Quantitative Differences in Collaboration Dialogue Acts Between Students in Problem-Solving Discussion

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Summary

COMPS collaborative small-group exercises are being used in NC A&T computer science classes. During computer-lab time students work together by special computer-chat page.

In this project, over a thousand student dialogue utterances were classified into four categories of dialogue acts relevant to collaborative activity: sharing ideas, negotiating ideas, regulating problem-solving, and maintaining communication.

The dialogue style of the teaching assistant also affects behavior.

- Tutoring style TA, teaches the material, associated with fewer student turns involving negotiating ideas.
- Mentoring style TA, facilitates student problem solving conversation.

Different patterns of dialogue behavior can be observed among the students in the group. The three students in one discussion can be ranked according to their score on the pretest. The most prepared student participates significantly more than the least, and their percentages of dialogue acts also differ.

Dialogue Act Categories

Table 1: Collaboration Categories

Category	Description	Label
Sharing Ideas	The participant shares their idea to the group. The idea has to be task-relevant or information that contribute to the process	A
Negotiating Ideas	The participant will listen to a previous conversation and express their idea to a group	B
Regulating of Problem Solving	The participant shows intent to direct or regulate workflow. General management of the group	C
Maintain Communication	The participant engages with the group that is casual or not related to the task work	D

- Break down each category into subcategories to further identify various examples within each category.
- Analysis of the collected student dialogue files involves categorizing each turn of dialogue into one of the four categories of collaboration.

Annotation Analysis

Table 2: A Teaching Assistant in Tutor role, Group A

Participate	Text	Dialogue Acts	Reasoning
St1	TA could you re explain the question	C	Expresses confusion
TA	for # 3?	TA-C	Check on understanding
St1	yes	D	Agree on none task-relevant
TA	Basically, you have to tell me which variables you can access from your method	TA-A	Share idea
St2	it would be the three formal parameters for number three right?	B	Ask to clarify
TA	*which class variables	TA-C	Suggest next step
St1	the principalAmount, intreset rate, and the term? because thats the values the method uses to calculate	A, B	Sharing idea, collaborate on an idea
St2	3. the principalAmount, intreset rate, and the term.....because thats the values the method uses to calculate TA?	C	Express of understanding
TA	Actually, its a bit more complicated than that.	TA-C	Suggest next step
St1	totalCurrentMortages	A	Sharing idea
TA	You have a static method for your example. Therefore you can only access a particular class var Explain why that is	TA-A	Sharing idea
St1	static methods can only access other static variables	A	Sharing idea
TA	good, you got it	TA-C	Show satisfaction of the group did

Table 3: A Teaching Assistant in Mentor Role, Group B

Participate	Text	Dialogue Acts	Reasoning
St1	num 4	C	Suggest next step
St2	yes sir	D	Small talk
St3	cool	D	Small talk
St2	i suck at tracing code	D	Small talk
St3	I am working on it	C	Explain current action
St1	can we get some help	C	Express confusion
St2	TA since i cant talk, can u please help me us*	D, C	Express confusion
TA	Can you point out which part is giving you trouble in the code	TA_C	Check on understanding
St3	public string toString	C	Express confusion
TA	Do you understand the code from main()?	TA_C	Check on understanding
St2	no sir	C	Express confusion
St1	well im confused still	C	Express confusion
St2	any ideas guys? guys??TA?	C	Express confusion
TA	Ok try to discuss the 1st two lines of main and what they do	TA_C	Suggest the next step

Annotation.

- Analysis of the collected student dialogue files involves categorizing each turn of dialogue into one of the four categories of collaboration.
- Some turns of dialogue display elements of more than one category, so we mark it as both categories as shown in Table 2 and Table 3.

Table 4: Teaching Assistant Dialogue Acts

	Group A tutoring	Group B mentoring
Sharing ideas	32%	06%
Regulating	60%	88%

Result of Teaching Assistant Interaction

- There are distinct differences in the dialogue acts performed by the teaching assistants between the group A and group B mixtures of dialogue acts.
- In both cases, categories B (negotiating) and D (maintaining communication) are negligible.
- In the tutoring role segments the TAs contribute many more ideas into the conversation.

