Chapter 2
The STEM Education Approach for Conceptual Learning

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ABSTRACT

The STEM education approach is an interdisciplinary approach to equip students with the knowledge and 21st century skills that are necessary to thrive in a rapidly evolving world driven by technological advancements. This approach is also aims to foster a deeper understanding of the interconnectedness of these disciplines and their real-world applications. By blending theoretical concepts with real world experiences, encourages hands-on learning, project-based activities, and collaborative teamwork, therefore prepare students for the challenges of the 21st century workforce. This approach utilizes social and situated learning methods to support conceptual understanding by connecting knowledge from different disciplines. How concept learning occurs while utilizing the STEM education approach? What types of knowledge (Factual, Conceptual, Procedural, and Metacognitive) are emphasized in the Engineering Design Process which is the frequently used in the STEM education approach? What are the factors affecting conceptual learning in this approach? are driven questions of this chapter.

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WHAT IS CONCEPT? CONCEPTUAL LEARNING IN SCIENCE EDUCATION

How do humans comprehend the world around them? Although this question may appear to be philosophical, it is a topic that has been extensively researched in educational science. The answer lies in the fact that we create a mental representation of the world through the perception and interpretation of things, events, features and ideas that shape our experiences (Barner & Baron, 2016). What is the process for creating this copy? Does the copy accurately represent its counterpart in nature? How can one effectively communicate their mental representation of the copy to another person? These questions all relate to the term “concept”. Researchers have defined this term in various ways. Some definitions of concepts include: 'abstract, timeless and universal mental constructs' (Erickson & Lanning, 2013); 'perceived regularity (or pattern) in events or objects, or records of events or objects, designated by label' (Novak & Cañas, 2006, p.10); and ' a cognitive category used to classify objects, behaviors, or other entities, based on common attributes or properties' (Messer & Kennison, 2013, p.1).

Concepts are inherently linked to language skills as they are the words we use to describe information stored in our memory and to organize our interactions with the world. According to researchers, concepts are culturally oriented and situated within a specific socio-cultural context (Ross & Tidwell, 2010). It is possible to encounter situations where a concept known in one culture is not known in another culture. While concrete objects like pens, paper, and windows may have consistent meanings, they can still be interpreted differently in certain situations. Furthermore, concepts can have varying interpretations depending on the context and culture. For instance, when a child from a Western culture and a child from a Japanese culture, where low tables are common, hear the word 'table', they may not have the same mental image. However, once the concept of a table is internalised, it can be recognised regardless of its features, such as the materials used in its production, size, or number of legs. The same applies to abstract concepts such as art, talent, and love. In fact, seen from this perspective, it is natural for the concepts to be shaped by the influence of the culture in which they exist and to show variation depending on different characteristics and different lives of individuals in that even an individual’s conceptual perceptions in childhood and adulthood are different.

Human beings store concepts and relations between concepts in their memory and not only store but also classify these concepts into different categories according to their various characteristics. Many studies have been conducted on how this storage and categorization process takes place, how information is retained in memory and how it can be used in different contexts. Among these studies, Piaget's studies, which are the most well-known and have changed the direction of educational research, are