Examining the Role of Verbal Interaction in Team Success on a Design Challenge

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Abstract: Collaboration is an essential component of many project-based learning environments; however, verbal interactions within groups can be ineffective. Extending previous research, this study investigated verbal interactions within teams of high school students as they solved a prototypical design-task called the Earthquake task. Videotaped performance assessments of high and low performing teams were analyzed in depth. Teams were categorized as high and low performing using two different methods: (1) highest successful structure built and, (2) percentage of successful designs. Results suggest that teams engaged in three different patterns of verbal interactions: *Accept-Build*, *Accept-Build-Discuss-Modify*, and *Discussion*. High performing teams most often engaged in, and were most successful when, their verbal interactions followed the *Accept-Build-Discus-Modify* pathway. The instructional implications of these results for promoting productive group collaboration and future research directions are discussed.

Background

With the renewed interest in instructional approaches emphasizing the connection between knowledge and the context in which it is to be used, there has been resurgence in the use of project-based learning in K-12 science classrooms. The enthusiasm and belief in the efficacy for project-based learning has waxed and waned over the years, resulting in only a handful of teachers adopting the approach consistently (Barron et al., 1998). There is strong evidence that problem-and project-based learning can be successful (e.g. Cognition and Technology Group at Vanderbilt [CTGV]. 1994, 1997; Collins, Hawkins, & Carver, 1991; Schauble, Glaser, Duschl, Schulze, & John, 1995). Yet, there are several factors that are important for the design of problem-or project-based learning environments that can influence their impact on student learning outcomes.

Collaboration is an essential component of many project-based learning environments and can greatly impact student learning. It provides opportunities for students to extend their thinking, share ideas, and draw on the expertise of others (Krajcik et al., 1994). Yet, we have much to learn about how to best foster collaboration for learning (Barron, 2003). Simply having students work together to complete prescribed procedures for an investigation or task does not constitute collaboration (Marx, Blumenfeld, Krajcik, & Soloway, 1997). Rather, collaboration involves the construction of shared meanings (Webb & Palincsar, 1996) through the exchange of ideas.

Unfortunately, collaboration that is productive and leads to the development of shared understanding is not always guaranteed (Barron, 2003). Not all verbal exchanges within collaborative groups lead to the solving of problems or the construction of shared meanings. Rather, productive verbal interactions within a group require that: (a) ideas are presented clearly and explicitly so that they may become shared, (b) group members elaborate on their own and others' ideas, and (c) reasoning and evaluation of the ideas is done collaboratively (Hoek & Seegers, 2005; Mercer, 1996).

The nature and structure of the task can also shape the collaborative process (Hoek & Seegers, 2005). Tasks that are likely to benefit most from collaboration are those that require group work and deal with ill-structured problems (Cohen, 1994). Design is a practice that deals with ill-structured problems that have no clearly predefined path leading from the problem specification to the final design solution (Fortus, Krajcik, Dershimer, Marx & Mamlok-Naaman, 2005). For tasks, such as design tasks, productivity will depend on the interaction that happens within the group (Cohen, 1994).

In order to better foster productive collaboration within groups, we need to understand the characteristics of interactions that lead to productive group collaborations (Barron, 2003). Much like Barron (2003), this research is focused on understanding how verbal exchanges between collaborators influences the collective achievements of the group. While Barron focused on the interaction between collaborators while solving mathematical problems, this paper reports on the verbal interactions that occur within teams of students as they work to solve a design challenge. Design tasks provide an interesting context in which to study group collaborations because unlike math problems, which are well-structured, design problems are characteristically ill-structured, with ill-defined goals, states or operators (Goel & Pirolli, 1992). Thus, a goal of this research is to understand the verbal interactions that occur when students collaborate to solve a design challenge. Studies such as this are necessary if we are to begin to help practitioners and researchers create learning environments that can take full advantage of collaborative learning in project-based or design-based learning environments.

The Study

This study is situated within the context of a larger study that examined student learning in an 8-week high school design-based learning curriculum unit. Design-based learning is a particular form of project-based learning. In design-based learning, the activity that is meant to promote learning is a design-project; students are required to use and extend their knowledge of science and math to develop a technological solution to a problem using available resources.

The research in this study focused on understanding how verbal interaction within teams affects performance in a design task. The analysis was motivated by prior research done within this context that examined the strategies students use to solve a prototypical design task, the Earthquake task (see Apedoe & Schunn, 2009). Results suggested that students use both science reasoning strategies (e.g. control of variables) and design-focused strategies (e.g. adaptive growth). However, the strategies commonly associated with success in science (e.g. control of variables) did not necessarily lead to success in design. In addition, while both science reasoning strategies and design-focused strategies led to content learning, the content learned was different. In this study, we extend the analyses to investigate the influence of verbal interactions on team performance on the Earthquake task.

