Variations in Student Authority in One Collaborative Small Group

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Abstract: In order to better understand inequity in small groups, the processes that lead to student status and authority in relation to other group members warrant further study. To describe status changes in authority of students in small groups, this article applies Langer-Osuna's influence framework (2016) to data of undergraduate students. This analysis found that these components change both longitudinally across days and rapidly within one day. These changes to students' positions suggest that not all interactions lead to the development of a singular identity (Langer-Osuna, 2018). These findings are consistent with positioning theory, which posits that identity is rapidly in flux as people position and reposition themselves (Davies & Harre, 1999; DeJarnette & Gonzalez, 2015).

Keywords: student authority, proposal negotiation units, temporal variation, collaborative learning

Introduction

There has been a shift in STEM education toward creating collaborative learning environments due to research on their effectiveness in promoting student learning and greater equity among group members (Langer-Osuna, 2016; O'Donnell & Hmelo-Silver, 2013). However, we worry that collaborative small groups can also discourage equity when authority is distributed unevenly among group members. We find value in Esmonde's (2009) definition of equity in collaborative small groups. She defines it as "the fair distribution of opportunities to learn," meaning that all students have "access to...content and discourse practices" and "(positional) identities as knowers and doers of" science (p. 249). When some students consistently have more authority than others, both the high and low authority students have diminished access to these discourse practices and identities. This is especially true when those practices help students to reason through content by discussion (DeJarnette & Gonzalez, 2015).

In this view, equity is impacted by the social negotiation of authority among group members. In an effort to understand how influence is negotiated among students during persuasive discussion, Engle, Langer-Osuna, and McKinney de Royston proposed a framework that identified four relevant components that impact the "social negotiation of influence" and the relationships among them (2014, p. 245). In subsequent work Langer-Osuna created a refinement of the Engle et al. framework to analyze influence in collaborative small groups. In this paper, we apply a slightly modified version of Langer-Osuna's framework to analyze video data of one collaborative small group across four days of its six-day existence during a pre-orientation program for rising undergraduate students. Our choice to start from Langer-Osuna's framework as our analytic lens grew out of research suggesting it is a promising method for "measuring" variations in authority among group members (Payne & Hutchison, 2019).

While much research has been done into assessing equity in collaborative small groups (Deitrick, Shapiro, & Gravel, 2016; Esmonde, 2009; Langer-Osuna, 2016; Langer-Osuna 2018; Lewis & Shah, 2015), existing studies focus on short time scales and either examine a single shift or assume no variation in authority. We wonder about the frequency of shifts in authority over longer time scales and how insight into that might enrich our thinking about how status and equity play out.

Data source and methodology

Our data is video of a collaborative small group from a pre-orientation program for undergraduates with underrepresented identities who express interest in the sciences (Franklin, Hane, Kustusch, Ptak, & Sayre, 2018). During the two-week long program, students engage in small group investigations related to climate change on most afternoons. A group of researchers collected video of all groups on all nine instructional days of the program. We focus on a single group for this project across the six days they worked together. The four pseudonyms for the members of the group are Brittany (she/her), Justin (he/him), Pat (they/their), and Jessica (she/her).

Our coding scheme follows the work of Engle et al.'s (2014) influence framework and Langer-Osuna's (2016) revision of it. These frameworks provide a basis for understanding influence among students. Both Engle et al. and Langer-Osuna operationalize their influence frameworks by coding classroom data of student interactions using proposal negotiation units (PNUs) and we follow that method. PNUs have two parts: first a student makes a bid, such as offering an idea or issuing a command, and second the bid is either affirmed, rejected,

or ignored by others in the group. This coding asserts that an affirmed bid supports an increase in the bidder's negotiation of status or authority and a rejected or ignored bid diminishes the status or authority of the bidder.

A short illustration may help make this process clearer. On a day our target group was working to construct an apparatus to collect and measure the CO_2 released when something is burned, the group was attempting to work out a method for measuring the increase in the volume of a liquid. Brittany initially proposed, "I think (pause) we put in the liquid amount in milliliters," (gestures to a glass tube) "then we take out all the liquid at the end and then measure the difference." Pat suggested a possible alternative container, "We could also use this" (gestures to an object out of the video frame) "just to make it easier." Justin responded, "I agree with that" (pointing to the tube Brittany held). In this episode there are two "intellectual merit" PNU bids, as both Brittany and Pat suggest ideas for making the measurement (Langer-Osuna, 2016, p. 112). In our analysis, this is a positive intellectual merit PNU for Brittany and a negative intellectual merit PNU for Pat. Within the framework, the positive outcome contributes to Brittany's greater status and authority, while the opposite is true for Pat.

