Smart Application for Smart Learning: How the Influence of the Factors on Student Swimming Learning Outcomes in Sports Education

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Abstract—Smart Application is one that can be used to learn swimming for students in sports education. This study aims to reveal and explain the usability of smart swimming applications to explore factors influencing students' swimming learning outcomes in sports education. Data of this study were 300 sports education students that took swimming courses. Statistical analysis was performed using multiple regression analysis with the help of the software Statistical Package for the Social Sciences (SPSS) version 16. Overall, the factors of learning motivation, physical activity, nutritional status, and V02Max have an F-table value of 105.605 > 2.25, while R2 is valued at 58.9%. The results of the t-test revealed that all those factors affecting swimming learning outcomes, with the t-count value are more significant than the t-table at a significance level less than 0.05, which is 0.000. Furthermore, all factors are interrelated and needed to each other to produce good quality student swimming learning outcomes. Therefore, adequate attention and good management are necessary for lecturers in teaching swimming materials to improve students learning quality in sports education.

Keywords—smart application, learning outcomes, learning motivation, physical activity, nutritional status, V02Max

1 Introduction

Smart applications are becoming a trend in the development of information technology and education [1], [2], including in the field of sports [3], [4]. Smart learning and mobile learning is in great demand in today's digital learning era, not least in swimming lessons in sports education [5]. Smart Application in swimming is an alternative in helping to improve student learning outcomes [6], in addition, through the smart application in swimming one can explore the factors that influence student swimming learning outcomes in sports education. A swimmer's achievement is the result of training that can be measured and predicted accurately. Achieving this goal requires a learning process and motivation that stimulates good behaviour or moves.

Motivation and learning outcomes can influence to each other [7]. Learning motivation is an impulse that occurs within individuals which always encourage them to improve certain qualities [8]. The learning outcome of a swimming lesson is not only determined by motivation and regular exercise [9], but also by excellent body condition, good nutritional status, healthy physical activity, and maximum oxygen volume (VO2Max) of the athletes [10]. Physical factors and swimming techniques can be modified or improved through special exercises [11]. However, all of these factors should be accompanied with a good nutritional status.

Lack of physical fitness and unbalanced nutritional status can interfere with a swimmer's development and growth [12]. Moreover, body movement when swimming requires energy [13], which comes from foods that contain sufficient nutrients [14]. Another factor affecting swimming learning outcomes is a physical activity directly related to specific body posture [15]. Physical activity includes all exercises, body movements, work, recreation, daily activities, and activities during vacation or leisure [16]. Swimming is strongly influenced by the ability to inhale a significant amount of oxygen called VO2Max [17], measured in milliliters in one minute per kilogram of the body [18]. VO2Max is used to measure the capacity of the heart, lungs, and blood to transport oxygen to various parts of the muscles, measured during exercise [19], that someone with a higher VO2Max value could train more intensively than those in harmful conditions [20]. Moreover, they can also perform more vigorous activities [21], dependent on cardiovascular, respiratory, hematology, and exercise ability [22].

Learning motivation, physical activities, nutritional status, and maximum oxygen volume (V02Max) that affect student swimming learning outcomes can run optimally by using the smart application in swimming. The use of smart applications in learning to swim is something that can provide students' interest and interest in learning to swim [23]. The benefits of using mobile learning in learning are to facilitate the teaching and learning process carried out in the classroom or outside the classroom [24], can attract students' attention and can also foster enthusiasm and can motivate students in learning so that the material being delivered can be easily understood. Swimming learning requires a clear understanding of practice and some students find it difficult to understand, the use of mobile learning can help understand the materials learning that students can learn and follow anywhere and can be repeated [25]. So this study tries to discuss and explain the usability of smart swimming applications to explore factors influencing students' swimming learning outcomes in sports education.

2 Research methods

2.1 Participants

The research is a descriptive quantitative study. This study involved 300 participants or students (Men: 227, Women: 73) of Universitas Negeri Padang that took part in training on swimming learning outcomes from October to December 2021. The

participants have an age range of 18–24 years, a weight of 45–85 kg, a height of 150–175 cm, a sitting height of 80–90 cm, and a leg length of 70–85 cm. They were informed about the aims and procedures of the research and expressed their willingness to participate in this study prior to the data collection.