The research questions of primary interest are:

1. What verbal interaction patterns are evident as teams collaborate to complete the Earthquake task?
2. What verbal interaction patterns distinguish high and low performing teams, as defined by the highest successful structure built?
3. What verbal interaction patterns distinguish high and low performing teams, as defined by the percentage of successful design trials?

Research Design and Methods

Research Design

This study utilized a high-low extreme case design to analyze student team performances on a design task called the Earthquake task, which was adapted from Azmitia and Crowley (2001). Extreme-groups comparisons provide greater statistical power without bias, and are particularly useful for labor-intensive studies such as those involving video-data coding. Teams of students completed the task, and the most successful and least successful performances were analyzed in detail. There were two criteria used to categorize teams as high or low performing: height of structure, and percentage of successful designs trials regardless of height. Teams that were considered high performing based on the highest successful structure built may have taken more risks with their designs, whereas teams that had a high percentage of successful designs, but not necessarily tall structures, may have been more conservative in their approach. Thus it was of interest to see if the verbal interactions within teams would differ based on these two different categorizations.

The Earthquake Task

Students were given 54 wooden blocks to build as high a structure as possible that would withstand (i.e. no blocks fall from the structure) a 20-second simulated earthquake (see Figure 1). Students were allowed to build and test as many structures as they wanted and were given approximately 20 minutes to complete the task.

The Earthquake design task was chosen based on two important criteria. First, the Earthquake task has the three elements that Cross (1994) describes as being common to all design problems: (a) a specified goal, (b) constraints within which the goal must be achieved, and (c) criteria for recognition of a successful solution. Akin to the design problems described by Goel & Pirolli (1992), the Earthquake task is ill-structured and requires creativity to move from the start state to the goal state. Secondly, the task did not require students to have any discipline-specific knowledge about the domain beyond elements of everyday experience.

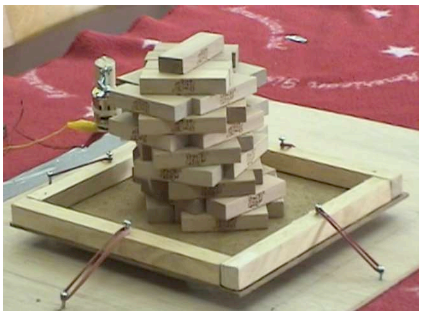

Figure 1. Sample student-designed earthquake-proof structure on earthquake simulator

Context & Participants

This research was conducted as part of a larger study that examines student learning in high school design-based learning units. As part of an effort to reform teaching and learning in high school science classrooms, teachers from a large urban area in the northeastern United States were invited to implement a design-based science learning unit in their classrooms. Teachers held design competitions within their classrooms to identify the top student team design projects, as part of the unit implementation. These top student teams were then invited to participate in a *Regional Design Competition* (See Reynolds, Mehalik, Lovell, & Schunn, 2009 for more details). During the *competition event*, while teams waited for their projects to be judged, they were invited to participate in this study, and complete the Earthquake task. A total of 191 students (42% female, 58% male), drawn from urban high schools with a moderate proportion of traditionally underserved students, participated in the study. Participants included 9th, 10th, 11th and 12th grade high school students enrolled in a science course (e.g. spectrum science, biology, chemistry, or physics) that implemented a design-based learning unit. Participants worked in pre-existing groups of same or mixed gender teams of 2-5 students.

Data Collection & Sources

The primary method of data collection for this study was performance-assessment interviews. Data were collected during the *Regional Design Competition* in both 2007 and 2008, with 29 teams of students participating in the 2007 session and 30 teams participating in the 2008 session. Student teams were videotaped while completing the Earthquake task. During the task, students were asked to explain their designs (e.g. Why did you build your structure this way?) to help clarify the design choices and problem-solving strategies they used. The data set analyzed for this paper included videos of 16 teams of students that represented both the highest and lowest performing teams based on the highest successful structure built. This sub-set was drawn from a larger dataset of 59 teams of students.

Data Analysis

Video-data was analyzed in multiple passes by the researcher (Miles & Huberman, 1994). A coding scheme was developed to establish verbal interaction patterns within teams as they completed the design task. A set of 17 videos, that were not included in the final analysis, were viewed and coded. The final coding scheme developed showed that with the initial presentation of a design idea, the verbal interaction patterns within a team typically followed one of four pathways: *Accept Build*, *Accept Build-Discuss-Modify*, *Discussion*, or *Reject* (see Figure 2).

