LEVERAGING COGNITIVE STRATEGIES IN CONTENT DESIGN TO SUPPORT CREATIVE THINKING IN MOBILE LEARNING

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ABSTRACT

The current examined the roles of cognitive strategies using Chi's framework in mobile learning. Three conditions (active, constructive, and interactive) were created for a college statistics I course where students were randomly assigned to each condition. The results indicate constructive and interactive support students' problem solving and number of solutions generated whereas active learning is less helpful in terms of students' problem solving and divergent thinking. It is suggested that mobile learning should take cognitive strategies into consideration when designing its content. Instructional designers should heed to the fact that constructive and interactive activities enable learners to become more productive in problem solving and solution generation.

KEYWORDS

Cognitive Strategies, Constructive Learning, Content Design, Mobility, Mobile Learning

1. INTRODUCTION

Creative thinking is perhaps one of the most important outcomes in education. It accounts for learners' cognitive abilities in making connections between concepts and information across domains and disciplines. Research has shown a significant correlation between learners' academic achievement and creative thinking, suggesting that creative thinking can enhance learners' academic performance in terms of deep understanding, multi-level problem solving, and far knowledge transfer within and outside academic domains and disciplines (Birgili, 2015; Goldschmidt, 2016; Lince, 2016; Zheng, 2020, 2022).

With the advancement of digital technology, new ways of teaching creative thinking skills have been introduced (Widiana & Jampel, 2016; Vale, et al., 2017). For example, the mobile learning is considered to be a viable platform to promote learners' creative thinking skills (DeSchryver, 2017). However, not much literature exists in exploring the use of cognitive strategies to support creative thinking such as divergent thinking in mobile learning. In this study, we investigated Chi's (2009) active-interactive-constructive framework in the quest of meaningful implementation for divergent thinking in mobile learning.

1.1 Active-Constructive-Interactive Framework

According to Chi (2009), there are three-levels of activities with each interacting with the content differently. The three-levels of activities are: active, constructive, and interactive. Active learning activities include learning activities like searching a term in the Internet, underlying a sentence in the textbook, or copying and pasting a text. By actively doing something, the learner becomes engaged with the content. However, being active in learning does not necessarily guarantee that the learner is processing the content deeply. Chi contended that for deep learning to occur, learners must be engaged in constructive and interactive activities in which they hypothesize, analyze, synthesize, and make inferences based on the data. Chi noted that being constructive is different from being active. The former involves producing new "content-relevant ideas that go beyond the information given" (2009, p.78) whereas the latter just shows the learner is doing something to being active.

2. THE STUDY

The current study applied Chi's framework to promoting learners' creative thinking in mobile learning. It was hypothesized that cognitive strategies (i.e., active, constructive, interactive) can influence learners' ability to think creatively. It was also hypothesized that learners' divergent think ability could affect the way they interact with the cognitive strategies deployed.

2.1 Design of Study

The study tested the role of cognitive strategies in mobile-based learning. The content (College statistic I) was hosted on an online platform that is accessible from laptop computer or mobile phone. Three conditions were created: Condition 1 requires students to focus on key concepts by highlighting or making the notes of the concepts or procedures they believe were important (Active). Condition 2 asks students to identify the concepts or procedures and apply them to a given problem. Students need to reason about which concepts or procedures were more effective in statistical problem solving. For example, under which circumstances, the T-test or ANOVA should be used and why since they both can be used to compare two groups (Constructive). Condition 3 asks students to manipulate certain variables in the procedure to explain or justify why a particular statistic method (T-test or ANOVA) should be applied to a problem (Interactive).

The study employed a 2 x 3 design in which levels of cognitive strategy (active, constructive, and interactive) interact with learners' divergent thinking (high vs. low) as measured by achievements and number of solutions generated.

2.2 Participants

Two-hundred forty participants were recruited from a Research I university in the United States. An institutional review board approval was obtained for the study. Participants were given consent to sign followed by a convergent thinking test with demographic information items. Guilford's (1967) Alternative Uses Task (AUT) was adopted to measure divergent thinking. After the divergent thinking test, the participants were randomly assigned to three groups: active, constructive, and interactive learning conditions. Participants then engaged in a 40-minute learning activity on College Level 1 statistics. At the end of learning activity, the participants took an achievement test which consists of 15 items with a possible max score of 30 and three application problems with a possible max score of 15. The max total possible score a participant can obtain is 45 points.

3. RESULTS

The 2x3 multivariate analyses have revealed significant differences across three cognitive strategies, $\lambda= .125$, $p <..001$, $\eta^2=.646$. There is a significant interaction between cognitive strategies and divergent thinking $\lambda= .851$, $p <..001$, $\eta^2=.077$. The follow-up multiple comparison analyses indicate there were significant differences between active condition and constructive/interactive conditions with regard to learner performance in conceptual questions. No significant difference was found between constructive and interactive by the same measure. In terms of problem solving, differences were found between active condition and constructive/interactive conditions. Again, no significant difference was found between constructive and interaction conditions. In terms of numbers of solutions generated, there was significant difference between active condition and constructive/interactive conditions. In addition, the difference between constructive and interactive conditions measured by learners' ability to generate number of problem solutions was significant.

By examining the differences between high and low divergent thinking learners in terms of their performance in conceptual questions, problem solving, and number of solutions generated, it was found that no significant differences were found between high and low divergent thinking learners in active conditions across three measures: conceptual questions, problem solving, and number of solutions. However, significant differences were found for constructive condition between high and low divergent thinking learners for problem solving and number of solutions but no significant difference was found for conceptual questions.

Finally, with regard to interactive condition, significant difference was found for number of solutions generated but no differences were found for conceptual questions and problem solving.

4. CONCLUSION

The results of current study suggest that embedding cognitive strategies in mobile learning can improve learners' performance in learning. In particular, constructive cognitive strategy supports high divergent thinking learners in their ability to solve problem and generate more solutions. It appears that interactive cognitive strategy helps solution generation for high divergent thinking learners but shows flat when measured by conceptual understanding and problem solving.

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