

Accidental Teachers' Mistakes in Solving Physics Problems: Teachers *Didactogenic*

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Abstract—There are many studies was conducted to analyze the relation between teacher's knowledge and student's achievement. But, none of the study that discuss about teachers accidentally-mistakes in solving physics problem. The aim of this study is to describe *didactogenic* or the teacher's mistake which accidentally happened that can cause students misconception based on gender. The participants of this study were 6-man teachers and 6-woman teachers who represented six subdistricts in Pontianak City. They were asked to assess about several physics' problems by answer, correct and incorrect. Three concepts in the study were Newton's First Law, Newton's Second Law, and Newton's Third Law. There were eight questions represented the concepts. The Results reveals most of teacher's comments have *didactogenic* both men and women. There are five (5) men and four (4) women had *didactogenic* on Newton's First Law, All participants on Newton's Second Law, six (6) men and five (4) women on Newton's Third Law. According to the results of this study, the man teachers have more *didactogenic* than woman teachers. Incorrect answer can make teachers do more *didactogenic* than correct answer. This study recommends in order to analyze cause and impact of teachers *didactogenic*, and how to decrease it.

Keywords—*teachers didactogenic, newton's law*

I. INTRODUCTION

Teacher quality is one of the fundamental factors that give many influences on student's achievement [1]. Teacher ability on class management can improve student's achievement [2]. On the contrary, "bad teacher" can decrease students' motivation [3]. Teachers must have good conceptions when teaching on the class [4]. Teacher who do a mistake on teaching show negatif impact for students' achievement [5]. However, many studies found that many teachers have mistaken on any concepts[6].

When doing a mistake on describing a concept, teacher also create student misconceptions[7]. Students misconceptions has negative influence on students' motivations[8]. Not only teacher, text book also can cause students misconceptions [9][10]. Because of that, a teacher must have good understanding about the concept, studying from the book or others reference.

Teachers mistakes has happened on almost the subject, especially in physics. On this subject, there are many teachers mistake even they have misconceptions, such as Newton's Law[11], object's moving [12], simple pendulum [13]and astronomy [14]. Its difficult to find teachers mistakes on physics, because subject or participants on many studies are not teacher. Most of them are just pre-

service teachers that from college environment such as on study ofoptice geometry [15]static electric [16], nature of matter [17], simple electric circuit[18], electric current [19], electric field [20], Newton's Law [21], astronomy [22][23][24]and heat and temperature [25].

The study of teacher mistake or misconceptions on physics educations it's just a few, because of an opinion that teacher has manage the concepts correctly [26]. Beside of that, the best method to describe teachers mistake is still not found. The method like diagnostic test, one tier [27], two tiers [28][29], three tiers [30], four tiers [31], open ended questions [32], and interview [33] are not effective. Because, those method just used to pre-service teacher and student, not to native teacher. Researcher think and worried that teacher is not cooperative when they know as a participant on the study. Because of that, the best method to describe accidental teachers' mistakes is needed.

One of the methods that can use to describe teachers' mistakes is ask them to assess students answer about any concepts [34]. In this method, teachers will don't know that they are as a participant or subject on the study. This study applies this method, and ask the teacher to asses several problems with answers that make by researcher. Teacher will write their conceptions about any problems that given. There is a possibility, teacher will be doing accidentally mistakes. This accidentally mistakes (on understanding and describing a concept) can cause student misconceptions. The term of this condition is called teachers *didactogenic*. Research question in this study are:

1. What is the type of physics teacher *didactogenics* on force and motion?
2. How is physics teacher *didactogenic* based on gender?

The rest of this paper is organized as follow: Section II presents a rudimentary on didactogenic and misconceptions. Section III describes proposed research method of this work. Section IV presents the obtained results and following by discussion in section V. Finally, Section VI concludes this work.

II. DIDACTOGENIC AND MISCONCEPTIONS

Teachers can make an accidentally mistakes when teach any subject on the class. The accidentally mistakes can called teacher *didactogenic*. *Didactogenic* is an accidentally mistake that doing by writer or teacher when describe a concept and can make reader or student have misconceptions [34]. Although, most of the Pre-service teacher accidentally mistake is about s understanding and describing a concept. Term of misconceptions is not used,

because it has negative sense for teacher or any professional program (writer, lecture, doctor, etc).