2.2 Measures

The data collection on swimming ability was carried out in 2 congregations. The first was an initial test to determine the students' swimming ability, and then the second data was taken after being given treatment. The data were measured based on the ability to swim freestyle for 50 meters. In measuring the ability of the freestyle swimming technique, the assessment score was obtained by referring to the observation sheet, which was assessed including head, feet, hands, breathing and coordination of movements. The learning motivation and physical activity instruments were obtained using grids and questionnaire sheets. A questionnaire is a data collection technique consisting of questions submitted to respondents [26]. Meanwhile, that it is a method of collecting data in written questions from respondents [27].

Furthermore, the instrument for the swimming learning outcomes is used in the form of an objective assessment. The instrument is arranged based on the following indicators: (1) the desire to succeed, (2) the encouragement and need for learning, (3) the hopes and aspirations for the future, (4) the appreciation for learning, (5) exciting activities, and (6) the conducive learning environment. These indicators were also used in the study carried out by Shepard *et al* [28]. As for swimming assessment, physical activity is done by recording the time score of swimming with a freestyle for 50 meters in length. Data collection was carried out in 2 congregations: pre-test and post-test. The scoring was obtained by dividing the time of the 50-meter freestyle swimming speed test, which was carried out twice. After the initial data collection, participants who became the research object at the next 16 meetings were given swimming training or treatment using the breaststroke and freestyle. This treatment was carried out with variations in the time and intensity of exercise in each meeting. Nutritional status is determined through anthropometric examination with Body Mass Index (BMI) by measuring weight in kilograms (Kg) and measuring height (TB) in meters (m) with the following formula [29]:

$$\text{BMI} = \frac{\textbf{weight (Kg)}}{\textbf{height (m)} \times \textbf{height (m)}}$$

The assessment used a descriptive percentage analysis technique to determine the overview of nutritional status based on the calculation of the weight and height index as shown in Table 1.

Table 1. BMI threshold category

	Category	IMT
Thin	Severe weight loss	< 17,0
	Mild weight loss	17,0 - 18,5
Normal	Ideal weight	> 18,5 - 25,0
Fat	Mild overweight	> 25,0 - 27,0
	Excess weight level	> 27,0

Source: [29]

2.3 Procedures

Prior to the experiment, participants were informed of the purpose and procedures of the study and expressed willingness to participate. Then students are asked to access the smart application in swimming to understand the swimming content in smart application in swimming and at the same time be able to use it when swimming lessons are being implemented. This application is known as SwimUp-Swimming Training, which is a free smart swimming application available on the Playstore, as shown in Figures 1 and 2.

