Research in Phyiscs Education (2023), **2**(2)

ARTICLE

Conceptual understanding and visual representation: are they still ordinary or extraordinary issues?

Surya Gumilar*

Department of Physics Education, Institut Pendidikan Indonesia
*Corresponding author. Email: surya.gumilarr@gmail.com

(Received 5 August 2023; revised 4 October 2023; accepted 5 November 2023; published 26 December 2023)

Abstract

This article critically examines the prevalent focus on conceptual understanding in Indonesian physics education research, particularly emphasizing abstract concepts like electricity and heat transfer at different educational levels. The author challenges the common perception that certain physics concepts, such as force, are inherently abstract, asserting that all physics concepts possess an abstract nature. The recurring choice of investigating electricity-related topics, driven by their perceived abstractness, is questioned. The author observes a consistent use of similar research instruments across primary, junior high, senior high, and university levels, raising concerns about the lack of adaptation to students' varying capabilities of abstraction. The argument is presented for aligning research topics with age-appropriate conceptual understanding, challenging the uniformity in the development of research instruments across different educational levels. In a parallel context, the article underscores the importance of visual representation as an evaluation tool in physics education. The scarcity of research in Indonesia utilizing visual representation is noted, attributed to students' confusion and a lack of understanding. Visual representation is posited as crucial for gauging students' comprehension of scientific concepts, with examples given in the realms of collisions and climate changes. In conclusion, the author hopes this issue becomes a reference for future physics education research, urging researchers to delve into robust studies on conceptual understanding and visual representation. The article underscores the pivotal role these elements play in shaping the trajectory of physics education research, advocating for a more nuanced and tailored approach to investigations in these areas.

Keywords: Conceptual understanding, visual representation

I have noticed that most physics education research in Indonesian contexts tends to focus on examining conceptual understanding in various physics concepts. For example, concepts related to electricity and heat transfer are commonly investigated at different educational levels. At the primary school level, investigators often explore the principles of currents. The rationale behind this choice lies in the abstract nature of this concept. However, is this argument truly valid? In my opinion, I have noticed that all physics concepts are abstract and not concrete in nature. Take mechanical concepts such as force, for instance. No one can directly observe the physical appearance of force concepts. Although it is easy to see how daily activities involve force, such as when students push a table in the classroom, demonstrating the application of force on the table.

When considering the same concept in junior high schools, the choice to focus on the current concept in electricity is based on the same reason. It is an abstract concept and challenging to visualize. In my view, it is likely that this becomes a favored topic for most investigators. I do not expect to find a different reason, but sometimes there is no difference in the instruments used to analyze concepts in primary and junior high schools. Sometimes I cannot discern significant differences in the instruments used. When, in primary schools, Indonesian investigators developed instruments dealing with the movements of negative particles (i.e., electrons) in the wire, the same question arises when different Indonesian researchers examine the same concepts. Moreover, the analysis of different levels of education, such as senior high school and university, reveals the same instruments when investigating current concepts. Sometimes, I think that the differences in students' ages do not change how researchers develop their instrument tests. This raises a significant question for me because students have different capabilities of abstraction related to the same term. Therefore, I emphasize that it is better to investigate the conceptual understanding of some physics concepts appropriate to the ages of the students and it can drive to reasoning thinking in physics (Hung and Jonassen 2006). Finally, in this issue of the journal, some authors focus on investigating conceptual understanding, which may be similar to my criticisms above. Still, it is crucial for college students to be aware when designing instrument tests for their research so that conceptual understanding is appropriately investigated.

In the second context of this editorial, I pinpoint the importance of visual representation as a tool of evaluation. Indeed, I understand that the use of evaluation tools should be adjusted to the aims of the learning and teaching conducted (Bustle 2004). However, visual representation plays a crucial role in presenting what students imagine and understand about some scientific concepts. For instance, when students understand concepts of collisions between two objects, they ideally present appropriate images dealing with this concept. Unfortunately, some students lack the capacity to make these representations. This may be caused by reasons such as a lack of familiarity and, more importantly, a lack of understanding. For the first reason, I understand that there is a scarcity of research in the Indonesian context that uses visual representation as a tool of evaluation. When students are asked to create an image, they tend to be confused because there are no clues in their brains about what they should draw. This explanation may strengthen the second reason that students truly do not understand what they learned in the learning process. They may answer verbal problems in physics because they have a trigger to answer them. However, when there is no trigger to stimulate what they should draw, they lose their engagement to present their understanding, such as an image of a collision. In this issue, some articles explore how visual representation was utilized as a tool of evaluation in some contexts of science, such as concepts of collision and climate changes. Indeed, these are not comprehensive research studies, but for the Indonesian context, these can be prominent triggers for further research dealing with visual representation.

I hope this issue becomes a reference for other educational research, particularly in physics education research. Indeed, I hope to read some robust research on conceptual understanding and visual representation because it determines whether conceptual understanding and visual representation become ordinary or extraordinary issues in physics education research for future studies.

References

Bustle, Lynn Sanders. 2004. The role of visual representation in the assessment of learning. *Journal of Adolescent & Adult Literacy* 47 (5): 416–423.

Hung, Woei, and David H Jonassen. 2006. Conceptual understanding of causal reasoning in physics. *International Journal of Science Education* 28 (13): 1601–1621.