In physics, there are some study that found teacher and writer accidentally mistake. The accidentally mistake is inconsistently on predict [35]. On the third Newton's Law, teacher didn't write negative mark (-) when describing the formula [36]. On textbooks, Zajkov, *et al.* in [10] found that any writers had done accidentally mistakes in electric current and magnetic field that can create misconceptions. Misconception is a condition when someone or students have different conceptions that allowed by the scientist or professional in a field[37]. Term of misconception is also used to describe incorrect convictions about a concept based on th experience [38]. Misconceptions also have negative impact on student's achievement [8]. Then, misconceptions are a conception that different with scientist and has negative impact on student achievement.

III. PROPOSED METHOD

This study is qualitative research that focus on teachers accidentally mistake that represented by their comment on several physics' problems. They ask to assess any several physics problems about force and motion. The comments of teacher become data in this study. Population in this study is all physics teachers on senior high school in six subdistrict Pontianak City. Total of the teacher cannot be determined, because not all the teacher has been recording on Educational Official Pontianak. Just 58 teachers that record on this department.

Purposive sampling is used on this study. It is non-probability sampling, where the quantity of sample is not considered. In purposive sampling, sample that selected based on criteria [39]. Participant on this study was 12 physics teachers that represented six (6) subdistricts on Pontianak City. The criteria on this sampling was all the senior high school physics teachers from private or national school that teaching minimal one (1) year in six subdistricts.

Instrument of this study is a sheet of observation heading of teacher comments about several physics problem with answer. The instrument was adapted from the study that doing by[27]. There are two (2) procedures of this study, planning and implementation.:

A. Planning Phase

The stages of this phase are (1) collecting the information about teachers *didactogenic* (2) Searching the question that will be adopt. (3) doing and answering the questions (4) Testing the validity of instrument (5) Testing the reability of instrument.

B. Implementation Phase

The stages of this phase are (1) asking12 teachers to assess the several problems with answers about force and motion (2) analyze comments of the teachers (3) drawing the result of this study.

IV. RESULTS

Data was analyzed to describe teachers *didactogenic* about force and motion (Newton's Law) based on gender. Table I show the number of men teachers who have

didactogenic and Table II women teachers. These tables I and II shows teachers *didactogenic* on four concepts.

TABLE I. MEN TEACHERS WHO HAVE *DIDACTOGENIC* ON EVERY CONCEPTS.

Teacher Code	First Newton's Law		Second Newton's Law		Third Newton's Law	
	Item 3	Item 4	Item 5	Item 6	Item 1	Item 2
NH	1	1	1	1	1	0
AK	1	1	1	0	1	0
SM	1	0	1	0	1	0
HY	0	0	1	0	1	0
KS	1	0	1	1	1	0
RV	1	0	1	0	1	0
Total	5	2	6	2	6	0

TABLE II. WOMEN TEACHERS WHO HAVE *DIDACTOGENIC* ON EVERY CONCEPTS

Teacher Code	First Newton's Law		Second Newton's Law		Third Newton's Law	
	Item 3	Item 4	Item 5	Item 6	Item 1	Item 2
RN	0	0	1	1	1	0
RS	1	1	1	0	1	0
LS	1	0	1	0	1	0
ET	1	1	1	0	0	0
SR	1	1	1	0	1	0
NU	1	0	1	0	0	0
Total	5	3	6	1	4	0

A. First Newton's Law

On first newton's law, item 3 and 4 there are five (5) men teachers have *didactogenic*. Two (2) teachers have incorrect conceptions and three (3) teachers give inconsistence comment. There are seven (7) comments show *didactogenic*. One of the comments is "term of stop must be described; indeed, the plan will stop moving if the machine is turned off".

There are three (3) teachers give inconsistence comment, show that they are hesitant to write the concept of first newton's law. It can cause student misconceptions. For example, item 3 a teacher said, "this object will stop moving, it's caused by the machine is turned off and this object stay on the space far away from gravitation force". His impression shows that force is a property of an object, an object has force and when it runs out of force it stops moving. But, on item 4 shows that his impression contrast with their impression on item 3. They think that although an object loss of the force, they still move.

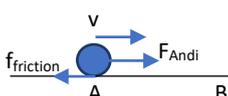
On the same concepts, therea are five (5) women teachers have *didactogenic*. Three (3) teachers have incorrect conceptions and two (2) teachers give inconsistence comment. There are eight (8) comments show *didactogenic*. One of the comments is "when an object lost their force, this object will stop immediately because ($\sum F=0$)". There are two (2) teachers who give inconsistence comment. One of the comments shows that when an object lost their force, this object will stop immediately (item 3), but on another (item 4) their impression show that it is not necessarily the resting object lost their force.

