The Influence of Physical Fitness, Motor Skills, and Learning Motivation on Cartwheel Skills in Physical Education

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Abstract: Background Problems: During the observation, many students were unable to perform cartwheel skills. This research is important so that students can pass the minimum completion criteria so that their physical education learning outcomes are not low. Research Objectives: This study aims to determine the factors that influence the skills of cartwheel. Methods: This type of research is quantitative. The population amounted to 392 students in class XI. The technique used to obtain the sample is simple random sampling using the slovin formula with an error rate of 10%. Based on this, the sample amounted to 80 students. The physical fitness test instrument used the Indonesian Student Fitness Test, the motor ability test instrument used the Barrow Motor Ability Test, the learning motivation data was collected using a questionnaire, and the cartwheel skill data used an observation sheet which contained the criteria for implementing the cartwheel movement. Path analysis was used as a data analysis technique. Finding/Results: The results of the study consist of: 1. Physical fitness and motor skills have a significant influence on cartwheel skills. 2. Learning motivation has no significant effect directly on cartwheel skills. 3. Physical fitness indirectly through learning motivation has no significant effect on cartwheel skills. 4. Motor ability indirectly through learning motivation has no significant effect on cartwheel skills. Conclusion: Physical fitness and motor skills have a significant influence on cartwheel skills. Students need to do it outside of PJOK class hours. For Further Researchers Conduct research on other gymnastic movements.

Keywords: Cartwheel Skills; Learning Motivation; Motor Ability; Physical Fitness

Introduction

Cartwheels are one of the movements learned by students in the gymnastics activity material in the PJOK subject. The results of observations conducted on class XI at SMAN 9 Padang showed that there were still many students who were not able to do cartwheels. If students get a score below the minimum completion criteria. It will affect the average score of the semester 2 report card. Therefore, factors that directly and indirectly influence the success of cartwheel skills in students need to be studied so that they can solve the problems felt by students.

The body's ability to carry out daily activities without experiencing excessive fatigue, so that it is still able to do other activities is called physical fitness (Bafirman & Wahyuri, 2019). The components of physical fitness related to cartwheels consist of arm strength, back flexibility, and balance (Pertiwi et al., 2021). At the cartwheel implementation stage, weak arm

strength makes students unable to support their body weight and insufficient back flexibility makes the body not upright. In the final stages of the cartwheel movement, poor balance makes it difficult for students to stand on both feet properly. Therefore, physical fitness is thought to have a direct effect on cartwheel skills.

Motor skills are the ability of a person's body to move (BZ et al., 2024) During observation, students were seen moving minimally to carry out the preliminary, core, and closing learning stages. Physical Education learning outcomes are positively correlated with motor skills (Noviardila, 2019). Although the results of the study stated that only general Physical Education subjects, it is strongly suspected that motor skills affect cartwheel skills. Thus, motor skills are thought to have a direct effect on cartwheel skills.

Learning motivation is the drive that makes students want to learn, the source of which comes from outside and within themselves (Osrita et al., 2020). During observation, students seemed reluctant to practice cartwheels. There is a relationship between Physical Education learning outcomes and learning motivation (R. S. Putra et al., 2024). Although the research results do not specifically mention the floor gymnastics material, learning motivation is strongly suspected to have an effect on cartwheel skills. Based on this, motivation is suspected to have a direct effect on cartwheel skills. Then, physical fitness and motor skills are suspected to have a direct effect on learning motivation. In addition, it is suspected that physical fitness and motor skills indirectly through learning motivation have a direct effect on cartwheel skills.

This research is at the forefront of physical education, especially in the context of gymnastics, by highlighting the importance of physical fitness and motor skills in mastery of cartwheel movements. Previous studies have discussed the role of learning motivation in improving students' physical performance, assuming that motivation is the main factor to achieve optimal results (Bafirman et al., 2023; Raffiandy Putra et al., 2024; Reno Putra et al., 2024). However, this study offers a new perspective by showing that, for specific skills such as cartwheel, physical fitness and motor skills have a more significant role than learning motivation (Hasibuan et al., 2024; Nur et al., 2023; Purnama et al., 2024). This suggests that mastering basic gymnastics movements requires a greater focus on the physical and technical aspects rather than relying solely on motivation.

