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Pre-Service Physics Teachers' Research Activities by Research-Based Learning

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ABSTRACT

The activities of prospective teachers in the learning process are very important to show the quality of the learning process, particulary research activities. This paper is intended to analyse the research activities of pre-service teachers and their responses in the learning process using research-based learning models. Descriptive qualitative designs were tested by applying qualitative approaches and case studies. Furthermore, data was collected from observations, field notes, interviews, and questionnaires given to 20 pre-service teachers at private universities in Lampung, Indonesia. Data taken from observations and questionnaires were analysed descriptively and then categorised into various categories ranging from very bad to very good. Data collected from interviews were analysed through interactive models, data reduction, data exposures and additions. The findings indicate that pre-service teacher research activities include: identifying problems, formulating hypotheses, preparing research plans, analysing data, drawing conclusions, increasing for three meetings and developing significantly in general. In addition, the research activities of pre-service teachers are considered good. This research is important for the scientific education community, especially in developing future teacher research skills.

Keywords: pre-service teachers, research-based learning, research activities.

INTRODUCTION

Learning is an activity and interaction that involves the teacher, students and the surrounding environment to achieve goals. One of the learning objectives can be achieved through the selection of the right learning model. Trianto (2015: 26) argues that there is no single best learning model, partly because each learning model is 'good' when tested on certain subject matter. This means that lecturers need to consider learning models that are in accordance with the subject matter. In addition, pre-service teacher activities are part of the learning process. There is no activity without learning. Pre-service teacher learning activities

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can be formed with the research process. The research process consists of identifying problems, formulating hypotheses, compiling research plans, analysing data and drawing conclusions (Vina Serevina, 2015). Pre-service teachers find problems related to learning and then get a solution to the problem. This concludes that pre-service teacher learning activities will determine the quality of learning.

Research activities are useful activities with problems that occur in the field. Problems found will get solutions from theoretical studies. The printed theories will build critical thinking and the ability to overcome problems that can be accessed through research activities. Research activities will support this profession in the future. However, teacher knowledge about research skills is still limited (Udompong, Traiwichitkhun, & Wongwanich, 2014). A learning model that trains the research skills of prospective teachers is required. Guided inquiry and open inquiry, which has positive implications for students to be more independent and creative (Zulfiani & Herlanti 2018).

Based on the observations and experience of researchers at the University; Pre-service teachers often have difficulty in analysing data and identifying problems, which is a so serious concern for lecturers. In general, pre-service teachers only learn through theory and do not discuss real problems that are relevant to the theory. Learning for pre-service teachers focuses more on knowledge than understanding science in the events or situations they face in everyday life (Çepnİ & Ülger, 2017). Teachers must be selective in choosing the right learning model to be able to develop the ability to analyse data and identify problems. The analysis and identification of problems can be formed through learning models that integrate research and learning (Blume et al., 2015; Brew & Jewell, 2012). Finally, research-based learning is recommended. The research-based learning model has several components, problem-solving, investigation, collaboration and other skills needed by pre-service teachers (Lee, Wu, & Tsai, 2009; Siegel, 2005). This model has various advantages, namely: 1) providing research experience as initial knowledge to prepare students' final assignments, 2) having the final results of knowledge applications; 3) developing systematic thinking, critical and logical thinking, scientific thinking, collaboration and communication, 4) not needing specific topics in the research process and 5) directly involved in environmental problems (Sonja & Broek, 2012; Wilson, Parkin, & Thomas, 2012; Zhu & Singh, 2012).

Research-based learning not only improves understanding, but also involves pre-service teachers as science producers, who will examine the products they produce with existing theories (Brew & Jewell, 2012; Guinness, 2012; Huang, Hwang, & Chen, 2014; Lambert, 2009; Langbeheim, 2015; Ming, 2012; Smith & Rust, 2011; Walkington et al., 2011). Research-based learning models can the ability to solve problems (Hunaiti & Grimaldi, 2010). In addition, research-based learning can have a better effect on critical thinking, open-mindedness, creativity, responsibility, collaboration and skills in the 21st century (Jiang & Roberts, 2011; Rodniam, Kaewurai, & Kaewurai, 2004; Walkington et al., 2011). The focus of this study relies more on the research activities of pre-service teachers in the learning process through research-based learning models. The research activities include: identifying problems, formulating hypotheses, compiling research plans, analysing data, and drawing conclusions.

The concept of research-based learning is based on a social constructivist perspective. Achieving success in learning can be done by honing the role of students through social interaction involving teachers and students in their proximal zone (Vygotsky, 1978). Student access is obtained through research that contributes to facilitating teaching activities, while the purpose of learning activities is to solve problems realistically and practically in the original settings. For research-based learning, this arrangement refers to realistic human settings, so students must engage in 'at work' activities rather than following a didactic explanation of abstract concepts. The argument is that students can approach unknown

problems and provide appropriate solutions. Research activities carried out in groups can develop social interactions through communication and dialogue.

