

Worked-out Examples in a Computer Science Intelligent Tutoring System

Barbara Di Eugenio¹, Nick Green¹, Omar AlZoubi², Mehrdad Alizadeh¹, Rachel Harsley¹, and Davide Fossati²

University of Illinois at Chicago¹ and Carnegie Mellon University in Qatar²
bdieugen, ngreen21, maliza2, rharsl2 (@uic.edu), oalzoubi, dfossati (@cmu.edu)

ABSTRACT

Our *CS Intelligent Tutoring System (ITS)*, ChiQat-Tutor, aims at aiding students in overcoming the initial difficulties in CS education, such as learning data structures. Here, we show our work on utilizing *Worked-out Examples (WOE)* in our linked list lesson. Despite being a promising strategy, we find that it can be detrimental to student growth.

Categories and Subject Descriptors

K.3.2 [Computers and Education]: Computer and Information Science Education—*Computer science education*

Keywords

Computer Science Tutoring, Linked List, Worked Examples

1. SET-UP AND EXPERIMENTS

ChiQat-Tutor [2] aims to teach by focusing on two major components; lessons and teaching strategies. We derived teaching strategies from a corpus of human-human tutoring data we collected and analyzed. Strategies used included different types of feedback, and worked-out examples (WOEs). Here we summarize our preliminary evaluation of the WOE component with the linked list lesson in an undergraduate CS lab session.

WOEs are a strategy that teach by example [3], and has been shown to aid students in learning new concepts. A WOE is broken into: (1) problem formulation, (2) solution steps, (3) final solution. In our human-human data, we found moderate but significant correlations between WOE usage by tutors and learning gains in tutees [1].

We ran experiments over four sessions as part of a 2nd year CS data structures class. Students were given 40 minutes to use the linked list tutorial, which included seven problems. Pre/post tests of 10 minutes were also given, and participants had their usage of the system logged. There were two conditions; 43 had on-demand WOE available, the rest did not. Tests were graded between 3 independent graders.

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Tutor	N	Pre-test		Post-test		Gain	
		μ	σ	μ	σ	μ	σ
ITS (No WOE)	39	.45	.14	.56	.22	.11	.25
ITS (WOE)	43	.50	.22	.48	.25	-.01	.23
Human	54	.40	.26	.54	.26	.14	.25

Table 1: Learning Gains of Students

Contrary to our hypothesis, and human-human results, students appear to make more gains *without* examples (Table 1). Logs also showed behavioral differences, with WOE users solving fewer problems (2.698 vs 3.923), although they attempted more (6.628 vs 6.487), contributing to many incomplete problems (1.372 vs 0.949). 86% of users used an example at some point, thus students were aware of WOE. 43% of students did not complete a problem after using a WOE. 16% also tried to learn the material by WOE only and not attempting associated problems.

2. CONCLUSIONS AND FUTURE WORK

While students appeared to engage with ChiQat-Tutor, WOE did not yield the learning gains as hypothesized. Next steps include understanding how student behavior differs from the two conditions by further analyzing log data. Potential modifications to the process could include modifying WOE content (statically/adaptively), understanding if and when to launch an example, or gamify the process.

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3. REFERENCES

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