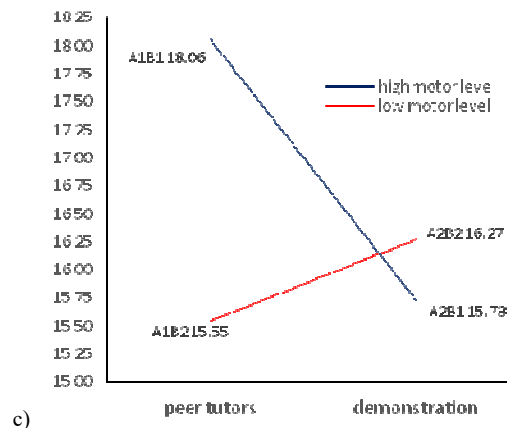


Figure 4. (a) Plot graphic, (b) Detrended normal plot, and (c) Interaction

As presented in Table 4, the result of the two-way ANOVA test indicated a significant difference between learning outcomes of the basic techniques in volleyball in groups A1 and A2 ($P < 0.05$), in which group A1 was better than A2 (with the average of A1 and A2 was $16.80 > 16.00$). Groups B1 and B2 also showed a significant difference ($P < 0.05$), where group B1 performed better than B2 (with the average of B1 and B2, $16.89 > 15.91$). Another significant interaction was identified between groups A and B ($P < 0.05$), as provided in Table 4 and Figure 4.c.

Table 4. Tests of between-subjects effects

Source	Type III Sum of Squares	df	Mean Square	F	P
Corrected Model	43.600	3	14.533	8.965	0.000
Intercept	11837.192	1	11837.192	7302.026	0.000
Learning methods (A)	7.112	1	7.112	4.387	0.043
Motor (B)	10.692	1	10.692	6.596	0.014
Learning methods (A)*motor (B)	25.796	1	25.796	15.913	0.000
Error	64.843	40	1.621		
Total	11945.636	44			
Corrected Total	108.444	43			

Dependent variable: Basic techniques in volleyball.

As described in Table 5, analysis of the post-hoc test of Tukey shows that learning outcomes of the basic techniques in volleyball in group A1B1 are better than A2B1 ($P < 0.05$) (average of A1B1 and A2B1, $18.06 > 15.73$). Then, learning outcomes of the basic techniques in volleyball in groups A1B2 and A2B2 do not have a significant difference ($P < 0.05$) (average of A1B2 and A2B2, $15.15 < 16.27$).

Table 5. Analysis of the post-hoc test

(I) Post Hoc	(J) Post Hoc	Mean difference (I-J)	Std. error	P	95% Confidence interval	
					Lower bound	Upper bound
A1B1	A1B2	2.5173*	0.54290	0.000	1.0621	3.9725
	A2B1	2.3355*	0.54290	0.001	0.8802	3.7907
	A2B2	1.7900*	0.54290	0.011	0.3348	3.2452
A1B2	A1B1	-2.5173*	0.54290	0.000	-3.9725	-1.0621
	A2B1	-0.1818	0.54290	0.987	-1.6370	1.2734
	A2B2	-0.7273	0.54290	0.544	-2.1825	0.7279
A2B1	A1B1	-2.3355*	0.54290	0.001	-3.7907	-0.8802
	A1B2	0.1818	0.54290	0.987	-1.2734	1.6370
	A2B2	-0.5455	0.54290	0.748	-2.0007	0.9098
A2B2	A1B1	-1.7900*	0.54290	0.011	-3.2452	-0.3348
	A1B2	0.7273	0.54290	0.544	-0.7279	2.1825
	A2B1	0.5455	0.54290	0.748	-0.9098	2.0007

Dependent variable: Basic techniques in volleyball, Tukey HSD, the error term is MS 1.621.

*the mean difference is significant at the 0.05 level.

