

Distribution of the Engineering Graphics Concept Inventory

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Abstract

The Engineering Graphics Concept Inventory (EGCI) has recently been completed and has reached the end of scheduled development. Thus far, the instrument has largely been administered and interpreted by the research team. With goals of making the instrument widely available to be utilized by the engineering graphics community, the EGCI would need a place where it can both exist beyond the duration of its authors, and be properly accessed by researchers. The EGCI is currently undergoing conversion to be put on a website dedicated to housing similar STEM education assessment tools. Plans to evaluate the successful utilization of the instrument in this medium will take place in the fall of 2018. Additionally, having the instrument housed in a sustainable location will allow improvements and refinements to be made as additional settings and populations are reached.

Introduction

This document and presentation will serve as the orientation and best practices for the online version of the EGCI. The EGCI has been refined to its planned level of rigor and is at the point of making it widely available to researchers. Over the fall semester of 2018, the instrument has been moved to a website that will help facilitate the long term goals of the project.

Assessment Instruments in Engineering Education

There are numerous standardized instruments that look to measure various areas in engineering education. Some of these tests are specifically related to graphics and focus on assessing visualization abilities such as the Purdue Spatial Visualization Test: Visualization of Rotations (Guay, 1976), and the Vandenberg Mental Rotations Test (Vandenberg and Kuse, 1978). Others measure specific engineering topics such as the Force Concept Inventory (Hestenes et.al, 1992) and the Statics Concept Inventory (Steif, 2004). Each instrument attempts to identify and measure a particular construct important to a specific area of engineering. Whilst most of the engineering graphics related instruments focused primarily on visualization abilities, the EGCI was intended to address the field of engineering graphics on a more holistic level, attempting to include topics that were deemed fundamental to the field (Nozaki, 2017). The instrument has been completed to its recommended level of quality and is ready for wide spread distribution. Having it available online for use by the intended audience will help satisfy the dissemination goals of the project.

Considerations of the Online Version

Development of the instrument spanned several years and utilized different platforms to acquire the needed artifacts. Paper versions of items were used in the early stages, then evolved to electronic platforms to efficiently reach a wider population. Until now, electronic versions of the instrument were hosted by institutions of the researchers. To avoid potential problems in the future caused by changes in licensing, software availability, funding, and movement of researchers, an independent site was deemed most appropriate to permanently house the EGCI.

There are many ostensible benefits to housing instruments in a like field together. The primary benefit is the increased traffic and exposure to the instrument, as those with an interest in an area would foreseeably be likely to use other similar instruments. Inclusion in other studies where the instrument was not a primary instrument would test the robustness across multiple settings. Maintaining a site that is larger may take more resources, though with enough use, hopefully such efforts would become a reasonable pursuit. Thus, an ideal site would include other similar educational instruments.

Continuous improvement of the instrument must be an option for the host site. As technology and conventions change, so too would related assessment activities. The site should allow for the instrument's authors to make relevant changes should the need arise. These changes include the ability to retain data for future testing and analysis.

With the intent of making the instrument available to a multitude of researchers at different levels of education and institutions, data management and privacy are paramount. The architecture of the online instrument should consider ways to

appropriately conduct research and minimize the risk of breaches in data security. The site needs to be accessible enough where interested researchers can independently administer the instrument, access the data, and interpret the results. The site also needs to be secure enough to protect the integrity of the data and maintain adequate privacy. Data shall be maintained in a manner where future research is possible and mining is not a hindrance.

Use of the Instrument

Based on input from graphics professionals in academia and industry regarding the fundamental concepts of engineering graphics, the EGCI was designed to be used for both outcomes assessment in engineering graphics courses, and to help plan curricula when creating new or revising existing engineering graphics courses.

Instructors and researchers wishing to use the EGCI for assessment will have to make a request, and be approved by the PIs, to obtain a researcher's login and password. Having a researcher account will allow them to administer the exam to their own students or other test subjects, and retrieve those results. To protect individual subjects' privacy, unique IDs will be automatically generated for all subjects taking the test. Demographic data will be gathered from participants, but protect privacy this data will not be associated with the automatically generated IDs.

Currently, the PIs on the project will have access to the entirety of the instrument. This includes site administration, data management, access permission, and instrument maintenance. Primary anticipated use of the instruments' data include longitudinal studies, and continuous improvement to the instrument. Stored data will be easily accessible to researchers, making studies across settings as well as time feasible. Feedback from a variety of sources can help in the improvement of the instruments presentation.

Future Work

The instrument will be constructed on the new platform over the course of the 2018 fall semester, with plans to introduce it for widespread use in the spring of 2019. It is the goal of the project that having the instrument housed in a more robust, sustainable platform will help spread the use to an increased number of settings and populations. Future papers will report on the utilization of web platform to collect results in a new educational assessment instrument. The findings of this work will also provide the authors with experience to advise on website creation and the implementation of similar assessment instruments.

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