

# Revealing Physical Education Students' Misconception in Sport Biomechanics

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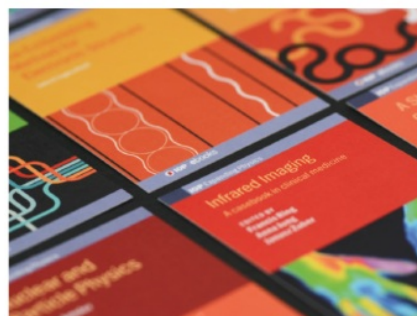
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## Revealing physical education students' misconception in sport biomechanics

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**Abstract.** The aim of this research is reveal Physical Education students' misconception in several concepts of Sport Biomechanics. The Data of misconception collected by standard question of Diagnostic Test that given to 30 students of Physical Education, Faculty of Sport, State University of Surabaya in academic year 2017/2018. Diagnostic Test completed with CRI (Certainty of Response Index) in order to collect data of students' certain in answered test. The data result of diagnostic test analysed through compilation graph of CRI right, CRI wrong and right fraction in every single question. Furthermore, students' answer result of diagnostic test categorized in to 4 quadrants, these: correct concepts, lucky guess, misconceptions, and lack of knowledge. Its categorizing data to know percentage of misconceptions that arise in every concept tested. These sport biomechanics concepts tested are limited on frictional force, deference of distance and displacement, deference of velocity and acceleration, and free fall motion. The result obtained arise misconception in frictional force 52,78%; deference of distance and displacement 36,67%; deference of velocity and acceleration 56,67%; and free fall motion 53,33%. Result of t-test in diagnostic test misconception percentage showed that percentage of misconception arises in every student above 50%.

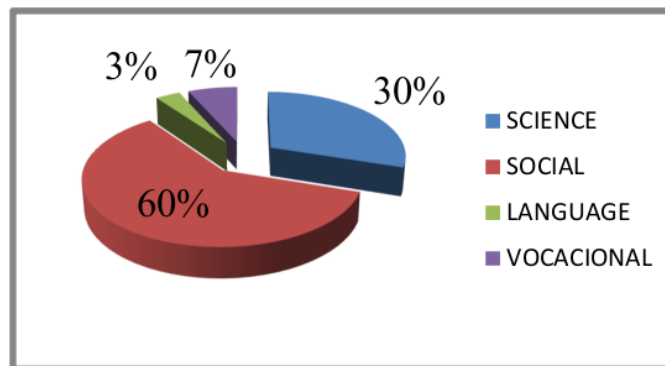
### 1. Introduction

The Students present at school with diverse experiences and ideas or thoughts on learning materials based on natural behaviour everyday [1]. The breadth of the idea differs from the background of the student and is usually different from the ideas the scientist has. The differences in the frame of mind have been described as misconceptions [2], alternative conceptions [3], preconceptions [4], alternative thinking frameworks [5], false ideas [6], and children's science [7]. to simplify the discussion, we use the term "misconception" to express ideas or thoughts that students have that are inconsistent or conflict with the generalization of ideas received by scientists [8]. Misconception is an interpretation of concepts in an unacceptable statement [9]. Brown [10] states that misconceptions are a false explanation and an idea that is inconsistent with the scientific understanding that experts accept.

Sport biomechanics is one of the study in sports education that emphasizes mechanical approaches in analyzing the movement of a professional athlete to get maximum movement. General understanding Biomechanics has been defined as the study of the movement of living things using the science of mechanics [11]. Some important mechanical concept approaches in sports biomechanics are the concept of friction, distance and displacement, speed and acceleration, and free fall motion. The wrong concept if owned by the student will lead to errors in the analysis of sports movement. Students in sports education majors are also prospective sports teachers, if the wrong concept is left then it is feared will be a source of new misconceptions in the future when working in the field of sport biomechanics.

The background of Sports Education students which 60% from high school with social majors contributes to the maturity of biomechanics materials held by students. Many students' preconceptions

are not appropriate and only on the wrong assumption. Here is the background of previous education from students majoring in Physical Education Department:



**Figure 1.** Distribution of previous education background from sports education students.

Several previous studies relevant to this research include Suana which concludes that as many as 36% of prospective students have mechanical misconceptions [12]. Tunc found that as many as 301 prospective teachers from various universities in Turkey experienced misconceptions on some Mechanics topics [13]. Bayraktar also found that the misconception of a potential physics teacher in Turkey is very strong (high) against the material of force and motion [14]. Lawrenz found that only 50% of prospective teachers answered the 11 questions correctly of the 31 questions tested [15]. Finegold states that student misconceptions are very much present in the material of Force [16].

