Abstract

This study highlights the importance of studying geometry as a foundation for learning mathematics and its relevance in science, technology, and engineering. This study adopts an exploratory approach, conducting a preliminary study to examine potential relationships between various measures. We explored the correlations between measures of geometry and engineering thinking, emphasizing the complex cognitive abilities required for problem-solving in both domains, including higher-order thinking skills and metacognitive processes. This study investigated the correlation between metacognitive thinking abilities and geometric and engineering thinking among first- and second-grade students from a low-middle socioeconomic status. The sample comprised 41 students (51.2% girls; 48.8% first graders). Data analyses indicated significant positive correlations between some measures of geometric thinking and some measures of engineering thinking among elementary school students. For example, the complexity level of the LEGO® model and the students' level of verbalization during the engineering task were significantly positively correlated with the level of improvement on the Geometric Thinking Questionnaire.

The study results indicated significant positive correlations between some measures of metacognitive thinking abilities, some measures of engineering abilities, and geometric knowledge, for example planning and monitoring abilities on the Geometric Thinking Questionnaire, significantly and positively correlated with the participants' geometric knowledge.

The study also explored the contribution of personal characteristics (i.e., age, general intelligence, and gender), various measures of metacognitive thinking, and measures of engineering abilities to geometric knowledge. Contrary to our hypothesis, no significant contribution of gender was found to the explained variance of the engineering and geometric

thinking measures. But age and general intelligence correlated with some measures of engineering thinking and geometric knowledge.

The results of the hierarchical regression analysis indicated that the students' age contributed significantly (24.6%) to their geometric knowledge. In the second step of the regression model, students' strategic awareness on the Engineering Thinking Task and their metacognitive monitoring ability on the Geometric Thinking Questionnaire significantly contributed (28.8%) to their geometric knowledge.

This innovative study provides valuable insights into the cognitive abilities and knowledge supporting students' geometric thinking. Furthermore, knowledge gained from this study can assist educators in designing more effective educational materials to enhance young elementary students' engineering and geometric thinking abilities, as well as metacognitive and self-regulation awareness throughout their schooling.