Discussion

Findings in this research show that the peer tutoring method is better than the demonstration in the learning outcomes of the basic techniques in volleyball. This finding is in line with prior research, which claimed that peer tutoring positively affected academic achievement (Leung, 2015), promoted enjoyable teaching, and encouraged students' participation in the classroom (Ansuetegui & Miravet, 2017). As argued earlier, educational

practitioners have shifted learning approaches to become student-centered as it is perceived as the most effective teaching method (Hattie, 2012), especially peer tutoring in physical education teaching (Klavina & Block, 2008). This learning approach will be mutually beneficial if applied correctly (Cervantes et al., 2013). These findings are also consistent with previous studies, where students were more motivated during learning when their peers played the role of tutors, leading their teams through learning or movement tasks (Casey & Goodyear, 2015). Meanwhile, in the demonstration method, the teaching was based on instructions given by the teachers. This method does not use a team or learning group which is led by a student as the tutor (Bruzi et al., 2006). In other words, it focuses on teachers in giving instruction and thus affects students' participation in the classroom (Rink, 2020).

Besides comparing the two learning methods, this research also figured out an interaction between the learning methods and students' motor skills. This finding confirms previous studies claiming motor skills as an important asset in sport and physical education (Moon, 2022). The implementation of different physical education can increase students' participation in the classroom, giving them learning experiences (Cuellar-Moreno, 2016). Regarding this, teachers need to adjust their teaching strategies based on students' competence and characteristics to make their teaching effective (Firdaus et al., 2023; Webb et al., 2011), including adjusting the different levels of students' motor skills. Further, another study revealed that health and daily productivity could be obtained through sports and physical activities (Ihsan et al., 2022; Welis et al., 2023), particularly in motor skill development (D'Isanto et al., 2019). It means that everyone (student) might have different levels of motor skills (Anderson et al., 2021), so physical education teachers must consider this difference and implement effective teaching. Other studies also suggest the importance of motor skill learning to develop basic techniques in sports and physical education (Moon, 2022).

Another key finding from this research was that students with high motor skills gained better learning outcomes of the basic techniques in volleyball when given the peer tutoring method. For low motor skill students, this research did not find a significant difference between both learning methods. However, the results would be better when they were taught by demonstration (based on a comparison of the means of the two groups). This finding is in accordance with previous studies that the peer tutoring learning method allows students to practice new skill components and receive immediate feedback to improve their assignments and performance (Van Norman, 2007). Also, peers generally teach using everyday language, which is more direct, so they (fellow students) more easily accept the learning process (Alegre et al., 2018). Contemporary motor learning theory should inform instructional design and delivery of instruction in physical education (Renshaw et al., 2015). This does not happen with traditional learning approaches in physical education (SueSee et al., 2019). This means that students with a high motor level will be better given peer tutoring learning methods than demonstrations based on teacher instructions.

The interaction between teachers and students is very important to study various skills of sports in conventional teaching (demonstration) (Rink, 2020), particularly feedback used as strategies to teach physical education that attract students' attention to particular movements or skills (Wulf et al., 2010). Meanwhile, students with motor skill disorders are generally caused by a lack of physical activities. They tend to have low academic achievement (Kueper et al., 2017; Nishizawa & Nakamura, 2021). Thus, it is more appropriate to provide them with a demonstration method. This finding is in accordance with previous studies where conventional and traditional teaching methods were perceived as obstacles to encouraging student involvement in the learning process (Park et al., 2006). Thus, students with low motor skills rarely participate in sports (including learning basic volleyball techniques), so it is more appropriate for them to be given demonstration methods based on teacher instructions.

All procedures in this research have been attempted optimally. However, this study has several limitations. For example, the sample in this study consisted of 44 junior high school students, so the motor level between the lowest serial number (high motor) and the highest serial number (low motor) may not be significantly different. Therefore, a wider sample size is needed for future research. Then, the sample in this research can only be controlled during the treatment schedule.

Conclusion

This research concludes the interaction between learning methods and motor skills. For high-motor students, the results of learning basic techniques in volleyball using the peer tutoring learning method are reported to be better than using demonstrations. Meanwhile, low-motor students can be given both learning methods. However, the results will be better if they are given a demonstration method. Finally, physical education teachers need to consider the characteristics of each student (motor skills) in implementing learning methods, especially for learning basic techniques in volleyball. Physical education is a learning activity that not only involves the cognitive and affective domains but also psychomotor, which is an important part of achieving learning goals in physical education. This means that motor skills are fundamental to achieving effective learning goals in physical education. A larger sample size is needed in future research to differentiate motor skill groupings (high and low) significantly.

Conflict of interest- The authors report no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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