Based on the background, the researchers took the initiative to reveal misconceptions that emerged in the students of the Department of Sport Education on several concepts of sports biomechanics such as the concept of friction force, distance and displacement, speed and acceleration, and free fall motion.

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## 2. Research method

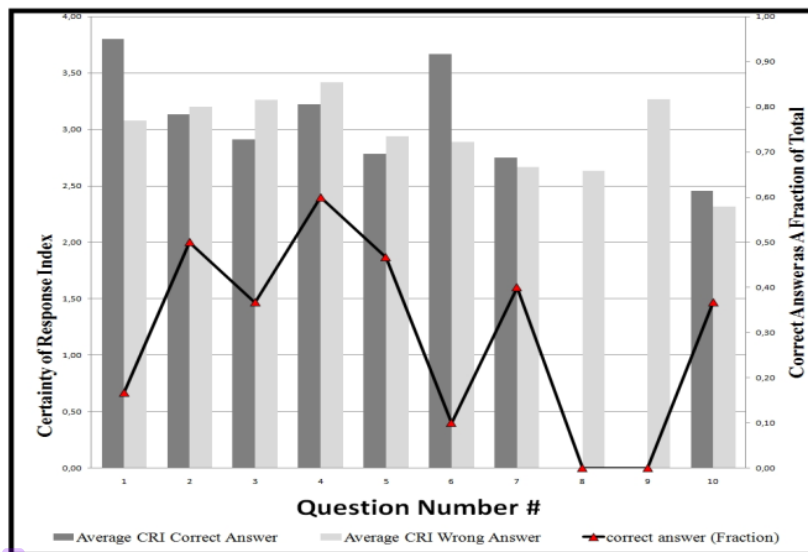
This research is a descriptive qualitative research. The sample used is 30 students Physical Education Department year 2017/2018 Faculty of Sport Science, State University of Surabaya. The instrument used is a multiple choice Diagnostic Test equipped with the reason for the answer and Certainty of Response Index (CRI) scale. The number of questions tested is 10 questions including the concept of friction force, distance and displacement, speed and acceleration, and free fall motion. The question of diagnostic tests used is a matter of standard mechanics developed by Chee [17], Suana [12], and Blazeovich [18] to determine the misconceptions used in CRI scales developed by [19]. The answers to diagnostic tests are categorized in the following four quadrants: (1) Know the concept, if the answer is correct and the CRI scale is high (3, 4, or 5), (2) Lucky Guess, if the answer is correct and the CRI scale is low (0.1, or 2), (3) Lack of Knowledge, if the answer is wrong and the CRI scale is low (0.1, or 2), (4) misconception, if the answer is wrong and CRI scale is high (3.4, or 5).

The analytical data were obtained from the diagnostic test so as to produce Correct CRI chart and Wrong CRI along with correct fraction of student's answer. The CRI is correctly obtained based on the average CRI value for the correct answer, whereas CRI is incorrectly obtained based on the average CRI value for the wrong answer. Correct answer A fraction of total is obtained based on the results for students who correctly answer the total number of students. Analysis of Diagnostic Test answers followed by categorization of student answers based on 4 categories. Non-parametric statistical analysis of t-tests was then performed to determine the level of misconceptions in students [20]. The paired t-test is performed after the assumption of sample normality is met. The diagnostic test data of misconception

categorization is t-tested to get general conclusion of misconception rate that happened to student above 50%. Each misconception is assigned a value of 1 and other than the misconception category is given a value of 0, so the high value indicates high misconception and otherwise.

### 3. Result and discussion

The results of the Diagnostic Test which consists of 10 questions covering several concepts in sports biomechanics are expressed in graphical form between Correct CRI, Wrong CRI, and Correct Answer Fraction of Total student obtained as follows:



**Figure 2.** Chart based on the results of 30 physical education students who took the diagnostic test. the bar graph shows the values of the average cri for correct and wrong answers, for each question. question numbers are shown on the horizontal axis

Based on Figure 2, the CRI chart is correct, CRI is wrong, and the Correct Answer Fraction of Total shows that in the case of numbers 1 to 6 (the matter of frictional force) CRI is very high with a low true fraction (the number of students is very high) indicates that there are many misconceptions which occurred in the span of the problem. In problem 7 (the question of distance and displacement) and 8 (the question of speed and acceleration) shows the same thing that is wrong CRI is high and the true fraction is low even the absolute number 8 all students answer the wrong answer, it shows the existence of misconception on college student. In the case of numbers 9 and 10 (the question of free fall motion) also shows the existence of misconceptions even in question number 9, all students absolutely answer the wrong answer.

