



Determining Learning Activities to Promote Scientific Reasoning in Science Learning: A Literature Review

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ABSTRACT

Objective: The objective of this study is to analyze learning activities in science learning that can promote scientific reasoning skills and provide the best way to teach it. **Method:** The method used is a literature review analyzing 20 articles indexed by the Scopus database from 2017 – 2022. There are 200 articles about teaching scientific reasoning in the Scopus database, and 20 articles that focused on science learning were selected. The 20 articles then analyzed the domain of scientific reasoning and learning activities to train it. **Results:** The results showed that science learning interventions in practicing scientific reasoning can be carried out starting from secondary to higher education levels. The learning interventions can be designed in face-to-face learning by integrating social science phenomena/cases, conducting guided investigations assisted by modules, and implementing argument-based learning or online learning using mobile apps/online simulations. There is a tendency that investigative activities are the most widely used intervention to promote scientific reasoning skills in science learning. **Novelty:** This study can provide an overview of science learning activities that promote scientific reasoning so that teachers can design the most appropriate learning activities to train students' scientific reasoning.

17 INTRODUCTION

Scientific reasoning is one of the aspects that can be taught within science learning. It considers **16** of the provisions for facing the global economy in the 21st century (Bao et al., 2018). Scientific reasoning is the cognitive ability to understand and evaluate scientific information. This process involves understanding **1** and evaluating theory, formulating hypotheses, and solving problems through inquiry. Scientific reasoning skills include the ability to identify scientific problems, formulate problems and hypotheses, predict the possibility behind phenomena, look for evidence **21** through modeling and experiments, as well as communicate and evaluate the concepts (Hartmann et al., 2015).

35 Scientific reasoning is included in the final stage of developmental cognitive abilities. According to Piaget's theory of cognitive development, this stage refers to formal operations, when children can make reasons more abstractly and logically by looking for links between concepts, analyzing problems scientifically, and searching and evaluating evidence to support or reject a hypothesis (Arends, 2012). Scientific reasoning is highly correlated with children's cognitive abilities in evaluating and developing hypotheses, especially about how phenomena occurred (Zulkipli et al., 2019). Therefore, students with scientific reasoning abilities **20** can apply scientific concepts to assist them in dealing with problems and planning investigations to solve scientific problems in real life (Zhou et al., 2021).

Scientific reasoning is essential for students. Vo & Csapo (2023) stated that scientific reasoning significantly affected learning achievement, including science. However, the profile of students' scientific reasoning skills is still low (Rimadani et al., 2017; Khoirina

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