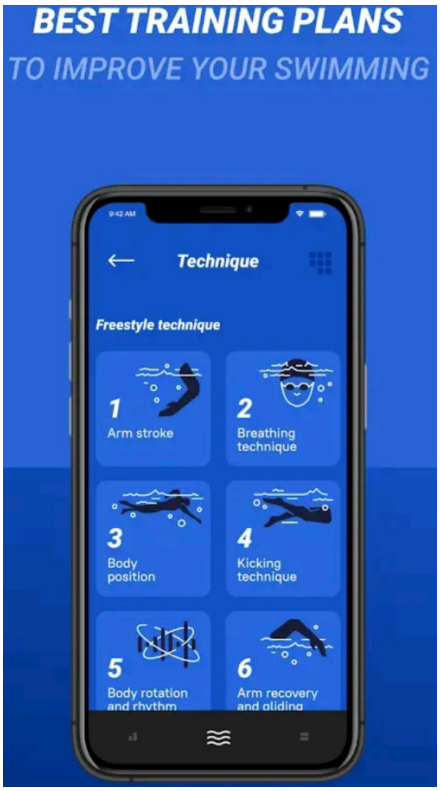

Fig. 1. Swimming training planning features

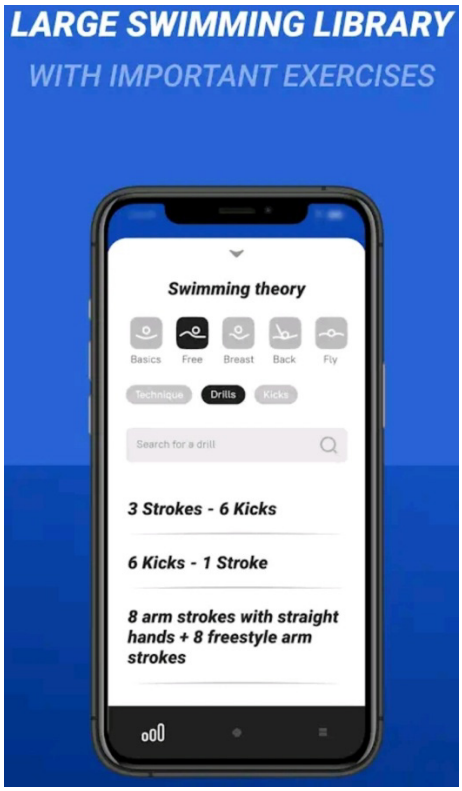

Fig. 2. Swimming theory features

Furthermore, participants then completed the learning motivation questionnaires. Nutritional status was gathered by collecting physical data of the participants, including age, height, and weight. The VO2Max of each participant was measured using Multi-Stage Fitness Test, made up of 23 stages where each stage lasts for about one minute. Each stage comprises a series of 20 meters shuttles where the starting speed is 8.5 km/hour and increases by 0.5km/hour at each stage. A single beep indicates the end of a shuttle, and three beeps indicate the start of the next stage.

Swimming lessons were conducted in 16 sessions. In each session, participants were trained with the 50-meter freestyle swimming technique. Prior to the lessons, each participant was tested for their swimming technique skills. Then learning outcomes were measured by testing the participants' swimming technique skills after swimming lessons were completed.

2.4 Statistical analysis

A Multiple Linear Regression Analysis was used to determine the factors that influence swimming learning outcomes. This analysis is in line with the study carried out [30], which states that multiple regression analysis is used to predict the rise and fall of 2 or more independent factors (learning motivation, physical activity, nutritional status, and VO2Max) on the dependent (swimming learning outcomes).

This analysis was carried out on more than 2 factors, with the following equation:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 . E$$

Information:
Y = Swimming Learning Outcomes
a = Constant,
b = Multiple Regression Coefficient
X_1 = Learning Motivation
X_2 = Physical Activity
X_3 = Nutritional status
X_4 = Maximum Oxygen Volume (V02Max)
b_1, b_2, b_3, ...bn = regression coefficient.
e = error

Before estimating the multiple linear regression models, the data used were free-deviations from the classical assumptions, which are multicollinearity and heteroscedasticity tests. This was preceded by the F_{test}, the Coefficient of Determination Test (R^2), and the t_{test}. Meanwhile, statistical analysis was performed using SPSS (Statistical Package for the Social Sciences) version 16.

2.5 Ethical considerations

This research has been carried out in accordance with 7 (seven) WHO 2011 Standards, namely 1) Social Values, 2) Scientific Values, 3) Equal distribution of Burdens and Benefits, 4) Risks, 5) Persuasions/Exploitation, 6) Confidentiality and Privacy, and 7) Approval after explanation, which refers to the 2016 CIOMS Guidelines. This

research has also been approved by the Health Research Ethics Committee of Universitas Negeri Padang (No.18.01/KEPK-UNP/II/2021).

3 Results and discussion

Before the data analysis process is carried out, it is necessary to test multicollinearity and heteroscedasticity, the results are as follows.

3.1 Multicollinearity test

Multicollinearity test is a test carried out to determine whether in a regression model there is an inter-correlation or collinearity amongst independent variables. Inter-correlation is a linear relationship or a strong relationship between one independent variable or predictor variable with other predictor variables in a regression model. Table 2 shows the multicollinearity test results with the lowest and highest tolerance values of 0.890 and 0.983 in the V02Max Learning Motivation factors above 0.1. Meanwhile, the lowest and highest VIF values of 1.017 and 1.123 were found in the Learning Motivation and the V02Max factors, which is less than 10. Therefore, the model does not have symptoms of multicollinearity, which means that there is no correlation amongst independent factors.

Table 2. Multicollinearity test results

Model		Collinearity Statistics	
		Tolerance	***VIF***
1	(Constant)		
	Learning Motivation	.983	1.017
	Physical Activity	.945	1.058
	Nutritional status	.946	1.057
	V02Max	.890	1.123

3.2 Multicollinearity test

The scatterplot graph shows the respondent's points spread out without forming a certain pattern, like in Figure 3. Therefore, it can be concluded that the regression model lacked a heteroscedasticity problem. This means there is no similarity of residual variance from one observation to another.