The quantitative approach used in this study, through path analysis, offers a more measurable and structured way to understand the relationship between physical fitness, motor skills, and learning motivation against cartwheel skills. The use of measurement instruments such as the Indonesian Student Fitness Test and the Barrow Motor Ability Test also demonstrates a commitment to the validity and reliability of the data collected. Thus, this research not only enriches the literature in the field of physical education, but also opens up new opportunities to develop more effective and directed learning strategies, which focus on the development of students' physical and motor skills.

Method

This type of research is quantitative. The population amounted to 392 students in class XI. The technique used to obtain the sample is simple random sampling using the slovin formula with an error rate of 10%. Based on this, the sample amounted to 80 students. The physical fitness test instrument used the Indonesian Student Fitness Test (Prasetyo et al., 2021), the motor ability test instrument used the Barrow Motor Ability Test (Barrow in Primayoga, 2020), the learning motivation data was collected using a questionnaire (Utomo, 2022), and the cartwheel skill data used an observation sheet which contained the criteria for implementing the cartwheel movement (Suprapta, 2015). Path analysis with the Sobel test was used as a data analysis technique (Abu-Bader & Jones, 2021).

Result and Discussion

The test results of the physical fitness variable grouped the samples into several categories, namely: 0 people were categorized as very good, 2 people were categorized as good, 12 people were categorized as average, 36 people were categorized as poor, and 30 people were categorized as very poor.

Table 1. The test results of the physical fitness variable

Value Range	Category	Frequency
27-30	Very Good	0
23-26	Good	2
19-22	Average	12
15-18	Poor	36
≤ 14	Very Poor	30

The test results of the motor ability variable grouped the samples into several categories, namely: 10 people were categorized as very good, 12 people were categorized as good, 32 people were categorized as average, 24 people were categorized as poor, and 2 people were categorized as very poor.

Table 2. The test results of the motor ability variable

Value Range	Category	Frequency
24-30	Very Good	10
21-23	Good	12
17-20	Average	32
13-16	Poor	24
$\leq$ 12	Very Poor	2

The results of filling out the learning motivation variable questionnaire grouped the samples into several categories, namely: 22 people in the very high category, 11 people in the high category, 43 people in the average category, 4 people in the low category, and 0 people in the very low category.

Table 3. The results of filling out the learning motivation variable

Value Range	Category	Frequency
135-150	Very High	3
120-134	High	30
105-119	Average	37
90-104	Low	10
$\leq$ 89	Very Low	0

The test results of the cartwheel skill variable grouped the samples into several categories, namely: 16 people were categorized as very good, 4 people were categorized as good, 10 people were categorized as average, 20 people were categorized as poor, and 30 people were categorized as very poor.

Table 4. The test results of the cartwheel skill variable

Value Range	Information	Category	Frequency
90-100	Pass	Very Good	16
80-89	Pass	Good	4
70-79	Fail	Average	10
60-69	Fail	Poor	20
$\leq$ 59	Fail	Very Poor	30

Classical Assumption Test

Before conducting a hypothesis test using multiple linear regression analysis test, it is necessary to conduct a classical assumption test. The classical assumption test is a statistical requirement for multiple linear regression analysis test to obtain estimation accuracy and avoid deviation/bias. The classical assumption test suitable for this study consists of normality test, multicollinearity test, heteroscedasticity test, and linearity test (Budi et al., 2024; Syarifuddin & Saudi, 2022; Vikaliana et al., 2022).

