The effect of question presentation on learning

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INTRODUCTION

With the rapid development of network and computer, online learning breaks the limitation of time and space, and the emergence of MOOCs and other platforms provides convenience for teachers and students. Due to the rapid progress of online learning, there are many challenges, the most obvious of which is the extremely high dropout rate. In order to further improve the effectiveness of video teaching, many researchers have begun to explore the impact of online learning factors. One of the more obvious factors is the teacher's question in online learning. Asking questions can promote the integration of knowledge and facilitate the learning of knowledge. However, in real classroom teaching, students ask questions less frequently and the quality is not high (Graesser & Person, 1994). Although some researchers have discussed the effects of questions on students' learning, current studies are not consistent, so it is necessary to further explore the effects of different presentation of questions on learning.

BACKGROUND

Graesser and Person (1994) divided problems into 17 types and roughly summarized these types into deep problems and shallow problems. Based on previous theories, it can be inferred that deep problems are most conducive to improving students' academic performance (Gholson & Craig, 2006).For example, construction-integration theory believes that questions can activate related concepts and mental models, so deeper questions can better integrate knowledge information (Kintsch, 1998;Chi, 2000); Schema theory also has a similar explanation. According to schema theory, the problem can be memorized, and the deeper the problem, the easier it is to process knowledge and map it into existing knowledge structure.

In order to confirm the theoretical inference, some empirical studies have discussed the effect of deep questions on learning, and found that deep questions can improve students' academic performance more than monologue (Craig, 2006;Dirscoll et al., 2003; Gholson et al., 2009; Sullins et al., 2010), but some researchers did not find that deep questions were better than monologues (Craig et al., 2009;Craig et al., 2012; Sullins & Denton, 2019), the reason for the difference may be related to the different presentation of the problem.

RELEVANT THEORIES

Schema theory

A schema is an organization of concepts and behaviors that can be changed at any time by new information. In terms of asking questions, deep-level reasoning questions activates relevant schemas of various sorts, and this activation makes new content easier to process and map onto existing knowledge structures.

Cognitive constructivism

Constructivism holds that knowledge is not imparted by teachers, but obtained by students through the cooperation and help of others, the reuse of necessary learning materials and the construction of meaning. Therefore, questioning is an important scaffolding for students to construct knowledge. Questions can serve as guides to the activation of relevant concepts and mental models (Chi, 2000). These concepts can then help information integration by forming stronger bonds.

Cognitive Load theory

Cognitive load theory is a concept based on working memory, which holds that learners' cognitive load is limited and will consume cognitive load when learning. The cognitive load consumed by learners through learning content is called intrinsic cognitive load, while external cognitive load is usually related to instructional design, and the germane cognitive load is the load caused by understanding the learning material. So based on questioning, deep questions can increase intrinsic cognitive load.

RESEARCH QUESTION

Based on the review of the above research, the following research questions are proposed:

1) In previous studies, subjects were asked a single question on the same knowledge point, which may be difficult for subjects with low experience. Therefore, several studies did not find the effect of questioning on learning. It is more beneficial for subjects to construct knowledge and reduce cognitive load if they are given multiple similar questions at the same time. Therefore, this study raises the question: Is it better to give subjects two questions at the same time than one? Is it better to have two questions of the same type (shallow question + shallow question) or different types (shallow question + Deep question)?

2) Previous studies have not verified the effect of questioning on learning. Can cognitive load theory explain the effect of questioning on learning?

3) Can questions affect long-term memory?

METHOD AND DESIGN

Experiment 1: Can asking questions promote learning?

Method

Learners use observational learning to learn. In this video, students ask a question and the teacher answers. A total of 100 college students from a certain university were randomly assigned to each experimental group.

Design

Five levels of single-factor between-subject design were used, with four conditions: Deep + Deep question, Shallow + Shallow question, Deep question, Shallow question and monologue. The dependent variables were cognitive load, retention test (include instant test and delay test), transfer test (include instant test and delay test). The lab materials are typical of errors in lab design and contain a total of 12 errors, so that each error is preceded by two or one question. The lab materials are run in Autotutor, where two agents talk to each other, the teaching agent asks the question, and the student agent answers the question. The subjects simply watched the conversation between the two agents.