Tutor-style TA segments.

- The problem-solving work ceases to be between the students and becomes between students and TA.
- The dialogue segment in Table 2 shows 6 out of 13 turns uttered by the TA, whereas with 4 people approximately 3 turns would represent an even participation rate.
- In Table 2 student 3 is lurking, not saying anything.

Mentor-Style TA segment

- TA works to promote student collaborative problem-solving.

Teaching Assistant Style Changes The Collaboration Environment

- The TA is invited into the conversation to check possible answers, so student behaviors plausibly change anyway because they are often no longer solving the problem.
- Tutoring-mode TAs increase their participation and increase their type A sharing ideas dialogue acts.
- Quantitatively differentiating TA styles is promising result, it could be useful for monitoring the conversations.

Discussion /Chat Engine

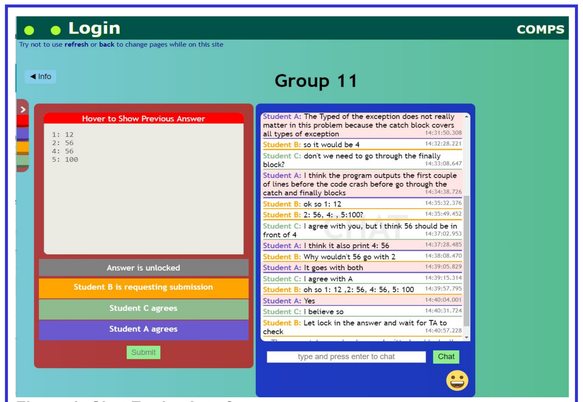

Figure 1: Chat Engine Interface

- Students are assigned to group and work together to find the answer
- Teaching Assistant is there to check students' answers and to give helpful hints.

Student Preparedness Changes Dialogue Style

Table 5 :Different styles of contribution, based on relative preparedness within the group.

	Rank 1: n=10	Rank 2: n=10	Rank 3: n=10
Avg learning gain	0.0	0.1	0.5
Numb. Dialogue Acts	442	311	220
A: sharing	30%	27%	25%
B: negotiating	28%	33%	33%
C: regulating	28%	27%	21%
D: maintaining	14%	13%	22%

Students Rank Measurement

- Measured learning gain over the course of the lab exercise from the pretest and posttest. Learning gain is calculated by:

(posttest score - pretest score) / (full point score - pretest score)

- The three students in a discussion group are ranked based on pre-test score.
- Rank 1 is the student within the discussion who was most prepared, rank 3 was the least prepared student.

Most Prepared Student Segment in Dialogue Act

- Participation increases with increasing relative preparedness. The most knowledgeable student talks more.
- With more preparedness: a) sharing dialogue acts increase, b) negotiating dialogue acts decrease, c) regulating increases.

Least Prepared Students Segment in Dialogue Act

- Rank 3 least prepared students show the largest dispersion in participation and dialogue act behavior analysis.
- Some rank 3 students seem to be disengaged or lurkers, resulting in a low participation rate.
- Others may to constantly ask for clarification, which enriches participation and the negotiation dialogue acts. Others devote large numbers of turns to conversation not related to solving the problem.

Conclusion

Student Learning Gain Support Lesser Prepared Student

- Most prepared students shows zero learning gains, on average, while the others show positive learning gains from the experience. Students can learn or establish better understanding of class material by discussing with their classmates.

Dialogue Act Promote Positive Change

- Provide training to TA to better promote collaborative problem-solving activity through typed-chat.
- Being able to detect dialogue act behaviors via text machine classifiers seems promising for assessing dialogues.
- We can help a machine tutor to understand what happened in the lab section and apply a response that is appropriate and helpful to every participant.

Future Work

Our future work will focus on further analysis of collaboration patterns we find through our annotations. We will also use our annotations to train a classifier to automatically recognize the category of each dialogue turn. With regard to fingerprinting errant conversations and providing machine recognition of this deviation from collaborative work.

Acknowledgement

Partial support for this work was provided by the National Science Foundation's Improving Undergraduate STEM Education (IUSE) program under Award No. 1504918. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

This work is made possible thank to graduate student, Matthew Trotter.