Can Tutors Diagnose Students' Understanding?

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It has been hypothesized that successful tutoring (Bloom 1984) lies partly in the ability of tutors to diagnose students' understanding and to adjust their teaching accordingly (e.g., Putnam, 1987). However, to what extent can tutors form a detailed diagnosis of their students' understanding? This study addressed this question in the context of human biology tutoring involving novice tutors.

In this study, 11 tutors tutored 22 eighth graders about the human circulatory system. The tutors, all undergraduates majoring in either the biological sciences or nursing, first tutored a student in whatever way they liked (tutoring condition): they were not given any explicit instructions on how to tutor the student. Then they tutored another student, but, this time they were instructed to use content-free prompts only (prompting condition): tutors prompted students to generate more self-explanations without giving specific content information. Twice during the tutoring session, students' understanding of the circulatory system was assessed by asking them to draw the path of blood flow in the circulatory system (once some time after the tutoring began and once toward the end of the tutoring session). While students were performing this task, tutors were asked to draw and talk about the students' understanding of blood flow in the body in order to assess the tutors' conception of their students' knowledge.

Results

What participants drew and talked about during the drawing task was analyzed in two different ways to determine how well tutors diagnosed students' understanding in detail. (Due to equipment failure only the data of 15 pairs, 5 pairs for the tutoring condition and 10 pairs for the prompting condition, are reported here.)

First, the tutors' ability to diagnose students' understanding was analyzed at the level of knowledge piece (KP): what the tutors and students drew and talked about were scored using a template which contained 38 pieces of correct knowledge. Overall, students missed 46% of the 38 KPs, and of these, tutors correctly assessed that the students missed them 63% of the time. Tutors in the prompting condition (70%) were better than the tutors in the tutoring condition (54%). In addition to this template scoring, incorrect knowledge pieces that the students manifested during the drawing were identified. Tutors in general were quite bad at detecting incorrect knowledge pieces that students manifested (7% overall), with tutors better when they were in the prompting condition (13%) than when they were in the tutoring condition (0%).

Second, all drawings and verbalizations were analyzed at the level of seven mental models that students commonly construct about the human circulatory system (see Chi, de Leeuw, Chiu, & LaVancher, 1994). This analysis was done to capture how students' knowledge is structured as well as to determine how well tutors can diagnose students' mental models. Tutors correctly diagnosed students' models 53% of the time (e.g., what the tutor drew and talked about was a Single Loop model when the student's model was indeed a Single Loop model). However, when their diagnoses were examined separately in terms of whether the student's model was the most correct one (Double Loop 2), it was revealed that tutors were correct 82% of the time when students had the most correct model, whereas tutors were correct only 15% of the time when students' models were other than Double Loop 2. It seems that tutors have a bias (77%) to assume that the students had the most correct model (Double Loop 2), and this tendency was more pronounced when tutors were in the tutoring condition (100%) than when they were in the prompting condition (65%).

Conclusion

Tutors' ability to diagnose students' understanding was assessed at two different levels in this study: at the level of knowledge pieces and at the level of mental models. Although the implicit assumption has been that tutors diagnose students' understanding, it seems that tutors—at least the novice tutors such as the tutors in our study—do not construct a detailed model of the individual students' knowledge. Rather they seem to simply assume that students know what was told to them. However, tutors' ability to diagnose students' understanding tended to improve when they prompted students to self-explain.

References

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