Prospective biology teachers’ research skills

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Abstract. This study aims to determine the research skills (RS) of prospective biology teachers who are completing their final projects. A total of 83 students were involved as subjects in this study. A self-assessment sheet was used to evaluate the RS of prospective biology teachers from four participating universities. The self-assessment instrument for RS was adapted from Garg and Vitae which covers four domains, namely domain A (intellectual knowledge and abilities), domain B (personal effectiveness), domain C (research and organizational governance), and domain D (involvement, influence, and impact). A differential semantic scale from one (1) to nine (9) was used to measure the levels of RS domain of the respondents. The distribution of the research instrument was carried out for two months, from May 4 to June 21, 2020. Based on the study, it was found that domain A (knowledge and intellectual ability) is still weak with 35% while domain B (personal effectiveness) is the highest aspect of RS with a percentage of 49%. The College should design effective curriculum and learning design to improve intellectual knowledge and skills of prospective Biology teachers in conducting research.

1. Introduction

One indicator of a world-class university is the large amount of research and publication of research resulted from its academic community [1]. Entering the 21st-century competition, innovation and research are the keys to winning the global competition. Research can lead to the discovery, innovation, creation and invention on technologies and products that can help improve and solve various political, socio-economic, cultural, technological, and environmental problems [2]. In this case, universities have very important role to create human resources who have knowledge and skills to conduct research. It has been identified RS as important skills to be mastered its graduates [3] by making scientific research and publication as requirement for graduates from higher education.

Research has an important role in the economic development of a country [2] [4]. In this context, Indonesia as a developing country has launched research, technology, and innovation to develop the nation’s economy and competitiveness [5]. In this connection, developing RS is one of the goals of education [6]. Another study developed a research development framework to guide educators in developing RS by their students [7]. Research itself is defined as a systematic process of collecting and analyzing information to improve understanding of the phenomena under study [8]. Research
activities are useful for further investigations by uncovering and answering various questions and solving problems scientifically and logically [9].

RS are the skills needed in conducting research including the use of tools, strategies, problem-solving skills, critical thinking, and dissemination of research results [8]. This is in line with the 21st-century skills framework which requires mastery of problem-solving skills, critical thinking, communication, and the use of ICT [10]. Nowadays, research is considered an important part of education, especially science education at the secondary and higher education levels [11]. RS in the field of science, in particular, refer to the ability to apply procedural and declarative knowledge to conduct scientific experiments correctly [12]. RS are the essential skills in the world of work because by mastering RS, a company can continue to conduct research and develop its business [13].

The low RS in Indonesia at both secondary and higher education levels are reflected in several studies conducted such as the studies reported [14-17] which come to the conclusion that students as research subjects still lack in mastering RS, especially in the aspects of using research methods, organizing research, answering research hypotheses, and publishing the research results. Through this research, it was designed and described later the general aspects of RS based on the results of students’ self-assessment during completing their final project. It is expected that the result of this study will be an input for universities in designing curriculum and effective learning to equip RS for their graduates and their teaching staff as well.

2. Methods
This study was a survey in the form of a self-assessment of some basic aspects of RS in prospective biology teachers who are completing their final projects. A total of 83 students were involved as subjects in this study. The self-assessment sheet was used to evaluate the RS of prospective biology teachers from four participating universities, namely Majalengka University, IAIN Sheikh Nurjati Cirebon, UIN Bandung, and Wiralodra University. The indicators of RS adapted from previous studies [18; 3] were used as a reference in preparing the self-assessment instrument in this study. According to the first study [18], there are four domains of research development framework, namely (1) knowledge and intellectual abilities; (2) personal effectiveness; (3) research governance and organization, and (4) engagement, influence, and impact. A semantic differential scale from 1 to 9 was used to measure the research skill aspects on respondents, which are categorized into five scales, namely: very good (VG), good (G), moderate (M), poor (P), and very poor (VP).

3. Result and Discussion
The results of the self-assessment on general aspects of students’ RS from four participating universities are described as follows.
Based on Figure 1 above, some general aspects of RS in students are still relatively weak, such as critical-thinking skills, organizing research, creativity, and innovation, as well as writing skills and scientific publications. These aspects must be emphasized by universities to be further strengthened through individual and group research activities. Judging from the indicators of the research development framework [18], the aspects of RS in Figure 1 can be categorized into four domains as follows.

Figure 2. Domains of RS aspects
Based on Figure 2 above, it is shown that domain A (knowledge and intellectual abilities) is still below average with a good score category of only 35%, meaning that students' knowledge and intellectual abilities in conducting research still need to be improved. Domain B (personal effectiveness) obtains the highest good score of 49%. This domain is related to self-confidence, willingness to continue learning, self-awareness, and self-discipline from a researcher.

RS of students were influenced by their previous learning experiences [19]. Therefore, these skills should be equipped earlier [20]. RS can be developed through a variety of appropriate learning methods and techniques such as inquiry learning [21-23] [6], research assignment activities [24]; writing research papers [25]; using the step-by-step model experiment method [16]. By mastering RS, students will be able to build strong intellectual and practical relationships between research and learning [26].

The aim of higher education is not only to develop the students’ skills in specific fields but also to prepare them for life-long learning, career and play important role in personals’ lives. Therefore, students need to be equipped with various general skills such as communication skills, problem-solving, the ability to integrate ideas and concepts, the capacity to work in teams, and RS [27].

4. Conclusion

Some research skill aspects of prospective biology teachers from the four participating universities show that their abilities are still lows, especially in domain A (knowledge and intellectual abilities), which includes knowledge about research issues, research methodology, research organizers, still needs to be improved. Higher education institutions need to equip their students and graduates with comprehensive research methodology courses (theoretically and practically) through the assignment of scientific research and research in education so that the students have skills to do research.

5. References

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