Data Normality

Data normality test was conducted for structural models 1 and 2 using the IBM SPSS Statistics Free Trial application. If the Asymp. Sig (2-tailed) value is greater than 0.05, then the data is normally distributed (Vikaliana et al., 2022). In structural model 1, the data is

normally distributed because the Asymp. Sig (2-tailed) value is 0.200. Then, the data in structural model 2 is normally distributed, because the Asymp. Sig (2-tailed) value is 0.200.

Multicollinearity

If the VIF value is less than 10.00 then there is no multicollinearity. If the VIF value is more than 10.00 then there is multicollinearity (Vikaliana et al., 2022). In structural model 1, the VIF value of the physical fitness variable on learning motivation is 1.315. Then, the VIF value of the motor ability variable on learning motivation is 1.315. Therefore, there is no multicollinearity in structural model 1.

In structural model 2, the VIF value of the physical fitness variable on cartwheel skills is 1.316. Then, the VIF value of the motor ability variable on cartwheel skills is 1.347. Then, the VIF value of the learning motivation variable on cartwheel skills is 1.039. Therefore, there is no multicollinearity in structural model 2

Heteroscedasticity

If the significance value between the exogenous variable and the absolute residual variable is > 0.05 then heteroscedasticity does not occur (Widana & Muliani, 2020). In structural model 1, the significance value of the physical fitness variable against is 0.326. Then, the significance value of the motor ability variable against is 0.066. Therefore, there is no heteroscedasticity in structural model 1.

In structural model 2, the significance value of the physical fitness variable is 0.200. Then, the significance value of the motor ability variable is 0.422. Then, the significance value of the learning motivation variable is 0.476. Therefore, there is no heteroscedasticity in structural model 2.

Linearity

The linearity test was conducted for structural models 1 and 2 using the IBM SPSS Statistics Free Trial application. If the significance value in the Deviation from Linearity > 0.05, then the relationship between exogenous and endogenous variables is linear (Vikaliana et al., 2022). The significance value between the physical fitness variable and learning motivation is 0.923. The significance value between the motor ability variable and learning motivation is 0.665. The significance value between the physical fitness variable and cartwheel skills is 0.768. The significance value between the motor ability variable and cartwheel skills is 0.183. The significance value between the learning motivation variable and cartwheel skills is 0.601. Therefore, all relationships between exogenous and endogenous variables are linear

Hypothesis Testing
Direct Effect of Physical Fitness on Learning Motivation

H0 means that physical fitness does not have a direct significant effect on learning motivation. Meanwhile, Ha means that physical fitness has a direct significant effect on learning motivation. Based on the results of the multiple regression test, the significance value is 0.789. This value is greater than 0.05. Therefore, H0 is accepted so that physical fitness does not have a direct significant effect on learning motivation.

Direct Effect of Motor Skills on Learning Motivation

H0 means that motor skills do not have a direct significant effect on learning motivation. Meanwhile, Ha means that motor skills have a direct significant effect on learning motivation. Based on the results of the multiple regression test, the significance value is 0.179. This value is greater than 0.05. Therefore, H0 is accepted so that motor skills do not have a direct significant effect on learning motivation.

The Effect of Physical Fitness and Motor Skills Simultaneously on Learning Motivation

H0 means that physical fitness and motor skills simultaneously do not have a significant effect on learning motivation. Meanwhile, Ha means that physical fitness and motor skills simultaneously have a significant effect on learning motivation. Based on the test conducted, the significance value in structural model 1 is 0.231. Therefore, H0 is accepted so that physical fitness and motor skills simultaneously do not have a significant effect on learning motivation (Zahriyah et al., 2021).

Direct Effect of Physical Fitness on Cartwheel Skills

H0 means that physical fitness does not have a direct significant effect on cartwheel skills. Meanwhile, Ha means that physical fitness has a direct significant effect on cartwheel skills. Based on the multiple regression test results, the significance value is 0.000. This value is smaller than 0.05. Therefore, H0 is rejected so that physical fitness has a direct significant effect on cartwheel skills.

