Correlation between a Student's Performance on the Mental Cutting Test and Their 3D Parametric Modeling Ability

H. M. Steinhauer, Ph.D.
Department of Freshmen Engineering
Embry-Riddle Aeronautical University

Summary

Engineering graphics has historically been viewed as a challenging course to teach as students struggle to grasp and understand the fundamental concepts and then to master their proper application. The emergence of stable, fast, affordable 3D parametric modeling platforms such as CATIA, Pro-E, and AutoCAD while providing several pedagogical advantages, such as interaction with a dynamic solid model, have also created a few new instructional challenges, such as clarifying the connection between the fundamental engineering graphics concepts and the overarching concepts of robust, parametric 3D solid modeling.

3D parametric modeling platforms offer students the opportunity to manipulate a completed solid model in space – enabling them to actually see views of the model not readily available in a traditional engineering drawing, helping them to build their conceptual modeling frameworks. The theory of parametric modeling must be thoughtfully integrated into the curriculum so it scaffolded by spatial visualization theory. One of the more common assessment instruments for spatial visualization is the Mental Cutting Test, (MCT), however there has been a little research on the relationship between the MCT and modeling ability /maturity, specifically the organization and order of the specification tree/model browser of 3D solid models.

This paper presents the results of such a study, 219 first-year engineering students from Embry-Riddle Aeronautical University participated in the fall semester of 2011. Each solid model was evaluated with a standardized rubric specifically developed for this research; the rubric measured five specific aspects of the modeling organization/ maturity: approach, structure, accuracy, robustness, and creativity. A Principal Component Analysis, PCA, was performed on the rubric section scores using SPSS 20. A significant relationship, of medium effect, was found between high performance on the MCT and 3D modeling ability on two separate modeling projects. Figure 1, and in each of the five distinct categories.

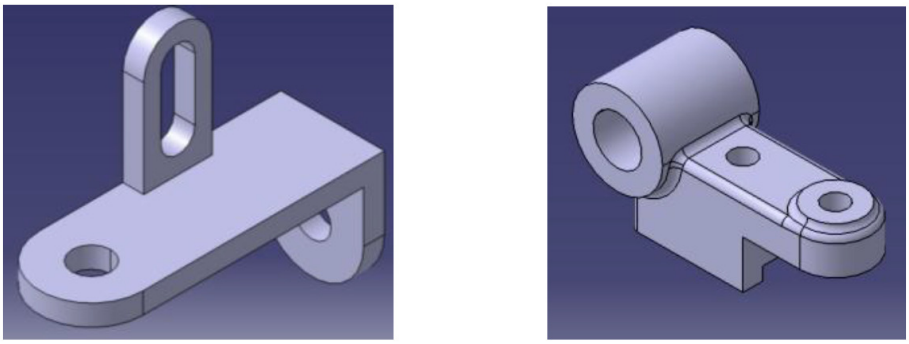

Figure 1 – The Two Common Solid Modeling Projects

The literature does suggest a connection between the MCT and 3D modeling ability, however, little of the previous research has included a detailed and structured analysis of the specification tree as a measure of modeling approach. It appears that this study has identified the same connection and these results may be indicative of the close relationship between the skills measured by the MCT and creating solid models, as both require the ability to discern the correct 2D profiles associated with a solid model.