Based on the result, on first Newton's law, the number of teachers *didactogenic* from men and women teachers are

same (five men teachers and five women teachers). But there is a different thing from the number of incorrect conceptions and inconsistency comments from men and women teachers. The teachers who have incorrect conceptions think that “when an object lost their force, it will stop moving immediately”.

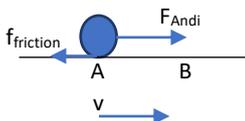
B. Second Newton’s Law

On second newton’s law, item 5 and 6, all participants (six men teachers) has *didactogenic*. Two (2) teachers have incorrect conceptions and so do teachers give inconsistency comment. There are eight (8) comments show *didactogenic*. Most of participants think that “the motion of an object is always in the direction of the net force applied to the object”. One of the comments that contain *didactogenic* is “The diagram is incorrect, it must be:”



From this comment, we know that its impression show that the motion of an object is always same with the direction of the net force.

There are two (2) teacher give inconsistency comment. For the example, item 5 “the motion of the ball is slowed down by friction force and after moving on several time, the ball stop at B, and the diagram is



From the diagram, we know that the teacher thinks the direction of the net force same with the direction of an object. But, on item 6, his/her impression show that the direction of the net force is not always same with the direction of an object.

On the same concepts, there are six (6) women teachers have *didactogenic*. Most of them give inconsistency comments and one (1) teacher has incorrect conceptions. There are seven (7) comments show *didactogenic* from women teachers. One of these comments is “Andi give the force to the ball that is bigger than the friction force, so the ball move to B and the diagram is:



Almost the participant (5 female teachers) give inconsistency comments. Third impression is the direction of the net force always in the direction of the motion of an object (item 5). But, on the another (item 6) they think contrast from before. Based on the result, all participant has *didactogenic* in second Newton’s law. But there is a different from amount of teacher’s incorrect conceptions and inconsistency comments. Teacher who have incorrect conceptions think that “the motion of an object is always in the direction of the net force applied to the object”.

C. Third Newton’s Law

On third Newton’s Law, item 1 and item 2, all men teachers have *didactogenic*. They have incorrect conceptions about this concept. They think that large objects exert a greater force than small objects and agree with the answer that given to them although the answer describe incorrect concepts.

On the same concepts, there are four women teachers who have *didactogenic*. They have incorrect conceptions. One of the comments is “based on second newtons law, mass is comparable with force. So, the force exert by Andi is greater than the force exerts by tube”

Based on the result, there are the different number of men and women teachers that have *didactogenic* about this concept, six (6) men teachers and four (4) women teachers. The *didactogenic* about third newtons law from all participant is large objects exert a greater force than small objects

V. DISCUSSION

This study aims to describe physics teachers *didactogenic* based on gender about force and motion. Data was obtained based on teachers comments about several physics problem with answer that made by researcher. In this study, three concepts that investigated are first newton’s law, second newton’s law and third newton’s law.

There are five (5) men teachers and so do women teachers have *didactogenic* on first newton’s law. They think that Force is a property of an object. An object has force, and when it runs out of force it stops moving. “Ref.[40]” found similar result about teachers’ conceptions, their impression is motion is force, no motion no force. It causes students misconceptions[38]because the accidental teachers mistake or teachers *didactogenic*.

On the second newton’s law, all participant has *didactogenic*. They impression is the motion of an object is always in the direction of the net force applied to the object. This result is same with [41]and [42]. Teachers think the direction of the net force is same with the direction of an object motion. It is caused by the impression about intrinsic force that make object always move based on the direction force act on the object [27].

On the third newton’s law, there are six (6) men teachers and four (4) women teachers have *didactogenic*. They impression is large objects exert a greater force than small objects. It is similar with [42] who found same teachers’ conceptions is like that.” Ref.[44]” also found 75% from the sample (teachers) that think large object exerts greater force.

There are some reasons why teachers have *didactogenic*.” Hestenes, *et al.* in [27]” said that because of the impression of active force or impetus. The impetus can make an object always move. The teacher is confused to decide a pair of force. As an additional, he said that interaction factor from the example of event, such bigger object will show greater force. Teachers also think that force is property of an object that appear from the interaction of two object [45] and often associate a concept to another concepts [46]. Other reason is teacher feel difficulty to determine the direction of force that different with the

direction of an object [41]. Teacher also don't know about the meaning of term net force [46].

VI. CONCLUSION

In this study, all participants (12 teachers) have *didactogenic*. Based on gender, men teacher has more accidental mistakes than women. As instrument, incorrect answers are potential to show teachers *didactogenic*. There are two types of teachers *didactogenics* about Newton's Law in this study. The types are incorrect conceptions (misconception) and inconsistency when give comments about the concepts.

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