



# Study of Multiple Representation Learning in Improving Pre-Service Biology Teacher's Representation Ability

Desfaur Natalia, Asni Johari<sup>(✉)</sup>, Evita Anggereini, and Intan Lestari

Doctoral Program of Mathematics and Science Education, Universitas Jambi, Jambi, Indonesia  
johari\_asni@yahoo.com

**Abstract.** Representation skills are important for pre-service teachers' students, especially in understanding and re-explaining complex scientific concepts. Several previous studies have shown that the representational ability of pre-services biology teachers' is low. Various efforts have been made but have not been fully able to improve the representational abilities of prospective biology teacher students. This study aims to examine the effect of the multiple representation learning approach on improving the representation ability of prospective biology teacher students. This is a descriptive qualitative study that employs the literature study method to extract references from various sources, particularly relevant journals. The results of the study indicate that the multiple representation learning approach can improve students' representational abilities. From the results of this study, it can be recommended that the multiple representation learning approach be applied by lecturers in learning.

**Keywords:** Learning Approach · Multiple Representations · Representation Ability · Student · Pre-service Teacher

## 1 Introduction

Biology is the part of science that studies living things and their environments. The structure and objects of biological studies are very dynamic and complex. Therefore, scientists conduct scientific observations, investigations, and interpretations in order to understand the objects of biological studies [1]. Knowledge gained by scientists from observation, investigation, and interpretation of data is communicated to the scientific community through various representation models such as text, images, charts, diagrams, videos, tables, symbols, mathematics, and schematics. Representation is part of the depiction of a model made by someone so that the person concerned can see what has been done and can share it with others [2].

Representation consists of two domains, namely the domain of internal representation and the domain of external representation. Internal representations are mental models contained in the mind and owned by a person based on experience, while external representations are analogies, metaphors, visualizations, discourses, multilevel and

modes of representation [3]. Thus, internal representations can be stimulated by the use of external representations, and conversely understanding of external representations is influenced by internal representations.

According to [4] there are three functions of representation in the learning process. *First*, as a complement that represents information that supports each other so that students can easily interpret a phenomenon. *Second*, as a barrier to other interpretations, for example, graphs are used to interpret mathematical equations. *Third*, to build a deeper understanding. The use of multiple representations really helps students understand the concepts being studied, so it is hoped that the use of various forms of representation can improve students' representational abilities.

Representation ability is an ability needed in translating scientific data and evidence so that conclusions can be drawn [5]. Representational ability can also be interpreted as a set of skills and practises such as creating, using, reflecting, interpreting, and explaining concepts when material is related to a process or an entity [6]. Representation skills can include the ability to obtain information from representations, create new representations from previous representations, evaluate the consistency of different representations, and modify representations if necessary [7]. Representation ability is the scientific skill needed to understand scientific data and evidence and draw conclusions from them [8].

The ability to represent is very necessary because it can be an important capital for students in understanding and mastering biological concepts. However, it is often found in the field that the representation ability of students is still low. Students are assessed to understand the concept of material if they are able to transfer and connect one concept to another [9]. Various research results show that students who perform well in exams still have difficulty understanding abstract science concepts due to their inability to visualize abstract concepts [10].

Therefore, an appropriate learning strategy is needed to help students improve their representational abilities. One of the lessons that can be used is learning based on multiple representations. Multiple representation learning is a learning where in the learning process students are required to be able to present the concepts that have been studied through various ways and various actions and expressions, such as conveying through oral, gesture, visual (with pictures, animations, simulations, graphics, pictograms, diagrams, etc.), verbal (writing, graphs, diagrams, etc.) and symbolic (symbols, formulas, mathematical calculations, etc.) [9].

## 2 Math and Equations

This research is qualitative research using a literature review study method that discusses theories, findings, and other relevant materials from various sources [11]. A literature review is a research methodology that aims to collect and extract the essence of previous research and analyse several expert reviews written in the text [12]). This study uses a narrative review approach, also known as a semi-systematic approach, designed for themes that have been conceptualised and studied by different researchers from various disciplines to identify and describe clearly a particular phenomenon [12]. The research data is sourced from articles taken from Google Scholar, Science Direct, ERIC, and other supporting references. The keywords used are multiple representation learning,

representation, and representation ability. The scope of reference is limited to learning based on multiple representations to help students who want to become biology teachers get better at showing what they know.

### 3 Result and Discussion

A study conducted by [13] on prospective biology teachers in lesson study activities shows that the application of multiple representation learning can help prospective biology teachers represent abstract material into concrete things. Prospective biology teachers feel closer to scientific phenomena and can present them in real-life learning activities. Another study conducted by [14] in a school in Turkey showed that the use of multiple representations in learning is very useful in understanding contextual concepts accurately and with quality. [15] states that from his research in developing and implementing multiple representation-based learning strategies, it was found that multiple representation learning can improve representational abilities and that there is a correlation between representational abilities and concept mastery.

According to [16], multiple representation learning can build students' deeper understanding of a concept. Multiple representation learning can also help students construct their conceptual understanding [16–18]; and [19]), improve critical thinking skills ([20]; [21]), foster students' self-confidence [22], and can improve problem-solving skills and be able to facilitate the relationship between new and old knowledge [15].

In multiple representation learning, students are trained with various forms of representation to make it easier to understand the concept of the material being studied. If students are able to construct and understand material concepts, are critical of a problem, and can connect new knowledge with old knowledge, then students will automatically be able to represent the concepts they have learned in various forms of representational models ([23]. According to [24], each student has a different way of thinking about how to interpret the material concepts they understand.

### 4 Conclusion

Multiple representation learning can improve students' representational abilities. Multiple representation learning can develop the ability to interpret and apply various student representations, so that students are able to construct and understand material concepts, especially those that are abstract, critical of a problem and can connect new knowledge with old knowledge. Therefore, the multiple representation learning model is very appropriate to be used to improve the representation ability of prospective biology teacher students. Multiple representation learning is very suitable to be applied to science learning, especially biology, where most of the material concepts are abstract.

**Acknowledgements.** Authors would like to thank the leadership of Jambi University who has provided facilities for conducting research.

**Authors' Contributions.** Asni Johari and Desfaur Natalia compiled the ideas presented. Desfaur Natalia wrote the script with the support of Asni Johari. Evita Anggereini and Intan Lestari verified the research methodology. Asni Johari did a final check on the context and writing of the article. All authors discussed the results and contributed to the final manuscript.

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