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Development of Learning Activities using Engineering Design Process within STEM Education Framework to Enhance Grade 7 Students' Creative Problem-Solving Ability

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Abstract

The purposes of the present study were: (1) to develop learning activities using the engineering design process within the STEM education framework on the topic of Thermal Energy for Grade 7 students with a target efficiency of 75/75; (2) to compare students' creative problem-solving abilities before and after learning through the designed activities; and (3) to compare students' learning achievement before and after learning through the designed activities. The cluster random sampling technique was employed to select 39 Grade 7/12 students studying in the second semester of the 2024 academic year at Prasatwitthayakarn School in Surin Province. The research instruments included: (1) lesson plans based on the engineering design process and STEM framework, (2) a creative problem-solving ability test, and (3) a science achievement test developed by the researcher. Percentage, mean, and standard deviation were used to analyze the data, while the hypotheses were tested using E1/E2 efficiency analysis and the dependent samples t-test. The results revealed that (1) the developed learning activities achieved an efficiency of 82.53/80.07, (2) students' post-test creative problem-solving ability scores were significantly higher than their pre-test scores at the .05 level, and (3) students' post-test learning achievement scores were also significantly higher than their pre-test scores at the .05 level. These findings suggest that integrating the engineering design process within the STEM education framework is an effective instructional approach for enhancing both creative problem-solving ability and science achievement in secondary school students. Future research in this field could explore how integrating the engineering design process with STEM education influences other 21st-century competencies—such as collaboration, critical thinking, and innovation—across diverse learning contexts.

Keywords: Learning Activities, Engineering Design Process, STEM Education, Creative Problem-Solving Ability, Thermal Energy

Introduction

Creative problem-solving (CPS) is a concept and approach developed in order to help problem solvers in using creative thinking to achieve their goals successfully. It enables individuals to overcome obstacles they face and promotes positive behaviors that lead to goal and dream realization (Treffinger & Isaksen, 2011). The creative problem-solving process is crucial because it focuses on finding solutions and resolving problems as well as improving existing environments and situations through cooperation, creative thinking, and critical thinking. In the process, creative thinking allows learners to create the most diverse ideas without immediate judgment as good or bad answers. Choosing and evaluating the best problem-solving method using critical thinking is the subsequent step (Chomphuphat, 2011, cited in Thinwiangthong, 2021).