Characterizing the Temporal Dynamics of Student-Teacher Discourse

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Abstract—Student-teacher verbal communication contributes to successful learning outcomes. In this study we explore the use of conceptual-based recurrence plots to characterize the dynamics of student-teacher interaction. The results indicate: 1) Individual differences in teachers’ speech styles 2) Teacher speech may reflect strategies that are sensitive to student performance and 3) Student-teacher discourse dynamics may influence learning outcomes. Findings have educational implications, particularly in classroom settings where teachers depend on verbal interaction to communicate to students; they also provide the foundation for modeling student-teacher interaction and creating automated tutoring systems that respond sensitively and effectively.

Index Terms—Discourse, Social-interaction, Education

I. INTRODUCTION

During student-teacher interaction, verbal communication contributes significantly to successful learning outcomes. Speech provides teachers with real time information about the student’s knowledge, and the opportunity to prompt or give further explanation [1-3]. While previous studies on student-teacher discourse have mainly focused on identifying individual speech patterns (e.g., teacher question-and-answering behaviors), few studies have addressed the interactional dynamics of student-teacher discourse. Understanding how teachers and students use speech in a learning context can help identify successful teaching strategies and form the basis for automated tutoring systems. The present study aims to characterize student-teacher discourse during one-on-one tutoring sessions using Discursis, a computer-based speech analysis tool that uses recurrence plots, an information visualization technique that can reveal trends and features in complex time series data. Recurrence plotting techniques have been previously applied to textual data; however, previous approaches plotted recurrence using term-based similarity rather than conceptual similarity of the text [4]. In this study we explore how the descriptive power of the conceptual recurrence plotting technique can be used to discover patterns of interaction during teaching discourse.

II. PROCEDURE

Participants were 20 middle school-age students (10 male, 10 female; age 13 years) and two middle school math teachers (one male, one female). Each student participated in a 10-minute pretest on logarithms, followed by a 40-minute one-on-one teaching session focused on logarithms, then a 10-minute posttest. All sessions were recorded via video cameras and transcribed using the Child Language Data Exchange System (CHILDES) [5]. Transcripts of verbal data were then uploaded into Discursis for analysis and extraction of speech metrics (quantitative measures of concept usage).

III. RESULTS

The results indicate: 1) Individual differences in teachers’ speech styles. Specifically, Fig 1 shows that the male teacher tends to be iterative in style, recalling previously mentioned topics throughout the tutoring session, and is goal oriented in presenting new topics to the student. In contrast, the female teacher responds more to topics initiated by students, suggesting a more conversational style. 2) When student-teacher interactions are grouped by student improvement (differences in pre- and post-test scores), results demonstrate distinctive verbal strategies when interacting with low improvement students versus high improvement students. Fig 2 shows that when the male teacher interacts with the lower improvement students, he is more likely to return to the same topics throughout the session; he also responds to topics initiated by the lower improvement students in the immediate time frame, reflecting conversational engagement. In contrast, when he interacts with the higher improvement students, over the long time frame, he is more likely to refer back to topics initiated by the higher improvement students than the lower improvement students, suggesting that he is summarizing concepts. 3) Finally, also of interest is a case study of a student with low overall improvement. The discourse dynamics of this particular student-teacher interaction more closely resembled a dyadic conversation rather than a directed teaching session as demonstrated by the student’s tendency to introduce new topics and her propensity to repeat her own topics; these suggest that she, rather than the teacher, controlled the conversation [Fig 3 and 4]. Her overall lack of
improvement coupled with these interaction dynamics suggest that when a student carries more of the conversation during a tutoring session, the learning outcome may be low. Similarly, a previous study on doctor-patient conversations found that when a doctor dominates the conversation, as this student did with the teacher, it results in an erroneous diagnosis [6].

IV. CONCLUSION

Overall, our findings show distinctive dynamic patterns of student-teacher discourse, varying by individual teaching style, student prior knowledge and performance. Findings have educational implications, particularly in classroom settings where teachers depend on verbal interaction to communicate to students; they also provide a foundation for modeling the dynamics of student-teacher interaction and creating automated tutoring systems that respond sensitively and effectively to students.

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REFERENCES