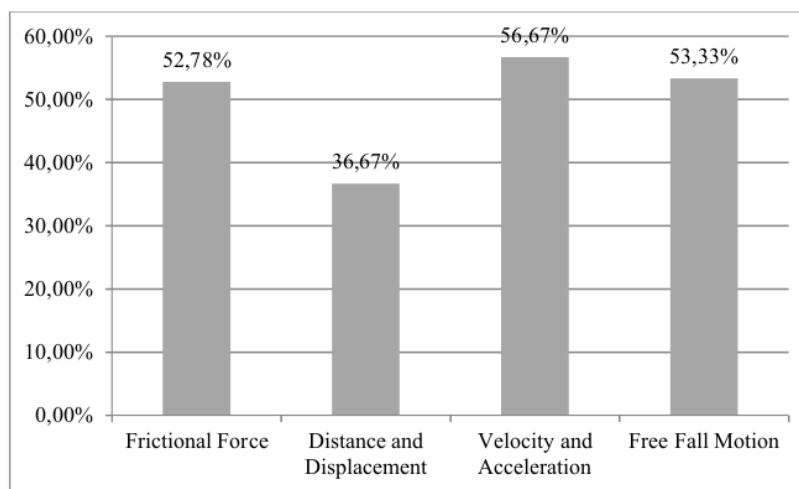
Based on the mapping of diagnostic test results 30 students also found the category in 4 quadrants with category of Misconception, Correct Concept, Lucky Guess, and Lack of Knowledge as follows:

**Table 1.** Result of diagnostic test categorized in 4 category.

Question number	1	2	3	4	5	6	7	8	9	10
Misconceptions	20	14	17	11	11	22	11	17	25	7

Question number	1	2	3	4	5	6	7	8	9	10
Correct Concepts	5	13	8	15	11	3	5	0	0	6
Lucky Guess	0	2	3	3	3	0	7	0	0	5
Lack of Knowledge	5	1	2	1	5	5	7	13	5	12

Based on the distribution of data in Table 1 it can be seen that the categories of misconception are dominant in every aspect of test diagnostic tested. From 30 largest misconceptions students found in questions 1, 6, and 9 each more than equal to 20 students. the least number of misconceptions is found in question number 10 is 7 students. based on data spread of student misconception can be determined the percentage of misconception that occurred in each concept is as follows:



**Figure 3.** Graph of the percentage of misconceptions on each concept.

Based on figure 3 it can be seen that there are quite high misconceptions in every category of sports biomechanics concepts tested. the highest misconception occurred on the concept of velocity and acceleration of 56.67% and followed by consecutive free fall motion concept of 53.33%, frictional force concept 52.78%, and the lowest misconception on the concept of distance and displacement 36.6%. in general the percentage of misconceptions high enough indicates that there is still need for further individual improvement to overcome or reduce the misconceptions that occur in the students of sports teacher candidates in the field of sports biomechanics.

Furthermore, based on the results of diagnostic tests mapped also misconceptions of each individual and then tested statistically parametric extent of the misconception that occurred in the classroom.

**Table 2.** Distribution misconceptions that occur in each student.

Name	Misconceptions	Name	Misconceptions
A	5	P	7
B	6	Q	3
C	5	R	5
D	7	S	5
E	7	T	4
F	2	U	3
G	0	V	4

Name	Misconceptions	Name	Misconceptions
H	5	W	10
I	3	X	5
J	8	Y	5
K	6	Z	6
L	5	AA	7
M	4	AB	2
N	8	AC	7
O	8	AD	3

After passing the normality test and the data stated Normal then subsequent data based on the spread of misconception in each individual hypothesis test and obtained data  $t_{count} 0,042 < t_{tabel} 1.699$  so  $H_0$  accepted that misconception that occurs in each student is above 50%.

The results of this study are highly relevant to some of previous [12, 13, 14, 15, 16]. In the study generally address the misconceptions that appear in each individual prospective teachers in their respective fields. this study shows the existence of misconceptions in sports biomechanics in prospective sports teachers. with the emergence of misconceptions it is expected that there is a grand formulation of instructional design in sports majors, especially the right sport biomechanics course to reduce the consistency of misconception considering the background of 60% sport students coming from social science in senior high school.

#### 4. Conclusion

Based on the results of the Diagnostic Test of Sport Biomechanics, the conclusion of misconceptions occurred in the students of Physical Education with the percentage of friction force concept of 52.78%; the concept of distance difference and 36.67% displacement; the concept of speed difference and acceleration 56.67%; and the concept of free fall motion 53.33%. T-Test Result on Diagnostic Test of percentage of misconception category shows the percentage of misconception that happened to every student above 50%, this is as revealed in [12, 13, 14, 15, 16].

Subsequent research of these findings is expected to develop appropriate methods or models including grand formulation of instructional design to reduce misconceptions that appear in Sports Education students or at least analyze the determinants of the emergence of misconception in order to minimize the misconception of Sports Education students in Sport Biomechanics.

#### Acknowledgement

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