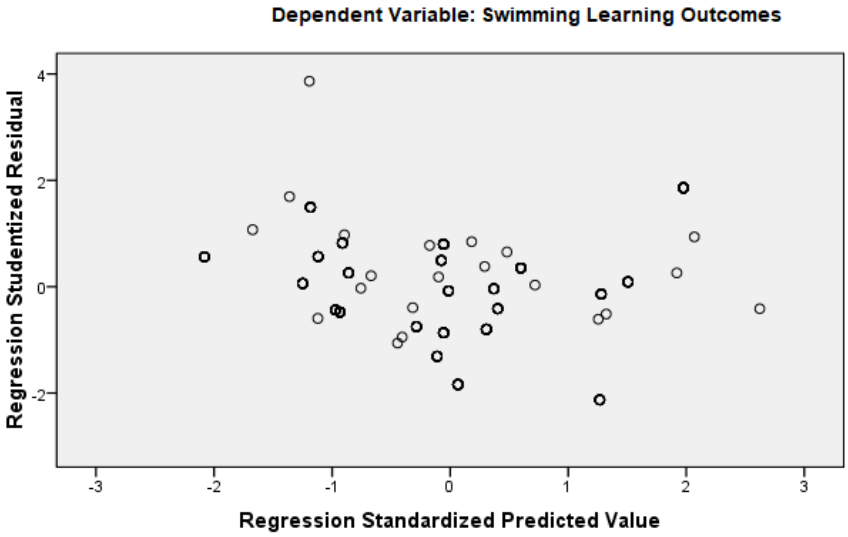

Fig. 3. Scatterplot graph

Furthermore, after 16 meetings of swimming lessons, the results of the F-Test, Coefficient of determination (R2), t-Test scores were obtained as follows:

The F statistical test shows the joint effect of the independent factors included in the dependent model. The results of the F_{test} are shown in Table 3.

Table 3. F Test results

ANOVA					
Model	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Regression	19750.161	4	4937.540	105.605	.000[a]
Residual	13792.683	295	46.755		
Total	33542.844	299			

a. *Predictors*: (*Constant*), V02Max, Learning Motivation, Nutritional Status, Physical Activity
b. *Dependent Variable*: Swimming learning outcomes

Table 3 shows that the numerator and denominator values are 4 and 295, with an F-table of 2.4022. The calculated F-value is greater than the F-table, which is 105.605 > 2.25. The significance level also shows 0.000, which is smaller than the 5% significance level (α) of 0.05, therefore it can be concluded that the independent factors simultaneously affect the dependent. Overall ,the 4 factors are learning motivation, physical activity, nutritional status, and V02Max on the dependent factor (swimming learning outcomes).

The value of the determination coefficient in the regression results is shown in Table 4, with an adjusted R-Square value of 0.589. This indicates that 58.9% of swimming learning outcomes factors are explained by Learning Motivation, Nutritional Status, Physical Activity, and V02Max. Meanwhile, 42.1% is influenced by other factors not included in the regression model.

Table 4. Coefficient of determination

Model	R	R Square	Adjusted R Square	Std. An error of the Estimate
1	.767[a]	.589	.583	6.83775

a. *Predictors: (Constant),* Learning Motivation, Nutritional Status, Physical Activity, V02Max
b. *Dependent Variable*: Swimming Learning Outcomes

Statistical t_{test} is basically used to show the influence of each independent factor in explaining the variation of the dependent factor. The percentage point of the distribution of t (df= 0.05: 394) is 1.966. The results of the calculations are shown in Table 5.

Table 5. t_{-test} calculation results

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	***Std. Error***	***Beta***		
(*Constant*)	-19.657	3.561		-5.520	.000
Learning Motivation	.541	.042	.484	12.859	.000
Physical Activity	.350	.037	.369	9.594	.000
Nutritional status	.189	.044	.166	4.317	.000
V02Max	.297	.046	.257	6.501	.000

a. *Dependent Variable*: Swimming Learning Outcomes

The regression equation is formed as follows:

$$Y = -19.657 + 0{,}541X_1 + 0{,}350X_2 + 0{,}189X_3 + 0{,}297X_4$$

Regression coefficients on learning motivation, physical activity, nutritional status, and V02Max of the dependent factors have a positive effect. Furthermore, the t-count value of each factor also shows that the t-count is greater than the t-table > 1.966, and the significance level is 0.000, which is smaller than 0.05. The effects of each factor are interpreted in Table 6.

Table 6. Each factor effects

No	Factor	t count	t table	Sig	Description
1	Learning Motivation	12.859	1,966	.000	Effect & Significant
2	Physical Activity	9.594	1,966	.000	Effect & Significant
3	Nutritional status	4.317	1,966	.000	Effect & Significant
4	V02Max	6.501	1,966	.000	Effect & Significant

The use of smart applications in various purposes is a current trend, the ease and effectiveness of this application is the main purpose of its use. Research on the use of smart applications can be found in various purposes such as youth financial management [31], science learning in primary school [32], disseminating messages and events of university colleges [33], and the formation of analytical competence of

future specialists [34], including in the field of sports education [35]. The use of smart applications in sports education, such as the smart application in swimming, is interesting to discuss, because the use of smart applications in learning to swim is something that can give students interest and interest in learning to swim. So that it affects students' swimming learning outcomes and is able to explore factors influencing students' swimming learning outcomes in sports education. Students' swimming learning outcomes are influenced by factors such as learning motivation, physical activities, nutritional status, and maximum oxygen volume (V02Max).