Langer-Osuna's influence framework, which was our starting point, includes six components. Langer-Osuna (2016) aims to develop the theory around how students gain influence in a small group. She identified two components that directly contribute to influence: "*intellectual authority,"* defined as whether or not "the student...is treated as a credible source of information," and "*directive authority,"* defined as "the student...is treated as having (or not) the right to issue directives" (Langer-Osuna, 2016, p. 112). Two other components indirectly contribute to student influence. Most relevant to our analysis is "*intellectual merit,"* which codes for the group's response to students' ideas (Langer-Osuna, 2016, p. 112). *Social influence*, or the student's ability to change the conversation topic, was added to better describe our data. The first author coded all data. The second author and another researcher occasionally coded sections of the data to assist in iterative refinement of the codebook. After modification of Langer-Osuna's codebook to fit our data, we analyzed 132 minutes across four of the six days the group was together, including the first and last day of the group's work.

Results and discussion

Our analysis suggests that PNU coding provides a useful analytic tool for identifying variations in student authority both across days and within days. While the intention of the influence frameworks is to understand the mechanisms of the "social negotiation of influence" and status (Engle et al., 2014, p. 245), our analysis suggests PNU analysis can also function to warrant claims about which students are functioning with relatively high or low status for a given period of time. A useful analogy for us is temperature. We are using a "tool" intended to explain temperature changes that we find also does a pretty good job of measuring temperature. By being able to measure relative status among group members, we can compare different students' status during different periods.

Our analysis reveals multiple instances of variation both across and within days. In what follows, we provide one example of each type of variation. We use our PNU analysis to warrant claims that there are frequent variations in students' relative authority. Our illustrations focus on days 7 and 9 of the nine total days from the program. On day 7, the group builds an apparatus to quantify the amount of CO_2 released when a popsicle stick is burned. On day 9, the group works to create an equation to determine the variables for the net amount of CO_2 in the atmosphere.

An example of across-days variation

By applying PNUs, we were able to identify differences in student authority across days 4, 5, 7, and 9. Analysis of days 7 and 9 are included as an example of the success of PNUs as a methodology for analysis of student authority. Overall, considering all categories in total bids, we observe that Pat is the student with the most authority on day 7, while Justin has the most authority on day 9. Differences in both the quantity of successful bids between days for an individual as well as the distribution of successful bids among the group members provide evidence for the variation in authority across days (see Table 1). While the social categories are mostly not relevant in these episodes, there is one exception. Justin jumps in social influence from a low status on day 7 to the highest status in the group on day 9. This increase in social influence contributes to his higher overall authority on day 9.

Considering intellectual merit, we can see variation through comparisons both between students and for individual students across days. On day 7, Pat has the highest number of successful bids in intellectual merit compared to the students, Brittany and Justin, who participated with similar frequency, while on day 9, Pat has the lowest number of successful bids (Table 1, rows 2-5). Pat's intellectual authority also makes a large contribution to their overall high status on day 7. On day 9, Justin's ideas for the equation are more accepted by the group than Pat's, leading to this status change (Table 1, rows 4-5). Individually, Justin and Brittany improve in the overall success of their bids between days 7 and 9 (Table 1, rows 3-4).

Table 1: PNU analysis for days 7 and 9 by type: first number is net PNU, second number in parentheses is total bids

	Intellectual Merit		Intellectual Authority		Directive Authority		Social Influence		Cumulative	
	Day 7	Day 9	Day 7	Day 9	Day 7	Day 9	Day 7	Day 9	Day 7	Day 9
Brittany	-15(33)	5(15)	1(11)	2	10(16)	0	2	3	-5(71)	9(27)
Justin	-10(18)	19(47)	0(2)	0	1	1	0	10	-10(26)	35(65)
Pat	-2(26)	-1(35)	10(12)	5(9)	0(2)	0	1	1(3)	10(42)	6(48)
Jessica	-1(3)	0	-1	6	3	0	0(4)	0	0(12)	6(6)

An example of within-days variation

Like the analysis of student authority across days, a similar comparison across time can be applied to an individual day divided into five-minute segments of video. A time-series analysis can be utilized to identify "inflection points," which initiate a "change in social hierarchy" (Payne & Hutchison, 2019, p. 1, 3-4). Payne and Hutchison did a talking time analysis of the same group of students. Justin's involvement in the group work on day 7 was described in that study. Payne and Hutchison observed that Justin maintains a high-status position throughout the program. They note that on day 7, as Pat is promoted by the instructor, Justin is demoted (2019). Analysis using Langer-Osuna's framework in our study illustrates a similar pattern in "social hierarchy" of the group on day 9 to the one suggested by Payne and Hutchison (2019, p. 3). Justin is involved in brainstorming ideas for the apparatus during Segments 2 and 3 (see Figure 1), but his ideas are consistently demoted by other group members. When he explains his idea to the instructor, he self-defeats, which allows space for Pat to suggest their idea. Pat's explanation leads to an increase in their status, as Payne and Hutchison describe (2019). However, using the analysis framework of Langer-Osuna, the current analysis provides a more detailed explanation, showing that Justin participates less when Pat's status increases.