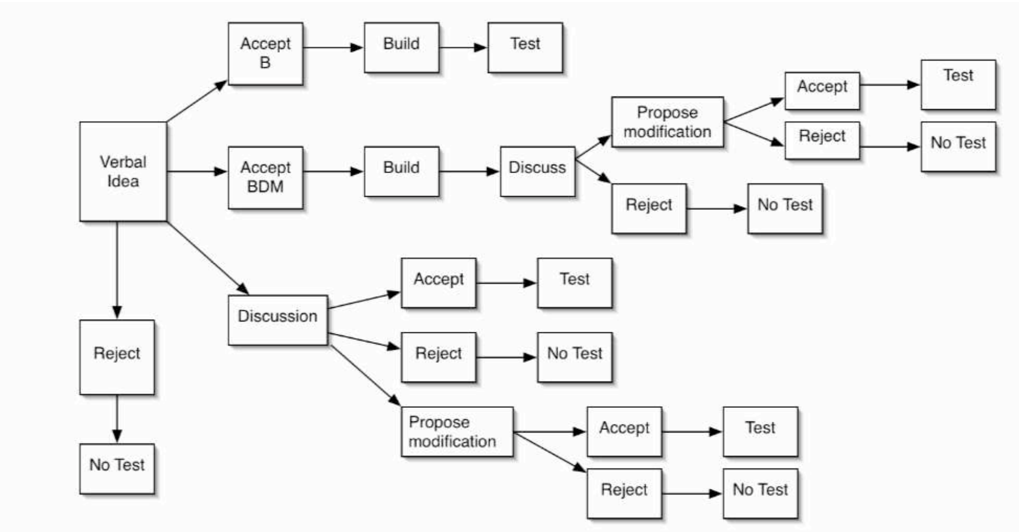

Figure 2. Possible Verbal Interaction Pathways

The first pathway, *Reject* describes the situation wherein a design idea is presented by a team member, but is immediately rejected by the rest of the team. The second pathway, *Accept Build (B),* describes instances wherein the initial design idea is immediately accepted and the team builds a structure.

The third pathway, *Accept Build-Discuss-Modify (BDM)*, describes instances wherein teams immediately begin building a structure. However, during the building of the structure, discussion ensues, often regarding the worthiness of the current design. At this point, either the current design idea is *rejected*, or a *modification* is proposed. This *proposed modification* is either accepted or rejected until an acceptable modification is proposed, and building resumes or a structure is tested. If an acceptable modification is not found, building stops, and the structure is never tested.

The fourth pathway, *Discussion*, begins with a design idea that is discussed by the team prior to physically building the structure. There are three sub-paths in the Discussion pathway: Discussion-Accept, Discussion-Reject, and Discussion-Proposed Modification. Discussion-Accept describes instances when a team member provides a design idea for the structure that is automatically accepted without any further discussion or modification prior to building and testing the structure. Discussion-Reject refers to the dismissal of a design idea after a discussion. In these instances, no structure is built until a new design idea is proposed and accepted. Discussion-Proposed Modification describes instances where a modification to the current design idea is suggested. These proposed modifications are either accepted or rejected. If accepted, the accepted proposed modifications are eventually tested after (n) accepted proposed modifications are made. If the proposed modification is rejected, then the team would continue to build the structure without any alterations, or until a new modification was proposed and accepted. All verbal interaction pathways end when the structure is finally tested to determine whether it could withstand the 20-second simulated earthquake.

Using the developed coding scheme, two coders independently coded the 16 teams' performances. Overall agreement between the two coders was 95.5%. In instances where there was a disagreement in coding, the discrepancy was discussed and resolved.

Findings

Verbal Interactions Used

All verbal interactions within teams were codable as one of the aforementioned pathways. Other logical possibilities, a *Reject* pathway and two sub-paths, the Discussion-Accept and Discussion-Reject, were never used by teams. Teams used the remaining verbal interaction pathways with varying frequency. The mean proportion of trials in which teams' verbal interactions followed the *Accept BDM* pathway was much greater than those that followed the *Accept B* or *Discussion* pathways. The average number of modifications made per trial during the *Accept BDM* pathway was 6.5, while during the *Discussion* pathway there was an average of 9 modifications per trial. Table 1 provides a summary of the overall trends in verbal interaction pathway use. Figure 3 shows the verbal interaction pathways used by teams.

Table 1: Summary of verbal interaction pathway use.

