Question Asking Practice Makes Perfect: Training Learners to Become More Efficient Question Askers Using Animated Agents in a Vicarious Learning Environment

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Introduction

Is it possible to teach a learner to become a better question asker in as little as 25 minutes? It is well known that knowing when to seek and apply help is an important part of self-regulated learning (Roll, Aleven, McLaren, & Koedinger, 2011; Tang, Butler, Cartier, Giammarino, & Gagnon, 2006). Self-regulated learning can be thought of as a proactive process in which students are attempting to learn through setting goals, using various learning strategies as they monitor their progress through the learning process (Zimmerman, 2008). It is beyond the scope of this paper to examine all available self-regulatory processes in order to determine what factors may be beneficial or detrimental to these processes. In fact, some researchers speculate that there are at least 33 separate strategies that can be implemented by learners. The focus of this paper is on teaching one specific self-regulatory process: self-questioning (Azevedo et al., 2008). Self-questioning specifically refers to a self-regulatory process in which a learner formulates a question, inquiry, or hypothesis about the material being studied. Sadly it is well documented that the ideal scenario of a curious question asker does not match reality. Students are unspectacular at monitoring their own knowledge deficits and their question generation is both infrequent and unsophisticated.

Predictions

According to vicarious learning theory (Sullins, Craig, & Graesser, 2010) learners who receive information vicariously would outperform learners who receive no training. A vicarious learning environment is one in which learners are not the addressee of the material and/or they do not have control over the material they are expected to master. Previous research has found vicarious learning environments to be an effective source of information delivery that significantly increases students' learning when compared to various controls (Gholson & Craig, 2006; Muller & Sharma, 2012). Based on vicarious learning theory, it would be expected that the learners in the question training condition would significantly outperform the learners in the control condition (question training > control).

According to the expertise reversal effect (Kalyuga, Ayers, Chandler, & Sweller, 2003), it would be predicted that the question training would be most beneficial to the low knowledge learners and may in fact hurt the performance of high knowledge learners (low knowledge > high knowledge = control). Scaffolding that is necessary for low knowledge learners to overcome limited working memory capacity in order to achieve schema development is actually detrimental to learners with high prior knowledge due to the redundancy of the information.

Conversely, the cognitive load theory (Sweller, 1988) states that we have a limited working memory capacity. If multimedia learning environments contain too much information, during schema development, low knowledge learners may experience a bottleneck of information which could prohibit any learning from taking place. The high knowledge learners could activate preexisting schemas that would offset the poor design and learn regardless of the interface limitations (high knowledge > low knowledge = control).

Methods and Procedure

Participants completed:

- Gates MacGinite Reading Comprehension test. The Gates MacGinite is designed to assess students' reading levels throughout the course of their education.
- 30 question prior knowledge questionnaire assessing general science knowledge in addition to history and literature
- Pretest (Earthquakes and Heart Disease counterbalanced between pretest and posttest) which consisted of two parts: 1) A paragraph broken into sentences in which learners had the opportunity to type any questions they may have about the sentence they just finished reading and 2) multiple choice test in which they were required to answer questions about the previously read paragraph.
- Participants were then randomly assigned to one of two different conditions:

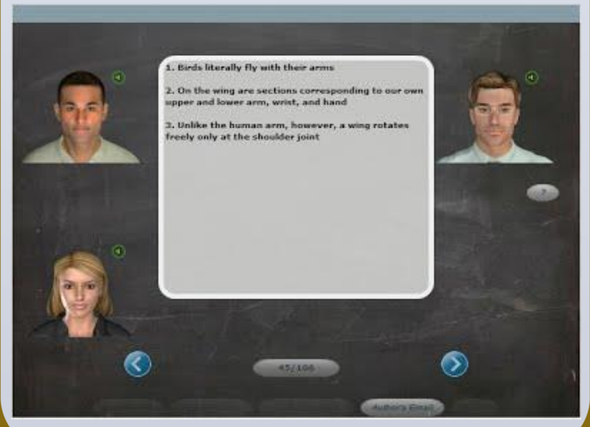
Question Training: participants watched a trialogue between three animated pedagogical agents (a teacher agent and two student agents). The training begins with a brief introduction where the teacher agent discusses the importance of question asking and describes the difference between a deep and shallow question. Following the introduction, a series of science passages appear on the screen and the two student agents take turns asking questions (deep and shallow) and receive feedback from the teacher agent. At predetermined points during the presentation, the participants were asked to generate their own question and received feedback on their question.

Artigo Condition (Control): participants were paired with an anonymous online partner and viewed various pictures on the monitor. Their job was to try to match as many words as they could with their online partner and would receive points for every matching word. The participants worked on this task for 25 minutes.

- Following the completion of the intervention, participants completed: posttest (counterbalanced with the pretest)
- Big Five Personality Test
- Motivated Strategies for Learning Questionnaire.

