Assessing Equity in Collaborative Learning Situations: A Comparison of Methods

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Abstract: We set out to apply methods for assessing equity in a collaborative learning situation of four college students. To do this, we utilized prior work assessing equity in programming pairs (Lewis & Shah, 2015; Shah, Lewis, & Caires, 2014) and coded for talking time, questions asked, and commands givne. Using these methods to analyze two different groups we found the groups to be very similar. However, our sense was that the groups were not similar in regard to equity. We then used an adapted version of Duek's (2000) group processing behaviors to code and analyze the two groups. This method indicated that one group engaged in far more equity-promoting behaviors than the other, suggesting a difference in the relative equity between them.

Keywords: equity, research methods, processing behaviors, collaborative learning

Introduction

Collaborative learning in small groups has been identified as an instructional practice that can support students' conceptual understanding and create the potential for a more equitable learning environment (Esmonde, 2009; O'Donnell, & Hmelo-Silver, 2013). Though some also worry poorly designed collaborative work has the potential to exacerbate inequity rather than promote equity. Because there is reason to be both hopeful and cautious, understanding equity-dynamics in collaborative learning contexts is important work for our research community.

Developing that understanding will be complicated. As a beginning point, one must define and then operationalize equity in collaborative learning contexts; no small task. Like others in this community (Langer-Osuna, 2011, Shah, Lewis, & Caires, 2014, Lewis & Shah, 2015, Dietrick, Shapiro, & Gravel, 2016) we find Esmonde's (2009) conceptualization of equity, from math education, useful when paying attention to equity in collaborative science learning contexts. Esmonde characterizes equity as "…the fair distribution of opportunities to learn…", going on to identify two kinds of access to attend to, "…students' access to mathematical content and discourse practices…" as well as "…their access to (positional) identities as knowers and doers of mathematics…" (p. 249). This characterization captures the potential we see for both the positive and negative equity-outcomes in collaborative learning situations. Equity is about fair access to opportunities. Compared with didactic learning situations, we expect learners have greater potential for access to content, discourse practices, and identities; but the social dynamics of collective problem solving may function to diminish such access for some group members.

Taking Esmonde's characterization as a starting point, the next task is to operationalize it. In our case, we aim to do quantitative analysis that allows for comparisons like, for example, different activities done by the same group or different groups engaged in the same activity. Our interest in quantitative methods, as opposed to qualitative ones, is pragmatic. Both contribute to the development of a rich understanding. Quantitative methods make analysis across multiple groups over longer periods of time more practical, which is why we are investigating them. A common quantitative method is to identify behaviors that serve as an indicator of equity and code video data for those behaviors. (ie. Lewis & Shah, 2015; Dietrick, Shapiro, & Gravel, 2016) Commonly used equity indicators are the distribution of talking time or turns of talk, commands given, and questions asked. Typically researches track the quantity of the behavior for each individual learner and assume that a more *equitable* situation will yield a more *equal* distribution of the behaviors.

Notably, these studies acknowledge that the distribution of indicators is at best a rough proxy for equity. This is one of the trade-offs one makes when choosing quantitative over qualitative methods. We value the use of rough proxies; it makes our goal of analysis of larger sets of data possible. But we question whether equal distribution is a reasonable proxy for equity. While it is easy to imagine extreme cases where, say, one student dominates the activity of a group, it also seems likely that there are group contexts where some students bid to contribute to the intellectual or social discourse and are rebuffed by other group members. A student whose bid is unsuccessful may lose access to content, discourse practices, and identities. In those cases, measuring these behaviors may not give reasonable insight into equity.

We set out to investigate and compare a variety of methods for "measuring" equity in collaborative learning situations. In this paper, we report on a comparison of two different methodologies for assessing equity. We had access to an extensive data set of videos of collaborative learning situations in a pre-orientation program for students about to begin school at their undergraduate institution. In the course of comparing all five student

groups in a class when they were engaged in the same activity, we somewhat luckily stumbled across two groups engaged who (1) appeared markedly different to us in terms of Esmonde's (2009) conceptualization of equity and (2) had remarkably similar distributions of talking times, questions asked, and commands. In what follows we first describe the comparison of the two groups using talking time and commands given analyses. Then, we describe how we adapted Duek's (2000) group processing behaviors into a coding scheme and describe the two groups through that analysis. The first analysis suggests the two groups are very similar, while the group processing behavior analysis shows large differences.