Research-based learning aims to create active learning analysis, synthesis, development of insights and evaluation and to improve the ability of students and educators in terms of the assimilation and application of knowledge. Research-based learning can be supported by laboratory activities, web, journals and other activities (Al-Maktoumi, Al-Ismaily, & Kacimov, 2016; Arcidiacono, et al., 2016; Botelho, et al., 2013; Gamarra, et al., 2010; Gao & Lei, 2016; Knutson, et al., 2010; Liu & Li, 2011a; Simpson & Bourner, 2007; Svihla, 2014). Forms of learning-based learning include: enriching learning activities with contemporary research issues and learning processes with small-scale research activities (Guinness, 2012; Lambert, 2009; Liu & Li, 2011b; Willcoxson, et al., 2011). The implementation of research-based learning needs to pay attention to the following:

a. Lecturers must master various research methodologies
b. Lecturers must explain how to conduct research in groups
c. Lecturers must explain the material to pre-service teachers as a basis for finding relevant problems
d. Lecturers must observe their research activities
e. Lecturers must guide pre-service teachers to write their research results in the form of scientific articles and then publish them.

Research purposes

This study aims to describe pre-service physics teacher's research activities through research-based learning.

METHODS

a) Design and Approach

The current study was conducted on pre-service physics teachers at Muhammadiyah Metro University, Lampung, who focused on pre-service teacher research activities. This research is also seen as a case study in the field of education.

b) Subject

This study recruited 20 pre-service physics teachers and lecturers at Muhammadiyah Metro University, Lampung, Indonesia. Pre-service teachers recruited have applied research-based learning in the 2016-2017 academic year. Pre-service physics teachers are divided into three groups.

c) Data collection

The main data from this study are research activities during the learning process with research-based learning models. Data related to research activities were collected through observation, field notes and closed questionnaires. Data on pre-service teacher responses were collected through interviews. Field observations and notes were carried out by two observers in three meetings discussing 'Electrical Dynamics'. At the end of each meeting a closed questionnaire was distributed. In addition, interviews were conducted randomly at the end of each meeting for several members of each research group.

d) Data analysis

Data on pre-service teacher research activities were analysed by encoding the results of observations and field notes from two observers at each meeting. Furthermore, credible data is obtained through triangulation methods from questionnaire data and field notes (Sugiyono, 2007). Next, calculating the percentage of research activities for each pre-service teacher in each meeting was analysed descriptively. The results are categorised from 'very bad' to 'very good' criteria. The interview data is taken from the triangulation time source by taking into account the similarity of the answers given and the consistency of pre-service teachers throughout different times. Data is then analysed through data reduction, data exposure and additions.

RESULTS

Research Activities and Their Responses

Research activities start from the first to the third lecture. Research activities in implementation include: identifying problems, formulating hypotheses, preparing research plans, analysing data and drawing conclusions. The average activity of each group in the course is shown in Table 1.

Table 1. *Research activities of each group*

Group (s)	Implentation			Average	Category
	First	Second	Third		
I	80%	95%	100%	92%	Very good
II	60%	80%	95%	78%	Good
III	75%	85%	96%	85%	Very good
Average	72%	87%	97%	85%	Very good

Based on Table 1, there has been a significant increase in research group activities by each group in each session, especially in groups II and III. The 'group II' research activity was 60% in the first session and then increased significantly to 80% in session 2, and reached 95% in the third session. Meanwhile, the activity of the research group in group III increased from 75% in the first session, then reached 85% in the second session and 96% in the third position. The average group research activity in the first to third sessions has increased by achieving the criteria of 'very good'. The increase in each meeting occurs because of good research collaboration, thoroughness in conducting research, and pre-service teachers already understand research activities. Table 1 also shows that the percentage of research activities for each group is different. This is because the percentage of groups is obtained from the average percentage of activity of pre-service teachers from each group. So, the role of group work is very important for achieving team goals. Analysis of each research activity in Figure 1.

