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Group Cognition in Problem Solving Dialogues: Analyzing differences between voice and computer transcripts

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ABSTRACT

This project shadows the work of student groups in Math 110, a quantitative literacy class, engaged in exploratory learning exercises. An instructor monitors these groups by both walking around the room and observing group conversation at another computer. Our goal is to put this exercise online, and as a result leave the entire monitoring process up to the computer, assuming the role that the instructor traditionally assumes.

Using annotation techniques to decipher meaning in dialogue of students working in groups for a Math 110, we try to see how students collaborate to solve problems together. "Bits of realization", conversation, and problem solving tags are sorted out and gathered to identify the main points that are expressed during the problem solving of the two-person game, Poison. Expanding upon previous research done by other students, we are able to add bits of realization that students encounter in their work.

Our first effort is to explore the differences between voice recorded dialogue and computer-mediated chat dialogue.

ABOUT

Math 110: Quantitative Problem Solving

How Poison is played:

- There are twenty tiles
- Two teams take turns removing 1 or 2 tiles
- The team to take the last tile loses
- Problem Solving- find the winning strategy

Transcripts used:

- 4 Cassette Recorded Dialogues
- 3 Computer Recorded Dialogues

GOALS

Project Goals for the 2011-12 School Year

- Math 110 students play online version of Poison
- The students use chat boxes for problem solving
- Learn how students work together
- Determine if there is a difference between computer and voice dialogues
- Use statistics from the transcript counts to interpret findings

Short term project goals:

- Analyze transcripts again for consistencies
- Include new bits of realization
- Manually tag transcripts based on newly added bits as well as conversation and problem solving tags

TRANSCRIPT ANALYSIS

Speaker	Line	Bit	CT	C	PT	P	Sentence
Ag	201	6	195	Rp			well everytime ive had 4, or 7 i lose.
Al	202	19	201	Rq			huh?
Ag	203	19	201	Et			Oh wait, that's every round >: (
Al	204	19	203	F			i dont think it matters
H	205	19		Nc			hahaha
H	206	16		O	P		lets do 23 again and ill pick a 1 to start instead of a 2?
Ag	207	19	206	F			FINE
Ag	208	19		S			It's quiet...
Ag	209	19	209	Et			Too quiet
J	210	13		O	R		i just tried to avoid 7 and still got stuck with 4
Ag	211	19		Nc			hahahahaha

Computer Transcript example

Speaker	Line	Bit	CT	C	PT	P	Sentence
C	39	13		Rq		Ch	5, if it was your turn, you'd want to take 1 right?
C	40	1	39	E	39	Re	To get it down to 4
A	41	19	40	F			Yeah
B	42	19	40	F			Yeah
C	43	13	40	El	40	Re	So that the other person would lose
B	44	17	43	Et2	43	Re	Yeah, so the next person would take 2 or 1
C	45	13		O		R	Ok so what if there was, so if there was 6 left, you'd want to take 2
A	46	1	45	Et2	45	Re	Yeah 'cause either way you want there to be 4 left, so you don't want there to be 5 when it's.
A	47	2		O		T	If there's 3 left, and it's not your turn, you should lose, because the other person should take 2.
C	48	10		O		T	OK so let's look at 7, because 4, 5, and 6 we know.

Voice Transcript example

Transcripts were annotated three ways:

- ▶ Bits of Realization: a set of annotations specific to solving the Poison problem developed at VU.
- ▶ Conversation: a set of dialogue actions, developed by the VMT project observing students solving math problems.
- ▶ Problem Solving: a set of problem solving actions, also from VMT.

Code	Conversation Tag
O	Offer
Rq	Request
Rg	Regulate
F	Follow
El	Elaborate
Et	Extend
Rt	Retype
Se	Setup
A	Agree
E	Explain

Code	Problem Solving Tag
O	Orientation
T	Tactic
P	Perform
Ch	Check
Re	Restate
Su	Summarize
Rf	Reflect
R	Result

Code	Bit of Realization
1	4 tiles is important
2	2 and 3 are good tiles
3	You want to leave your opponent with 19 tiles
4	Going first gives you control of the game
5	You want to take 1 tile on your first move
6	1, 4, 7, 10, 13, 16, 19 are the poison numbers
7	"Opposite" strategy
8	"3 pattern"
9	Wrong statements
10	Exploring
11	Playing the game
13	Making an observation
14	Clarifying observations
15	Clarifying rules
16	Exploring further versions of the game
17	Hypothesizing
18	There is a winning strategy
19	Filler ("Yeah", "OK")
20	Perspective
21	Opponent knowing strategy
22	Computer references "reset", "boxes"

CHI SQUARED TESTING

	χ^2 test p-values
Bits of Knowledge	2.3×10^{-52}
Conversation Tags	1.6×10^{-31}
Problem Solving Tags	3.0×10^{-11}
Threading	2.2×10^{-21}

The null hypothesis that voice and computer-mediated behavior are the same is rejected. All $p < 0.001$.

Observing the differences in Bits of Realization, the Problem Solving annotations, and the Conversation annotations, the difference is clear: the online participants were far more into playing Poison as a video game while the in-person participants were working more on solving the exercise.

FUTURE WORK

- Online play is restricted to using 20 tiles or fewer
- Use COMPS to monitor problem solving and perform the tasks the professor performs
- COMPS identifies the 3 different annotation tags

Can the computer correctly analyze the tags

- Conversational
- Problem-Solving
- Bits of Knowledge

STATISTICS

Bits	Comp	Voice
1	2.61%	4.07%
4	0.25%	1.31%
11	22.86%	12.48%
13	4.97%	15.51%
19	50.68%	28.91%

Conversation	Comp	Voice
El	1.49%	7.08%
Nc	15.03%	5.74%
O	6.96%	18.29%
Rq	11.18%	11.08%
S	21.86%	4.14%

Problem Solving	Comp	Voice
Ch	7.53%	10.00%
O	10.75%	2.89%
P	9.68%	17.63%
Rf	7.53%	13.16%
T	38.71%	12.11%

The percentages suggest that working in person with a group produces a different conversation and problem-solving flow than working through a computer chat program.

Bits of Realization:

- voice conversations richer with Bit 13 **making an observation**
- online conversations richer with Bits 19 **filler** and 11 **playing the game**

Conversation:

- voice conversations richer in **offer** and **elaborate** dialogue moves

Problem Solving:

- voice conversations richer in **perform**, **check**, and **reflect**
- the online conversations richer in **tactic**.

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