Methods

The video data analyzed in this paper comes from the Integrating Metacognitive Practices and Research to Ensure Student Success (IMPRESS) program. This is a two-week pre-orientation program aimed at supporting science-interested deaf/hard-of-hearing students and first generation students about to start their first year at the Rochester Institute of Technology (RIT). (Franklin et al., in preparation) A large set of data, including videos from collaborative learning activities, has been accumulated by a research group that uses the program as a site for data collection.

The IMPRESS program's content focuses is on climate change. We analyzed the activity of all five of groups in one session when they worked to construct a physical model of the atmosphere. As we note above two of the groups were remarkably similar in the typical equity indicators but intuitively appeared very different in terms of equity. "Group A" contained three female students, Brittany, Arya, and Pat, and one male student, Daniel (all names are pseudonyms). "Group B" was all male and contained Justin, Jakob, Herb, and Brock. The data for this paper comes from the second day of the program. Our analysis focuses on the same 20-minute time period for each group.

In the following analysis, we first use a system similar to Shah and Lewis' (2015) scheme to quantify the distribution of talking time, questions, and commands by each individual in each group. We used BORIS software to record start and stop times of each utterance and mark questions and commands. Then we used an adapted version of Duek's (2000) group processing behaviors to code the same data. A description of that coding scheme is provided below. As this is relatively new analysis for us we first created transcripts of each group to allow for easier comparison of different coders' codes. We broke the 20-minute period into 5 minute segments and independently coded a few of the segments. We compared results and talked through instances of disagreement until we resolved each difference.

Results and discussion

The first quantitative measure analyzed was talking time, shown in Table 1. The groups are surprisingly similar in distribution of talking time among participants. The percentage of the total time that each student was responsible for is within 1 or 2 percent of the person from the other group in the same rank-ordered position. For example, Britany and Justin talked the most in their groups, 38 and 40 percent of the total talking time respectively. Arya and Brock ranked third in their groups, 20 and 19 percent respectively. We compare the percentage distribution here because of the difference in the overall time spent talking by each group. The members of Group B had almost five more minutes of talking time in aggregate than Group A, 1112 seconds compared to 844 seconds, during the twenty-minute segment. This disparity is caused by the students of Group B engaging in a significant amount of overlapping talk, while the students of group A tended to take turns when talking.

Table 1: Distribution of Talking Time and Commands Issued

Group A	Time (s)	%	Commands	%	**Group B**	Time (s)	%	Commands	%
Britany	321	38	25	71	Justin	445	40	0	0
Daniel	247	29	5	14	Jakob	329	30	19	76
Arya	172	20	5	14	Brock	195	18	3	12
Pat	104	12	0	0	Herb	142	13	3	12
Total	844		35		Total	1112		25	

The second measure on which the groups were similar was commands issued, also shown in Table 1. In each group one student dominated the number of commands issued with the other three students having a few or

zero commands. An interesting difference that bears comment is Justin, in Group B. He is the student who speaks the most yet he gives no commands. Justin's talk is largely arguing in support of his ideas when they disagree with the ideas of others. He is also the student who takes the group off task a couple of times. So, while Justin talks frequently he is not directing the on-task progress of the group.

Based on the assumption that equality is a rough proxy for equity, the similar distribution of talking times and commands in these two groups suggests they are relatively similar in terms of equity. Perhaps based on the fact that there is wide variance in how much different group members talk and how commands are distributed we should consider these groups relatively inequitable. However, when watching and analyzing the video of each group, the discourse in Group A appears to offer greater support for all students' access to content, discourse practices, and identities than Group B. The members of Group A support each other's access to such opportunities while the members of Group B engage in a significant amount of closing off access to opportunities.

