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### **Proceedings of the Annual Meeting of the Cognitive Science Society**

#### **Title**

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#### **Permalink**

<https://escholarship.org/uc/item/97c7f8vg>

#### **Journal**

Proceedings of the Annual Meeting of the Cognitive Science Society, 29(29)

#### **ISSN**

1069-7977

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#### **Publication Date**

2007

Peer reviewed

# Developmental Differences in Self-Regulated Learning and Question Asking During Learning with Hypermedia

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**Keywords:** Self-regulated learning, question asking, hypermedia, developmental differences, science

## Theoretical Background

Are there developmental differences in the quality and quantity of questions generated by learners while using hypermedia to learn about a complex science topic in a hypermedia environment? There is some dispute among psychologists that question generation is an integral part of comprehension, problem solving, and reasoning (e.g. Graesser, Singer, & Trabasso, 1994). In addition, asking good questions has been shown to lead to improved comprehension, learning, and memory of the instructional materials among learners of all ages. However, what is not yet known is the role of question-generation as a key self-regulatory process during the learning of complex and challenging science topics with hypermedia (Azevedo, 2005). Understanding the nature and role of question-generation during learning with hypermedia is vital to (1) developing a conceptual framework for the understanding of self- and external- regulated learning, and (2) Building dialogue systems for adaptive hypermedia learning environments based on the frequency and types of questions generated and the self-regulatory processes that precede and follow learners' questions. This study examined such factors in college students and adolescents who were being tutored by a human during a 40-minute hypermedia learning session about the circulatory system.

## Method

College students (n=20) and adolescents (n=20) participated in a think-aloud study examining the effectiveness of human tutors as external regulating agents in fostering students' learning about the circulatory system with hypermedia. All students had access to a human tutor who regulated their learning of the circulatory system throughout the 40 minute tutoring session. By regulation, we mean that the tutor facilitated learners' deployment of planning, monitoring, and learning strategies during the learning episode. More specifically, our experiment addresses three research questions: 1) *Is there a significant difference in the quantity of questions generated by adolescents versus college students?* 2) *Is there a significant difference in the quality of questions generated by adolescents versus college students?* 3) *Is there a significant difference in the amount of self-regulatory processes used by adolescents and college students prior to and following a student generated question?*

## Results

The first analysis revealed that there was a significant difference in the amount of questions that were asked between the college students ( $M = 13.65$ ) and adolescents ( $M = 7.40$ ),  $t(38) = 2.312$ ,  $p = .026$ . In addition, analysis revealed that there was a significant difference in the amount of deep-reasoning questions asked between the college students ( $M = 5.70$ ) and the adolescents ( $M = 2.40$ ),  $t(38) = 3.173$ ,  $p = .003$ . As for the self-regulatory processes used by each developmental group, the results indicated that there was a significant difference in the amount of metacognitive monitoring (e.g. judgment of learning) used by college students preceding a question  $t(38) = 2.491$ ,  $p = .017$ . There was also a significant difference in the amount of planning (e.g. creating sub-goals) used by college students following a student generated question  $t(38) = 2.535$ ,  $p = .015$ . Analysis revealed a significant difference in the amount of learning strategies (e.g. summarization) used by college students following a student generated question,  $t(38) = 2.455$ ,  $p = .019$ .

## Discussion

In general, the results suggest that college students ask more deep reasoning questions. College students also seem to be self-regulating their learning more efficiently. These results have implications (1) for designing adaptive hypermedia learning environments designed to foster conceptual understanding of complex and challenging science topics, (2) for understanding the developmental differences and nature of help-seeking behavior as a key self-regulatory process aimed at seeking external contextual regulation.

## Acknowledgements

The research was supported by a grant from the National Science Foundation (REC#0133346 and REC#0633918) awarded to the second author.

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