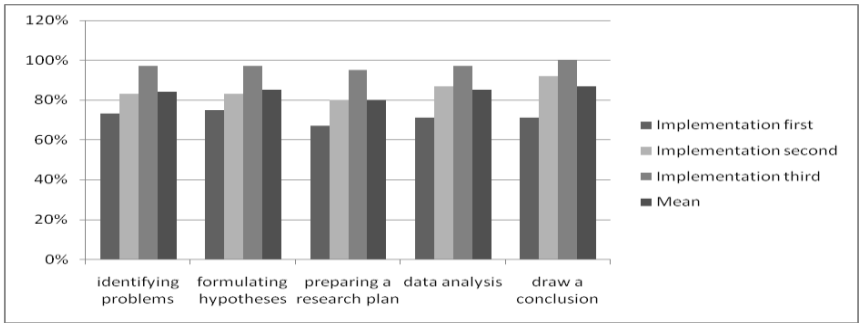

Figure 1. Analysis of each research activity

Based on Figure 1 shows an increase in identifying problem activities that accumulated to 73% (good) in meeting 1, reaching 83% (very good) in meeting 2 and 97% (very good) at meeting 3. The average activity of identification problems was taken of the three meetings 84.33% in very good criteria. Furthermore, formulating hypothetical activities developed from 73% (good) in meeting 1, up to 83% (very good) in meeting 2 and 97% (very good) at meeting 3, with an average of 85% in very good criteria. Meanwhile, research plan activities from 67% (good) in meeting 1 developed significantly to 80% (good) in meeting 2, and 95% (very good) in meeting 3, with a total average of 80.66% (good) Data analysis activities showed an increase in activity of 71% (good) at meeting 1, reaching 87% (very good) in meetings 2 and 97% (very good) in meetings 3. The average activity of data analysis taken from the three meetings was 85% in very good criteria. Drawing conclusions shows a 71% increase (good) in meeting 1, reaching 87% (very good) in meetings 2 and 100% (very good) in meetings 3. The average draw of conclusion activities taken from three meetings is 87.66% in criteria that are very good.

Based on the results of interviews given to pre-service teachers, it can be concluded that all have been happy with learning activities using research-based learning. As per the SEA statement as follows:

> ‘I feel happy learning to use research-based learning, study research and encourage myself to read more’.

This result is also in accordance with the AF statement, namely:

> ‘I am very happy because I work in teams, and deepen the concept of the material being studied’.

In addition, pre-service teachers have held discussions and are responsible in teams, such as sharing assignments to prepare research such as preparing tools and materials needed, analysing data and drawing conclusions. This is in accordance with the following FAT statement:

> ‘As a researcher, I am responsible for all stages of research, and I have done that, and I am satisfied’.

The obstacle found by pre-service teachers at the time of research activities is the implementation of research. This is in accordance with the following AKA statement:

> ‘Our team has difficulties in conducting research, due to under-planning research planning’.

Difficulties in conducting research can be solved by preparing appropriate research planning (Al-Maktoumi et al., 2016; Gao & Lei, 2017; Simpson & Bourner, 2007; Svihla, 2014).

Research activities through research-based learning are not carried out entirely by pre-service teachers. Lecturers have an important role to control and direct their research activities. Student learning commitment and learning environment contribute significantly to the convenience of learning (Nidzam & Saidatul, 2017). Ensure that research can be completed in a predetermined time and help pre-service teachers who have prior experience in their research difficulties. The ability to analyse data is an important factor to draw conclusions.

DISCUSSION and CONCLUSION

The essence of learning in higher education requires the integration of research with learning. Learning needs to direct the pre-service teacher to be able to develop research skills in the learning process (Blume et al., 2015; Brew & Jewell, 2012). Research conducted in learning requires careful preparation. The research begins with problem finding activities, therefore, in research there are inquiry elements which play a role in finding problems (Kocagül & Şahin, 2017). Research conducted in learning requires careful preparation.

Research carried out in learning can help prospective teachers in developing critical thinking, problem-solving skills and deepen knowledge. Outdoor learning activities that emphasise students' direct experience of objects that are being studied to be linked to theories to practice and improve students' skills in observation, measurement, data collection, and analysis (Mundilarto & Pamulasari, 2017). Therefore, research-based learning is one model that not only increases knowledge but also performance in solving problems through research (Hunaiti et al., 2010). Effective implementation of research-based learning, lecturers must make perfect preparations for several aspects, consisting of: to help determine research preparation, observe research time, and provide guidance to pre-service teachers when experiencing difficulties while conducting research. Cooperation between teachers and students in learning is needed to produce quality learning (Dickson, Kadbey, & Mcminn, 2016).

Based on the results of the research data, pre-service teacher research activities can be developed with research-based learning. Group research has manifested itself in direct activities to actively participate in research on 'dynamic electricity'. Basically, this model is suitable for developing research activities of pre-service teachers, especially for the ability to design research. In fact, this research is limited to research on pre-service physics teachers in electrical matter that are dynamic and do not include other learning activities. Furthermore, research on the analysis of learning processes and results in other parts of other subjects through research-based learning is still wide open.

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