Direct Effect of Motor Ability on Cartwheel Skills

H0 means that motor ability does not have a direct significant effect on cartwheel skills. Meanwhile, Ha means that motor ability has a direct significant effect on cartwheel skills. Based on the results of the multiple regression test, the significance value is 0.042. This value is smaller than 0.05. Therefore, H0 is rejected so that motor ability has a direct significant effect on cartwheel skills.

Direct Effect of Learning Motivation on Cartwheel Skills

H0 means that learning motivation does not have a significant direct effect on cartwheel skills. Meanwhile, Ha means that learning motivation has a significant direct effect on cartwheel skills. Based on the results of the multiple regression test, the significance value is 0.522. This value is greater than 0.05. Therefore, H0 is accepted so that learning motivation does not have a significant effect on cartwheel skills.

The Effect of Physical Fitness, Motor Ability, and Learning Motivation Simultaneously on Cartwheel Skills

H0 means that physical fitness, motor ability, and learning motivation simultaneously do not have a significant effect on cartwheel skills. Meanwhile, Ha means that physical fitness, motor ability, and learning motivation simultaneously have a significant effect on cartwheel skills. Based on the test conducted, the significance value in structural model 2 is 0.00. Therefore, H0 is rejected so that physical fitness, motor ability, and learning motivation simultaneously have a significant effect on cartwheel skills (Zahriyah et al., 2021).

Indirect Influence of Physical Fitness through Learning Motivation on Cartwheel Skills

Based on the results of the Sobel Test, the statistical test value is 0.248. This value is smaller than the Z table of the two-sided test for a 95% confidence level which is 1.96. Based on this, H0 is rejected so that physical fitness indirectly through learning motivation does not have a significant effect on cartwheel skills.

Indirect Effect of Motor Ability through Learning Motivation on Cartwheel Skills

Based on the results of the Sobel Test, the statistical test value is 0.578. This value is smaller than the Z table of the two-sided test for a 95% confidence level which is 1.96. Based on this, H0 is accepted so that motor ability indirectly through learning motivation does not have a significant effect on cartwheel skills.

Discussion
Direct Influence of Physical Fitness on Learning Motivation

The results of the hypothesis 1 test state that physical fitness does not have a significant direct effect on learning motivation. Similar findings were obtained by (Putri & Andrijanto, 2023) which stated that the relationship between physical fitness and learning motivation was not significant. However, other studies have found that physical fitness is significantly related to learning motivation (Amir, 2023; Atwi & Firdaus, 2020)

The reason physical fitness does not have a direct effect on learning motivation is because many other

factors influence it. Learning motivation is influenced by factors that come from within (intrinsic) and outside (extrinsic). Internal factors include the need to learn, and the desire to succeed (Faristin et al., 2023; Iskandar & Rejeki, 2020). External factors include school facilities, school environment, teachers, and family environment (Iskandar & Rejeki, 2020).

Direct Influence of Motor Skills on Learning Motivation

The results of the hypothesis 2 test state that motor skills do not have a significant direct effect on learning motivation. Similar findings were obtained by (Ensrud-Skraastad & Haga, 2020) which stated that the relationship between autonomous motivation and motor competence in children with an average age of 11.7 years. However, another study found that motor skills have a significant direct effect on learning motivation in elementary school children (Kiram et al., 2022).

The reason motor skills do not have a direct effect on learning motivation is because many other factors influence it. Learning motivation is influenced by factors that come from within (intrinsic) and outside (extrinsic). Internal factors include the need to learn, and the desire to succeed (Faristin et al., 2023; Iskandar & Rejeki, 2020). External factors include school facilities, school environment, teachers, and family environment (Iskandar & Rejeki, 2020).

The Effect of Physical Fitness and Motor Skills Simultaneously on Learning Motivation

The results of the hypothesis test 3 stated that physical fitness and motor skills simultaneously did not have a significant effect on learning motivation. Physical fitness and motor skills are included in physical activities. When students do a lot of physical activities without regulating nutritional intake and rest, they will feel tired (Welong et al., 2020). Fatigue will have a negative impact on students' learning motivation.