Procedure

After entering the lab, the participants filled in the demographic information, then watched all the contents in the Autotutor, and finally filled in the remaining subjective scales, including learning tests and cognitive load scales.

Experimental expectation

The academic performance of two questions is better than that of

one question (Deep + Deep question > Shallow + Shallow question > Deep question > Shallow question > monologue).

Experiment 2: The influence of the collocation of deep problems and shallow problems on learning

Method

Same as experiment 1

Design

Four levels of single-factor between-subject design were used, with four conditions: Deep + Deep question, Shallow + Shallow question, Deep + Shallow question, Shallow + Deep question and monologue. The others were the same as experiment 1.

Procedure

Refer to experiment 1

Experimental expectation

The more times of deep questions, the better for learning (Deep + Deep question = Shallow + Deep question > Deep = Deep + Shallow question > Shallow + Shallow question > monologue).

FUTURE DIRECTIONS

Future research can consider whether the interaction between subjects and agents can affect students' learning in the context of questioning; In addition, different timing of questioning may also have different effects on learning, such as the presentation of questioning in preview, learning and review.

SUMMARY

The purpose of this study is to explore the influence of the presentation of questions on students' learning. Experiment 1 is to explore the effect of the number of questions on learning; Experiment 2 is to explore whether the collocation of deep questions and shallow questions will affect students' academic performance when they ask multiple questions at the same time. It is expected that the more the number of questions, the more beneficial to learning. When there are more deep questions, it can promote students' academic performance.

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REFERENCES

Chi, M. T. H. (2000). Self-explaining expository texts: The dual processes of generating inferences and repairing mental models. *In Glaser, R. (Ed.), Advances in Instructional Psychology (pp. 161–238)*, Hillsdale, NJ: Erlbaum.

Craig, S. D., Brittingham, J., Williams, J., Cheney, K. R., & Gholson, B. (2009). *Incorporating vicarious learning environments with discourse scaffolds into physics classrooms. In V. Dimitrova, R. Mizoguchi, B. du Boulay, & A. C. Graesser (Eds.), Artificial intelligence in education, building learning systems that care: From knowledge representation to affective modeling (pp. 680–682)*. Washington, DC: IOS Press.

Craig, S.D., Gholson, B., Brittingham, J.K., Williams, J.L. and Shubeck, K.T. (2012). Promoting vicarious learning of physics using deep questions with explanations. *Computers & Education, 58*(4), 1042–1048.

Craig, S.D., Sullins, J., Witherspoon, A. and Gholson, B. (2006) . Deep-level reasoning questions effect: the role of dialog and deep-level reasoning questions during vicarious learning. *Cognition and Instruction, 24*(4), 563–589.

Driscoll, D., Craig, S. D., Gholson, B., V entura, M., Hu, X., & Graesser, A. (2003). Vicarious learning:Effects of overhearing dialogue and monologue-like discourse in a virtual tutoring session. *Journal of Educational Computing Research, 29*, 431–450.

Graesser, A. C., & Person, N. K. (1994). Question asking during tutoring. *American Educational Research Journal, 31*(1), 104-137.

Gholson, B., & Craig, S. D. (2006). Promoting constructive activities that support vicarious learning during computer-based instruction. *Educational Psychology Review, 18*(2), 119-139.

Gholson, B., Witherspoon, A., Morgan, B., Brittingham, J., Coles, R., Graesser, A. C., et al. (2009). Exploring the deep-level reasoning questions effect during vicarious learning among eighth to eleventh graders in the domains of computer literacy and Newtonian physics. *Instructional Science, 37*, 487–493.

Kintsch, W. (1998). *Comprehension: A Paradigm for Cognition.* New York: Cambridge University Press.

Sullins, J., & Denton, R. (2019). Not all confusion is productive: an investigation into confusion induction methods and their impact on learning. *International Journal of Learning Technology*, *14*(4), 288-303.

Sullins, J., Craig, S. D. , & Graesser, A. C. (2010). The influence of modality on deep-reasoning questions. *International Journal of Learning Technology*, *5*(4), 378-387.

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