Learning motivation factors increases sports education students' swimming learning outcomes, because this factor has a significant level lower than 0.05, which is 0.000. Everyone has a different motivation for an activity. With motivation, a person can determine the activities carried out according to his sense of self. Thus, it is assumed that self-knowledge, motivation, and self-control significantly affect exercise intensity and can prevent stimuli that interfere with the goals to be achieved [36]. When a person is intrinsically motivated to do something, they will engage in the activity because they are interested in and enjoy it. Further, physical activity factors significantly affect swimming learning outcomes because the better a swimmer's body condition, the greater his or her ability, this factor has a significant level lower than 0.05, which is 0.000. An increase in activity leads to a rise in the body's work metabolic system, which stimulates the need for food intake. This is influenced by the level of energy needed and the metabolic used based on the activity and intensity of each teenager. More intense activity stimulates the body's metabolic system into energy and vice versa [37]. Moreover, an exercise program that involve much physical activity for 33 weeks significantly improve students' health and skills in swimming learning [38]. Therefore, it can be concluded that physical activity stimulates the metabolism of a swimmer's body into energy which affects the learning outcomes of sports education students.

The nutritional status factor significantly affects the swimming learning outcomes because a swimmer is more influential at a learning outcome, this factor has a significance level lower than 0.05, which is 0.000. Moreover, nutritional status in adolescents can also be influenced by direct and indirect factors, such as adequate nutritional intake, patterns of physical activity, food, sanitation, and economic influences. It is essential to focus on the nutritional intake of adolescents because when the amount is not intense, it tends to have a significant impact on swimmers' ability to carry out this activity.

Moreover, lack of nutritional intake also affects adolescents' immunity, which is more susceptible to disease [39]. Nutritional factors may be indirectly involved with some aspects of acute injury. Inadequate nutrition contributes to the fatigue that facilitates poor concentration and technique or it can increase risk of accidents [40]. Good physical health will significantly support a person in carrying out daily tasks without causing significant fatigue. However, physical fitness is not entirely influenced by physical activity and nutritional intake but it is also influenced by healthy living behaviours. Thus, it can be stated that physical activity and nutritional status can affect physical fitness [41]. The sample in this study comprises students in sports education. They are categorized as teenagers that are independent in choosing their nutritional

intake. Therefore, when the nutritional intake does not fulfill the body's needs, it affects negatively the ability to swim.

Furthermore, V02Max factor significantly affects swimmers, leading to a more effective learning outcome, this factor has a significance level lower than 0.05, which is 0.000. Therefore, based on the findings, the calculated t-value of the V02Max factor ranks third after learning motivation and physical activity, which indicates an important attribute. Their study is conducted to identify the influential factors in the exercise program to improve athletes' performance. All factors that affect student swimming learning outcomes can be assisted by the smart application in swimming, because of the nature of this smart application as a student self tutor in mastering swimming skills, so that it has an impact on student learning outcomes. The findings reveal that learning motivation, physical activity, nutritional status, and V02Max are interrelated and influential factors that are used to succeed in swimming learning outcomes for sports education students. In addition, optimal swimming practice impacts good swimming learning outcomes [42], [43], and supported by the use of swimming application technology [44], [45], and other technology needs [46], [47].

4 Conclusion

The results of this study reveal that smart applications are very important in supporting learning, including learning in sports education in swimming courses. The smart application in swimming helps students to be independent and become more interested in swimming courses. So that it indirectly has an impact on students' swimming learning outcomes, and it was also revealed that learning motivation, physical activity, nutritional status, and maximum oxygen volume (V02Max) have a significant effect on increasing sports education students' swimming learning outcomes. It is found that learning motivation can improve the swimming learning outcomes of sports education students. This variable provides more significant contribution compared to others. Each swimmer has a different learning motivation in swimming activities, this motivation factor is also interrelated with other related variables. The physical activity, nutritional status, and V02Max factor also significantly influence the swimming learning outcomes of sports education students. The research findings indicate that students' learning outcomes can be increased by integrating learning motivation, physical activity, nutritional status, and maximum oxygen volume variables. The factors that are tested and interact with each other can be justified in improving the quality of students' learning outcomes.

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