Evaluating Computer-Based Science Assessments for Universal Design Learning Principles

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Abstract: The Universal Design for Learning (UDL) principles suggest guidelines which should be considered to effectively serve the diverse range of students in classrooms today. In this qualitative study, we seek to examine the extent to which our computer-based science assessments across three domains of science cater to these UDL principles.

Introduction

Learners come with a variety of educational needs, and these should be acknowledged and accommodated to ensure access to all (Fuller et al., 2004). Considerations for equity and accessibility are of paramount importance to learning environments today. Regardless of students' socio-economic background, race, or ability, they must be able to not only access learning materials, but also feel interested and engaged in the learning process. In hopes of creating a more equitable learning environment, these concepts must be prevalent in the curriculum and how we assess.

Universal Design for Learning (UDL), outlines three main principles which are thought to construct learning for our diverse and inclusive classrooms, as this aspect has been often overlooked in the design of our curriculum, assessments, etc. (Rose et al., 2005). Creating assessments incorporating UDL principles calls for the implementation of alternative assessments, such as embedding assessments in immersive interfaces (e.g., simulations) which presents the possibility of providing scaffolding, authentic inquiry, engagement, and the abstraction and use of evidence to support students' claims. This encapsulates the design of the computer-simulated assessments for this study, however, how closely aligned to the strategies of UDL are these assessments is yet to be determined. As such, we seek to answer the following questions: (1) *How did the design elements of science assessment tasks cater to UDL?* (2) *What attributes of the science simulations contributed to students' engagement across the three tasks?*

Methods and analysis

For this study, participants were selected from a rural Midwestern intermediate and junior high school. Through convenience sampling a total of 20 students were chosen from grades six and nine with equal representation of grades and genders. Each student completed three simulation-based assessments in the domains of ecosystems, earth systems and body systems, which were designed similarly to each other in structure. Participants then engaged in individual 20-minute semi-structured interviews, in which they discussed their experience. A thematic analysis of the transcribed interviews revealed three major themes which emerged from the qualitative data. Throughout the analysis, agreement of coding was obtained by team members to promote consistency and accuracy of the data. The analysis produced the themes of *relevance, interest and variety*. These themes were then mapped unto the UDL principles of representation, engagement and expression and their attributing tasks. This helped researchers form clear parallels of alignment from students' experience and the UDL principles.

Findings

The findings of the analysis illustrate the alignment of the interview themes and UDL principles as demonstrated throughout the three science assessments (see Table 1). Each assessment of 14 items total, consisted of matching and ranking items, model building tasks, videos, simulations, multiple choice questions (MCQ's) and constructed response (CR) items. Students indicated that they appreciated the diversification of tasks which aided in maintaining their interest and helped them engage and better understand the science constructs which were represented throughout the activities. This theme of *variety* could be found in each of the three UDL principles as discussed below.

Forms of Representation was the first UDL principle to be addressed in the interviews and included all three themes of *interest, relevance* and *variety*. This principle essentially calls for multiple means through which information may be relayed to learners including multiple forms of media, clear and concise syntax and vocabulary, the highlighting of patterns and auditory and visual alternatives to information. The assessments comprised of a mixture of means through which visual, written and audio information was conveyed to students. From this concept, the principle of Forms of Engagement arises.

All three themes of *interest, relevance* and *variety* were mapped unto this principle of multiple Forms of Engagement. Having multiple types of questions, activities for learners, and contexts for the scenarios was paramount in holding students' interests and keeping them engaged in the assessments. In addition to this, designing the simulations around contexts that learners could relate to and providing them with real-world scenarios to solve, helped students grasp the relevance of the activities and as such proved helpful in retaining their interests and engagement. Furthermore, the genders of the protagonists varied to help learners relate to the characters. As Baker (2016) advocates, educators and researchers need to incorporate activities, examples and practices from students' cultural and home environments as part of their teaching and assessment strategies to help motivate female and minority groups in science education.

Lastly, the principle of Forms of Expression was mapped on to the themes of *interest* and *variety* as the participants discussed their enjoyment of being able to answer questions of different formats such as being able to write their responses and simply selecting answers. Also, the range of activities enabled learners to interact with the content material in a number of ways, such as through observing a video, building a model and using a simulation.

Table1: Interview themes aligned to UDL principles

Themes	UDL Principle	Assessment Tasks	Student Quotes
Interest, relevance, variety	*Forms of Representation* Multiple ways in which information is represented	Videos, Simulations, Model building	• "Enjoyed the visuals and simulations".
Interest, relevance, variety	*Forms of Engagement* Multiple ways in which students are engaged in learning	Model building, videos, simulations	• "I like how it had a real-life situation that you could try to apply yourself to."
Interest, variety	*Forms of Action of Expression* Multiple ways in which learners interact with content and how they express themselves	Model building, CR's, MCQ's, Matching and ranking items	• "I enjoyed the writing part because you could express what you thought about the question."

Conclusion and implications

This study demonstrates the importance of designing assessments that address the needs of diverse students. In designing the simulations for our assessments, we chose to frame learning within the context of the interests of students. This was thought to create an inviting and appealing learning environment for all learners. In hopes of creating a more equitable, learning environment, these concepts of Universal Design for Learning must be prevalent in the curriculum and how we assess. It is our hope that these assessments serve as an example to researchers and science educators, of how UDL considerations may be included in science assessments across various domains for all our learners.

References

Baker, D. R. (2016). Equity issues in science education. In *Understanding Girls* (pp. 127-160). Sense Publishers, Rotterdam.

Fuller*, M., Healey, M., Bradley, A., & Hall, T. (2004). Barriers to learning: a systematic study of the experience of disabled students in one university. *Studies in higher education*, *29*(3), 303-318.

Rose, D. H., Meyer, A., & Hitchcock, C. (2005). *The Universally Designed Classroom: Accessible Curriculum and Digital Technologies*. Harvard Education Press. 8 Story Street First Floor, Cambridge, MA 02138.

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