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ABILITY PROFILE OF MULTIPLE REPRESENTATIONS (MR) STUDENTS OF TEACHER PROSPECTIVE ON STATIC ELECTRICITY TOPIC

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ABSTRACT

The purpose of this study is to identify the profile of multiple representations ability of physics education teachers student prospective on the topic of static electricity. The research method is descriptive method that describes the ability of MR profile teacher students prospective that includes the format: 1) verbal representation; 2) mathematical representation; 3) representation of graph, and 4) a pictorial representation (drawing/ diagram). The research instrument consists of 16 item multiple choice questions with 5 options (there are four items for each representation format). The quality of student representation capability based on the accumulated answer to each student representation format qualitatively made in four categories, namely: 1) the category of excellent with a score of 4; 2) good category with a score of 3; 3) poor category with a score of 2; and 4) the category of very poor with score of 1. Study participants were 31 students majoring in physical education in fifth semester academic year 2012 that had followed the School of Physics course. The results of this study indicate that the ability of the highest student representation on the topic of static electricity is the ability of verbal representation (80.6% verbal representation capabilities of students is in a good and excellent categories). The next representation ability is the mathematical representation (71.0% is in the good and excellent category). While the pictorial representation of only 35.5% which is in good category and 65.5% is still in the poor and very poor category. The lowest representation ability is the graphical representation format (only 22.6% in good category, while 77.4% are in poor and very poor category).The average scores and standard deviation from the highest to the lowest are: verbal representation with $\bar{x}$ = 2.84 ± 0.64; mathematical representation $\bar{x}$ = 2.65 ± 0.71; pictorial representation of the $\bar{x}$ = 2.23 ± 0.68, and the graphical representation of $\bar{x}$ = 1.97 ± 0.72.

Keywords: *Multiple representations, verbal representations, mathematical representation, pictorial representation, graphic representations*

INTRODUCTION

Physics is a branch of science that studies the phenomena of nature. The scientists construct the concepts and theories abstractly to represents the symbol to explain the phenomenon of nature. So that it becomes difficult to understand for the student. It makes physics sometimes are feared by students. Redish, 1994 in Ornek et al.1, (2008) indicates that physics was difficult to the student because of the physics requires various representations such as in words (verbal), graphs, equations, tables, and sketch. To study the subject matter of physics, students need the ability to use algebra and geometry generally and specifically. Angell

et al.2 (2004) has explored the opinion of students and teachers about physics and the results indicate that the physics is difficult because it have the experiments, formulas and calculations, graphs, and conceptual explanation at the same time. It is also requires a transformation between these representations such as from the graphical representation into a mathematical representation.

Representation is something that symbolizes or represents objects and/or process (Rosengrantet al.3, 2007). Multiple representations (MR) is a way to represent a concept in various representations (Prain& Waldrip,4 2006). MR covers verbal representation, mathematical representation, pictorial (image / diagram), and the graphical representation. Verbal representation is a good way to express a concept, definition or process by oral or writing. Mathematical representation helps quantitative reasoning which are useful to solve quantitative problems. In addition, the mathematical representation can facilitate students to understand a verbal quantitative explanation. For example, the concept of the electric force in the verbal representation will be more easily understood by students when it represented in a mathematical format. Graphical representation is useful to represents a long verbal explanation of a concept that is related to other concepts or variables. Therefore the ability to create and read a chart is a very important skill. Pictorial representations (drawings/diagrams) represent a real object or concept in the form of sketches/diagrams. As well as in the electrical diagrams, free-body diagram in the mechanics are very helpful for students to identify the features of the problem more easily and make conclusions directly in solving the problem.

Good representation can convey ideas and information to students significantly and effectively. So that the ideas and informations can be stored in long term memory as an organized body of knowledge (Arends5, 2008). Ainsworth6, (2006) stated that the use of multiple representations (MR) is good for teaching an abstract scientific concepts. Represents the phenomena or concepts of physics with a variety of formats such as verbal, drawings or sketches, diagrams and equations (mathematical) is seen as an important strategy in learning physics. Several studies was related to multiple representations in learning can enhance student's understanding of the concept include the study results of Adadan et al.7 (2009) and Abdurrahman8, (2010) that learnimg with multiple representation; and the study result of Prain, et al.9 (2009) indicate that multiple representation learning effective to improve students' understanding of concepts as well as to improve the knowledge of teachers on students' understanding.

Etkinaet al.10 2006) suggests that skills represent the concepts of the scientific competencies that must be mastered by the teacher. Furthermore in Kaudafelt11, (2008) stated that a teacher must have an instructional intelligence to represent concepts that can challenge

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students to think. Thus, it is a necessity for prospective teachers to master the abilities/skills in teaching multiple representations before becoming a professional teacher.

METHODOLOGY

This research is descriptive method. The purpose of the research is to reveal how the ability of MR (verbal representations, mathematical, pictorial, and graphics) student teacher physics prospective. The study was conducted in one of the physical education program LPTK in North Sumatra. The participants involve 31 students majoring in Physical Education 2012 5th semester which has followed the School of Physics course. The research instrument consisted of 16 items of multiple choices. Each question has 5 options in static electricity topic in the School of Physics. Item tests include verbal, mathematical, charts, and graphs representations (there are four items for each representation format). For each item on the correct answer was given a score of one. To reveal how the capabilities of MR in every format it is necessary to count the data description (frequency, percentage, mean, standard deviation). The quality of student representation capability based on the accumulated answer to each student representation format qualitatively made in four categories, namely: 1) the category of excellent with score of 4; 2) good category with score of 3; 3) poor category with score of 2; and 4) very poor category with score of ≤ 1.