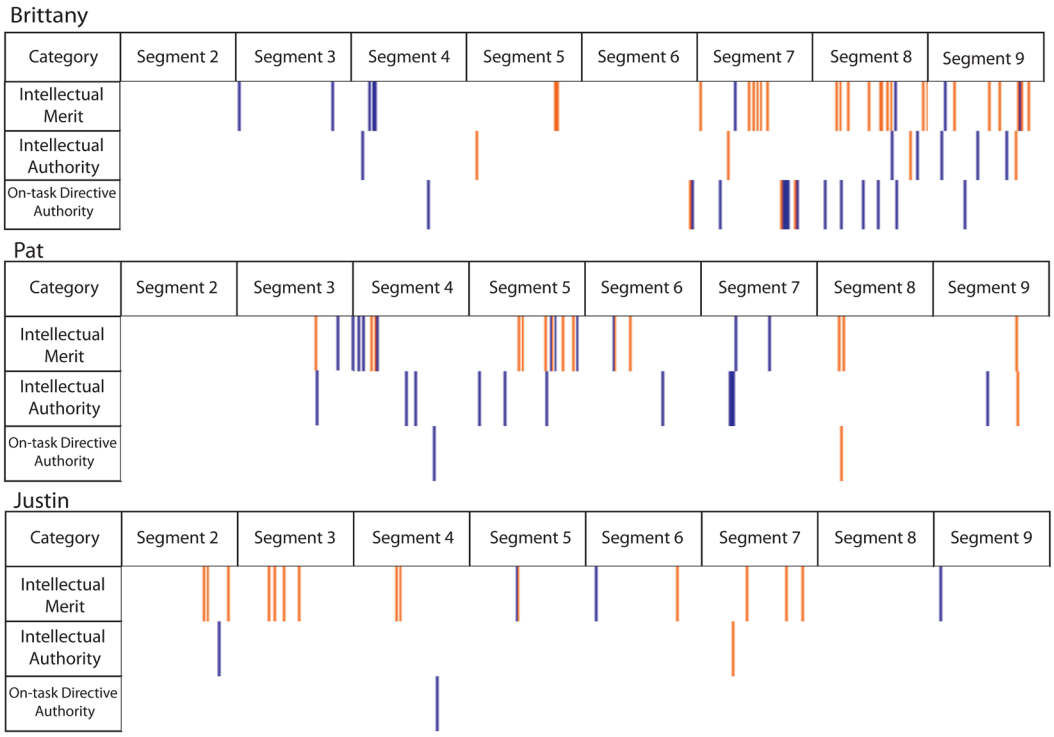

Figure 1. Status promotions in purple and demotions in orange on day 7 in components of Langer-Osuna's framework for Brittany, Pat, and Justin over time.

The status hierarchy does not remain static throughout the rest of day 7. A rapid change in Brittany's authority and merit was identified in segment 7 (Figure 1). In this segment, while the students debate the amount of the lime water that should be added to their apparatus, Pat rejects or ignores Brittany's suggestions. This leads to a

decrease in Brittany's intellectual merit. However, Brittany's successful commands to Pat increase Brittany's directive authority. Brittany is then able to gain intellectual authority beginning in Segment 8. However, Brittany's ideas continue to be rejected by her group members. PNUs are useful for elucidating the complexity of student authority, as well as the variety of paths students can use to develop authority in the group. Identification of these changes within a single day in one student's authority contribute to our claim that PNU analysis is useful for locating a change in authority within a day in addition to across days.

Conclusion

To our knowledge, we are the first to utilize Langer-Osuna's framework to describe how student authority and merit can change temporally. From our analysis, we see that the highest status students change over the days of the program. We also find that student authority and merit can change rapidly within a day as well as seen on day 7. Justin was demoted and Pat was promoted in status, before Brittany took over the group with increasing intellectual and on-task directive authority. A previous review of the literature cited multiple studies which imply that a student gains or loses influence and then retains this status for the remainder of the episode, which leads to the development of a positive or negative identity toward the course material (Langer-Osuna, 2018). Other studies have described similar case studies (Engle et al., 2014). Our study joins literature that suggests that authority and influence can be traded among students (Payne & Hutchison, 2019). Our study also joins literature that indicates that student positioning can change rapidly (DeJarnette & Gonzalez, 2015). These rapid changes are accounted for by positioning theory, the basis for Langer-Osuna's framework (2016). Positioning theory suggests that a person's position can change with every utterance, which is consistent with our finding (Davies & Harre, 1999).

We also offer a methodological observation. Our use of PNU analysis suggests it may be a more powerful technique for analyzing the complex dynamics of student authority in collaborative small groups than we currently realize. Our analysis provided rich insight into the interactions of this group, which our descriptions in this paper only begin to capture. The work of conducting this study suggests that, as we continue utilizing PNU analysis, we may find other insights it provides and we encourage others doing such work to consider testing it.

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