Our sense of this difference was based on how members of each group interacted with one another, that is, the discourse that occurred between them. So, we looked for coding schemes of group interaction behaviors in the context of assessing for equity and found Duek's (2000) work. We considered which of her behaviors were good candidate coding categories for our data. For example, several were not behaviors we could reliably code and we discarded them. We added an "Ignoring" code because we saw the behavior occasionally and it is a similar type to other behaviors Duek identified. We then considered whether each behavior we could reliably code promoted or demoted equity, using Esmonde's (2009) characterization of equity to guide our choice. We considered whether each behavior could be identified as promoting or demoting access to content, discourse practices, and identities. In cases where the outcome was unclear or seemed ambiguous we removed the code from our analysis. We ended up with the eight codes listed in Table 2. The fact that there are four each that promote and demote equity was not planned, but we like that feature of what we are left with.

Table 2: Group Processing Behaviors with description and impact on equity

Behavior	Description	Equity Impact
Encouraging/ Energizing	Statements or actions that promote the ideas or statements of another student	Promotes
Orienting/ Clarifying	Statements or questions that attempt to clarify/understand an idea or action in the group	Promotes
Gatekeeping	Attempts to get any/all members of the group to participate in the discussion or activity	Promotes
Forwarding	Taking a leadership role in moving the group towards completion of the task at hand	Promotes
Ignoring	Not verbally engaging or acknowledging the ideas or attempts to contribute of another member of the group.	Demotes
Overtalking/ Aggressing	Talking louder while another student is talking, making harsh comments or tone of voice toward another student	Demotes
Individual Blocking	Any action or statement that prevents another student from contributing their ideas to the group	Demotes
Derailing/ Group blocking	Statements or actions that cause the group to become off task or lose focus on the task	Demotes

We then coded the same data using our Duek-inspired coding scheme. Frequencies of each behavior category are shown in Table 3. There are a number of things to point out. The most notable is to look at the different percentages of equity-promoting and equity-demoting behaviors in each group. In group A, the one we perceived as being the more equitable of the two, there was a fairly equal split between equity-promoting and equity-demoting codes. In group B, the less equitable of the two, there were far more equity-demoting codes than equity-promoting ones. So overall this coding matches our intuitive sense of the relative difference between the two groups.

We also note that several codes are markedly different across the two groups. We are interested to see if these differences are a function of these two groups of if they will hold up with other groups. The complete or near absence of Encouraging/Energizing, Forwarding, Ignoring, and Individual Blocking in one but not the other group leads us to wonder if presence or absence of those behaviors are particularly salient markers of equity.

Other behavior codes are frequent in both groups. Overtalking, an equity-demoting code, is the most frequent code (or nearly so) in both groups, but a larger percentage of the total in Group B, the less equitable

group. Its frequent presence in both groups is unsurprising. The social dynamics of four students collaborating is simply going to involve overtalking. Orienting/Clarifying, an equity-promoting behavior, occurs equally in both groups, though it is a larger percentage in group A, the more equitable group. Again, this seems unsurprising, four students working together should involve instances of seeking clarification or explanation. But in both cases, the percentage supports our sense of more or less equity in the groups.

Table 3: Group Processing Behaviors exhibited by each group

Behaviors	**Group A**	%	**Behaviors**	**Group B**	%
Encouraging/Energizing	7	13	Encouraging/Energizing	1	1
Orienting/Clarifying	16	29	Orienting/Clarifying	16	18
Gatekeeping	0	0	Gatekeeping	0	0
Forwarding	5	9	Forwarding	1	1
Ignoring	0	0	Ignoring	8	9
Overtalking/Aggressing	14	26	Overtalking/Aggressing	47	54
Individual Blocking	0	0	Individual Blocking	4	5
Derailing/Group blocking	13	24	Derailing/Group blocking	10	12
Equity Promoting	**28**	**51**	**Equity Promoting**	**18**	**21**
Equity Demoting	**27**	**49**	**Equity Demoting**	**69**	**79**
total	55		total	87	

Conclusion

As the above section hopefully communicates, we are excited that this processing behavior coding scheme produces a result that is robustly consistent with our sense of which group was more or less equitable compared to the other. That suggests there is potential for a useful rough proxy for equity. We are driven by many questions these analyses beg. We want better calibration for this coding instrument, which analysis of more and different data will provide. We wonder how the number of group members matters. Much of the work we look at for methodological guidance focuses on programming pairs in computer science. What systematic differences should we expect when groups get larger? We look forward to continuing to investigate and refine this coding scheme.

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