RESULT AND DISCUSSION

The statistical description of data representation ability of students in this study are shown in Table 1.

Table 1. Descriptive statistics of score multiple capabilities representation

Parameter		Verbal	Matematis	Pictorial	Grafik
N	Valid	31	31	30	30
	Missing	0	0	1	1
Mean		2.84	2.65	2.23	1.97
Std. Deviation		.638	.709	.679	.718
Minimum		1	1	1	1
Maximum		4	4	3	3

Table 1 presents the descriptive statistics (frequency, percentage, mean, standard deviation) of multiple representations of student ability in verbal representation, mathematical representation, pictorial representation, and graph representation format. These results indicate that the average score of the ability of the students representation from the highest to the lowest are verbal representation: $\bar{x}=2.84 \pm 0.64$;; mathematical representation of the $\bar{x}=2.65 \pm 0.71$;

pictorial representation of the $\bar{x}$=2.23 ± 0.68, and the graphical representation of $\bar{x}$=1.97 ± 0.72.

The quality of each student representation format based on the cumulative score of the student answers on the representation as shown in Table 2-5. Based on Table 2-5, the best representation of the student's ability category is the verbal representation which 77.4 % of students were in the category of good and excellent, but there are still 22.6 % in the poor and very poor category (Table 2.)

Table 2. Distribution of quality of verbal representation.

Parameter		Frequency	Percent	Valid Percent	Cumulative Percent
Score	1	1	3.2	3.2	3.2
	2	6	19.4	19.4	22.6
	3	21	67.7	67.7	90.3
	4	3	9.7	9.7	100.0
	Total	31	100.0	100.0	

The next ability is mathematical representation ability that is about 64.5 % and in excellent and good category while 35.5 % is still in poor and very poor (Table 3). This happened because the inconsistencies of student in understanding physical meaning of mathematical format, so the students had difficulties in solving the problem about that mathematical format. Like electricity force in two charged point that are separated by some distances is equal to each charged point. But there are still many students who still don't understand this concept.

Table 3. Distribution of quality of the mathematical representation

Parameter		Frequency	Percent	Valid Percent	Cumulative Percent
Score	1	2	6.5	6.5	6.5
	2	9	29.0	29.0	35.5
	3	18	58.1	58.1	93.5
	4	2	6.5	6.5	100.0
	Total	31	100.0	100.0	

The pictorial representation is only 36.7 % in good category and 63.3 % in poor and very poor category (Table4). From the discussion and investigation result in student's answers found that more than 50 % of the students have not yet represent the concept of electrical static on a two charged point in pictorial point. It is also found that students cannot implement the concept of vector on other physical quantities such as electric force and electric field. Whereas the pictorial representation of vector quantities is the basic pictorial representation from many physical quantities in physics.

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Table 4. Distribution of quality of pictorial representation

Parameter		Frequency	Percent	Valid Percent	Cumulative Percent
Score	1	4	12.9	13.3	13.3
	2	15	48.4	50.0	63.3
	3	11	35.5	36.7	100.0
	Total	30	96.8	100.0	
Missing	System	1	3.2		
Total		31	100.0		

The lowest representation is in graphical representation that is only 23.3 % in a good category while 76.7 % in poor and very poor category (Table 5). For graph format students experienced the difficulty in identifying the graphic that is related to mathematical representation. The students also had difficulty to interpret the relation between variables in a graphics.

Table 5. Distribution of quality of the graphical representation

Parameter		Frequency	Percent	Valid Percent	Cumulative Percent
Score	1	8	25.8	26.7	26.7
	2	15	48.4	50.0	76.7
	3	7	22.6	23.3	100.0
	Total	30	96.8	100.0	
Missing	System	1	3.2		
Total		31	100.0		

Results of interviews with students and lecturers course, that the tasks and learning approaches generally rely on a mathematical representation combined with explanation (verbal). Students are also more comfortable to resolve the problems associated with formula or mathematical equation. In the course by lecturers pictorial and graphic representations rarely shown. Likewise in the students' tasks, pictorial and graphic representations almost never used as a learning goal. Problems created by lecturers generally only focused on the mathematical representation. This makes students unskilled/able to represent concepts in other representations. This situation according to Kohl and Finkelstein12 studies, which found that the representation of the tasks on mathematical format is a higher representation of the graphical representation.

Findings profile representation ability of students in this study suggests that learning with a variety of formats representations (multiple representation) is very necessary. This is in accordance with the recommendations of science education researchers lately like Hubber et al.13; Prain et al.9, who recommended that effective science learning students need to understand the various formats of representation to express a concept. According to Kohl, et al.14 that multiple reresentation is a key capability in learning physics

CONCLUSION

The result of this study indicates that the ability of the highest representation of students on the topic of static electricity is verbal representation capabilities (80.6% verbal representation capabilities of students are in the category of good and excellent). Next ability representations are representations of mathematical ability (71.0% of students were in the categories of good and very good). While the pictorial representation of only 35.5%, which is in good category and 65.5% are still in the category of less and poor. The lowest ability representation of the fourth representation format is the ability of the graphical representation (only 22.6% in both categories, while 77.4% are in the category of less and poor).

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