The Direct Effect of Physical Fitness on Cartwheel Skills

The results of the hypothesis test 4 stated that physical fitness had a significant direct effect on cartwheel skills. This finding is supported by the results of research which states that there is a relationship between arm muscle strength, flexibility, balance, and leg muscle explosive power on cartwheel skills (Pertiwi et al., 2021; Tresnowati et al., 2021). Measurement of arm muscle strength is in the dipping test item. Then, the measurement of leg muscle explosive power is in the vertical jump test item. In addition, in the T-Test item, although the main purpose is to measure agility, the implementation of this item is also supported by flexibility and balance. Therefore, the 3 test items support the implementation of cartwheel skills.

Direct Influence of Motor Ability on Cartwheel Skills

The results of the hypothesis 5 test state that motor ability has a significant direct effect on cartwheel skills. This finding is supported by the results of research which states that there is a relationship between arm muscle strength, flexibility, balance, and leg muscle explosive power on cartwheel skills (Pertiwi et al., 2021; Tresnowati et al., 2021). Measurement of leg muscle explosive power is in the standing broad jump item. Then, measurement of arm muscle strength is in the medicine ball put test item. In addition, in the zig-zag run item, although the main purpose is to measure agility, the implementation of this item is also supported by flexibility and balance. Therefore, the 3 test items support the implementation of cartwheel skills.

Direct Influence of Learning Motivation on Cartwheel Skills

The results of the hypothesis 6 test state that learning motivation does not have a significant direct effect on cartwheel skills. Success in cartwheel movements is obtained through repeated physical activity. Even though there is a desire to learn, if they do not move, students have not learned (Ashidqy et al., 2023; Dermawan et al., 2022). Therefore, the role of learning motivation does not have a significant effect on cartwheel skills.

The Effect of Physical Fitness, Motor Ability, and Learning Motivation Simultaneously on Cartwheel Skills

The results of the hypothesis test 7 state that physical fitness, motor ability, and learning motivation simultaneously have a significant effect on cartwheel skills. Although motivation does not have a significant effect, with physical fitness and motor ability, motor skills can be significantly affected by the 3 variables.

Indirect Effect of Physical Fitness through Learning Motivation on Cartwheel Skills

The results of the hypothesis test 8 state that physical fitness indirectly through learning motivation does not have a significant effect on cartwheel skills. Learning motivation did not succeed in mediating the effect of physical fitness on cartwheel skills. Therefore, students need to train arm muscle strength, flexibility, balance, and leg muscle explosive power to be skilled in cartwheel movements (Pertiwi et al., 2021; Tresnowati et al., 2021).

Indirect Effect of Motor Ability through Learning Motivation on Cartwheel Skills

The results of the hypothesis 9 test stated that motor ability indirectly through learning motivation did not have a significant effect on cartwheel skills. Learning motivation failed to mediate the influence of motor ability on cartwheel skills. Therefore, students need to

train arm muscle strength, flexibility, balance, and leg muscle explosive power to be skilled in cartwheel movements (Pertiwi et al., 2021; Tresnowati et al., 2021).

Conclusion

The conclusion of this study shows that physical fitness and motor skills have a significant influence on students' ability to perform cartwheel movements. Although learning motivation does not have a significant direct effect on cartwheel skills, it is important for students to improve their physical fitness and motor skills through exercises outside of PJOK lesson hours. This study confirms that a focus on improving physical fitness and motor skills is the main key to achieving competence in cartwheel movements, as well as encouraging further research on other gymnastic movements.

Author Contributions
Each author contributes in some way to the completion of this research activity. The main author provides basic ideas and provides research materials and the second, third, fourth authors design research methods and furthermore, all authors share responsibility for data collection, data tabulation and analysis, review process, and article writing.

Conflicts of Interest
Regarding this study, the author declares that there is no conflict of interest.

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