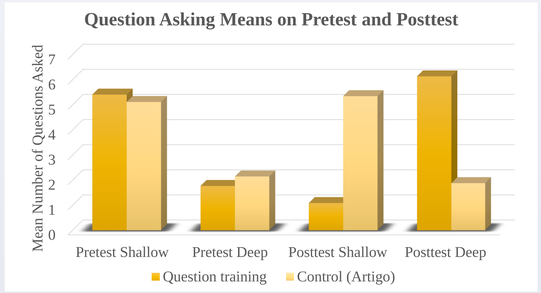
Vicarious Learning Environment

The multimedia learning environment used in the current study was AutoTutor Lite. The AutoTutor Lite system is based on AutoTutor (Graesser, Chipman, Hayes, & Olney, 2005) an intelligent tutoring system shown to be effective in empirical tests. AutoTutor Lite presented in the current study is a minimalist implementation of AutoTutor. It only includes an AutoTutor style interface and interaction with a lightweight language analyzer. For the purpose of the current study, AutoTutor Lite was used as an information delivery system.



Results

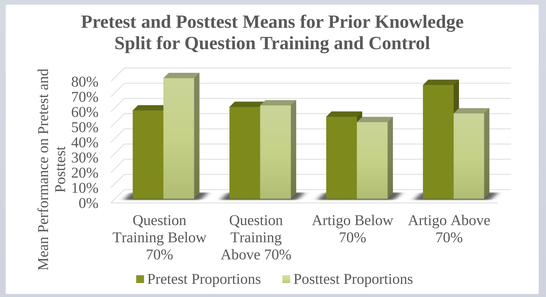
Results revealed a significant difference in the quality of questions generated on the posttest as a function of condition. Participants in the *Question Training* condition asked significantly more "deep" questions on the posttest than did the participants in the control condition, F (1,46) = 77.87, p = .000, η^2 = .62.



Results revealed a significant difference in learning as a function of condition. Participants in the *Question Training* condition scored significantly higher on the posttest than did the participants in the control condition, F (1,47) = 10.042, p = .003, η^2 = .18

Results revealed a marginally significant interaction between condition and prior knowledge, F (1,42) = 3.54, p = .06, η^2 = .08. More specifically, results show that participants in the question training condition with low prior knowledge (M = 79.5) scored significantly higher on the posttest compared to participants with low prior knowledge that were in the control condition (M = 50.54), p = .000.

Furthermore, participants with low prior knowledge in the question training condition (M = 79.5) scored significantly higher on the posttest compared to participants with high prior knowledge in the question training condition (M = 61.5), p = .03



Conclusions

The current study sought to answer the question: can students be taught to become better question askers in a relatively short amount of time? The results suggest that the answer is yes. More specifically, the results seem to support the *vicarious learning theory*. It was discovered that learners who received the question training did ask more deep questions along with performing significantly better on the posttest than those in the control condition.

The unexpected finding was revealed once the data was split based on prior knowledge. Further analysis seems to provide support for the *expertise reversal effect*. These data revealed question training is more beneficial for those students who enter the training with a lower level of knowledge.

It is the belief of the authors that cognitive load plays a role in these substantial results (i.e., intrinsic, extrinsic, and germane; Sweller, 1988).

The explicit instruction along with explicit examples may have served as scaffolding to the low knowledge learner which in turn could have freed up working memory capacity that the learner could have then used to form the appropriate question generation schema.

However, some learners entered the session with preexisting knowledge (schemas) and therefore may not need additional instructional assistance because their schemas provide full guidance. However, in the current study, instructional assistance was provided and high knowledge learners were unable to avoid this information. Because of this there was an overlap between the instructional assistance and their existing schemas which resulted in the presentation of redundant information which required additional working memory resources which could have caused a working memory overload (Mayer, 2009).

References

Azevedo, R., Moos, Greene, Winters, & Cromley, J. (2008). Why is externally-facilitated regulated learning more effective than self-regulated learning with hypermedia? *Education Tech Research Dev, 56*, 45-72.

Graesser, A.C., Chipman, P., Haynes, B.C., & Olney, A. (2005). AutoTutor: an intelligent tutoring system with mixed-initiative dialogue. *IEEE Transactions on Education.* 48(4).

Mayer, R. (2009). Multimedia Learning. *Cambridge University Press.*

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

Kalyuga, S., Ayres, P., Chandler, P., & Sweller, J. (2003). The Expertise Reversal Effect. *Educational Psychologist*, 38(1).

Muller, D.A. & Sharma, M.D. (2012, October). Tackling misconceptions in introductory physics using multimedia presentations. In *Proceedings of the Australian Conference on Science and Mathematics Education.*

Roll, I., Aleven, V., Mclaren, B., & Koedinger, K. (2011). Improving students' help-seeking skills using metacognitive feedback in an intelligent tutoring system. *Learning and Instruction*, *21*(2), 267-280.

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.

Sweller, J. (1988). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction.* 4(4), 295-312.

Tang, I. A., Butler, D. L., Cartier, S. C., Giammarino, M., & Gagnon, F. (2006, May). Strategic help-seeking by secondary ESL students in reading contexts. In *annual meeting of the Canadian Society for Studies in Education, Toronto, ON, Canada.*

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, (1). 166.

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