Perceived Cognitive Load and Dosage of Instruction: Predicting Student Outcomes When Learning Using a Multimedia-Based Instructional Tool

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Introduction

Students with learning disabilities and English Language Learners face a variety of challenges in academic environments, which can lead to limited achievement, especially in rigorous STEM courses.

Technology-integrated instruction may be a way for teachers to bridge this achievement gap. However, multimedia-based learning can introduce high cognitive demand if not carefully shaped. It is therefore necessary to create and use videos that rely on evidence-based strategies known to limit extraneous cognitive load.

Cognitive Load

According to cognitive load theory, extraneous load is associated with instructional designs that include unnecessary information. The combined intrinsic and extraneous cognitive load then determine the working memory resources needed to process information and learning (Ayres, Chandler, & Sweller, 2011). Cognitive overload occurs when new information being presented is too dense or fast-paced (extraneous) for the learner to make necessary connections and transfer between working and long-term memory.

Instructional design should strive to reduce extraneous load and enable more germane resources for intrinsic load, eventually resulting in more effective learning.

Content Acquisition Podcasts (CAPs)

CAPs are short, multimedia-based instructional vignettes that deliver high-quality instruction for one vocabulary term or concept at a time (Kennedy and Deshler, 2015). They are informed by the instructional design principles of multimedia learning (Mayer, 2001), which provides an explicit framework for designing multimedia intended to control cognitive overload.

Past research has shown that CAPs can significantly improve vocabulary performance for students with learning disabilities (Kennedy, Deshler, & Lloyd, 2015).

Results

• **RQ**: Students with CAP access performed significantly better than students without CAP access on post-tests.

• **RQ, & RQ**: The average number of CAP views and students’ perceived cognitive load were significant predictors of post-test performance.

• **RQ**: There was a significantly strong positive relationship between the average CAP views and post-test scores (r = 0.850); see Figure 2.

• **RQ**: There was a significantly strong negative relationship between the average perceived cognitive load and post-test scores (r = -0.877); see Figure 3.

• **RQ**: There was a significantly strong negative relationship between the average perceived cognitive load and average CAP views (r = -0.843); see Figure 4.

• **RQ**: There was a significantly strong negative relationship between course GPA and average CAP views (r = -0.843); see Table 1.

• **RQ**: Average CAP views were recorded for each student using Edpuzzle.

• The post-tests showed high reliability with Cronbach’s alpha scores of 0.962 and 0.986. There was also high validity, since students took two versions of assessments and science teachers chose the science vocabulary terms based on the state’s educational standards.

Discussion

• In order to effectively use multimedia to instruct students with disabilities and English Language Learners, teachers need to incorporate evidence-based strategies into instruction. CAPs provide this form of instruction.

• Results show that watching CAPs many times may lead to stronger learning. Teachers may want to encourage students to watch CAPs more than once.

• As the perceived cognitive load increased, post-test scores decreased but as the CAP views increased, post-test scores increased, suggesting that CAPs for more difficult words may need to be viewed more than once for successful learning. Results on cognitive load can also help teachers determine how much instructional time should be spent on each term based on perceived difficulty.

• Students with high performance in the class were also more likely to frequently view CAPs than students with low performance. Since results show that higher count is associated with high post-test performance, teachers may want to emphasize the importance of viewing CAPs more than once.

• Limitations include that students were not randomly assigned to groups. There was also a small sample size and an uneven number of students with disabilities and English Language Learners. Also, the testing materials used for the study were created by teachers and were not standardized.

Future Directions

Future research can be done to analyze the effectiveness of CAPs on vocabulary learning in other STEM subjects, such as mathematics. Effectiveness of CAPs can also be analyzed with a larger sample size of students as well as general education students. This research has the potential to increase STEM achievement for students with disabilities and English Language Learners.

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