Pathways	Mean Proportion of Use (all trials)	Mean Proportion of Successful Designs when Used (all trials)	Mean Proportion of Successful Designs (pathway specific trials)
Accept B	.23	.18	.53
Accept BDM	.63	.21	.37
Discussion	.14	.40	.50

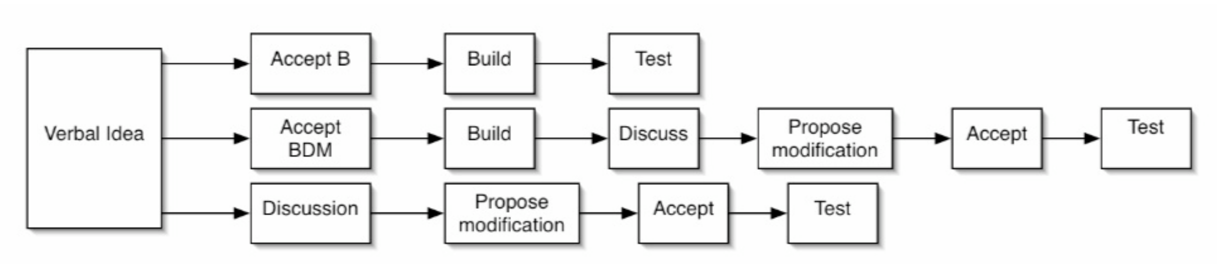

Figure 3. Observed Verbal Pathways Actually Used by Teams

Distinguishing High & Low Performing Teams

Highest Successful Structure Built

Teams were categorized as high performing or low performing based on the highest successful structure they were able to build. Using a median split teams were divided into high and low groups, with the high groups' highest successful structures ranging between 13-45 stories tall, while the low group structures ranged from 0-10 stories tall.

High performing teams' verbal interactions followed the *Accept B* pathway significantly more frequently than did the low performing teams, t (15) = 1.94, p = 0.04. However, there was no significant difference in how frequently high and low performing teams' verbal interactions followed the *Accept BDM* pathway, t (14) = -1.04, p = 0.16 or the *Discussion* pathway, t (8) = -0.44, p = 0.33. Table 2 provides a summary of the verbal interaction pathways used by high and low performing teams.

With regard to design success, high performing teams had marginally significantly more successful designs across all trials when using the *Accept B* pathway, *t* (14) = 1.43, *p* = 0.09, as well as within trials that used the *Accept B* pathway, *t* (10) = 1.46, *p* = 0.09. High performing teams also had marginally significantly more successful designs when their verbal interactions followed the *Accept BDM* pathway over all trials, *t* (14) = 1.50, *p* = 0.08. When the analysis was narrowed to focus on only successful designs within trials that had verbal interactions following the *Accept BDM* pathway, high performing teams performed significantly better, *t* (14) = 1.90, *p* = 0.04. However, there were no significant differences in the amount of successful designs over all trials, *t* (14) = 0.83, *p* = 0.21, or within pathway only trials when verbal interactions followed the *Discussion* pathway *t* (14) = -0.61, *p* = 0.28. Table 3 provides a summary of the design success and its relation to verbal pathway use.

Finally, as part of the *Accept BDM* and *Discussion* pathways, the number of modifications proposed by team members was coded (see Table 3). There was no significant difference between high and low performing teams in the number of modifications made per trial when their verbal interactions followed the *Accept BDM* pathway, *t* (14) = 0.82, *p* = 0.21. There were also no significant differences in the number of modifications made per trial when their verbal interactions followed the *Discussion* pathway, *t* (12) = 0.59, *p* = 0.28.

Table 2: Verbal interaction pathway use by high/low teams as defined by highest successful structure.

	High Performing Teams (*M* proportion of trials)	Low Performing Teams (*M* proportion of trials)	Effect size (*d*)
Accept B*	.35	.10	0.89
Accept BDM	.55	.72	-0.51
Discussion	.11	.17	-0.23

*Indicates statistically significant difference (p<0.05) between high and low performing teams

Table 3: Design success by verbal pathways for high/low teams as defined by highest successful structure.

	Accept B	Accept BDM	Discussion
Successful Designs (all trials)	M_{high} = .23▾ M_{Low} = .06▾ *d* = 0.73	M_{high} = .52▾ M_{Low} = .27▾ *d* = 0.75	M_{high} = .32 M_{Low} = .17 *d* = 0.42
Successful Designs (pathway specific trials)	M_{high} = .31▾ M_{Low} = .07▾ *d* = 0.73	M_{high} = .61* M_{Low} = .20* *d* = 0.95	M_{high} = .13 M_{Low} = .25 *d* = -0.29
Modifications (per trial)	*N/A*	M_{high} = 31 M_{Low} = 22 *d* = 0.42	M_{high} = 6 M_{Low} = 4 *d* = 0.23

* Indicates statistically significant difference (p<0.05) between high and low performing teams
▾ Indicates marginally statistically significant difference (p<0.10) between high and low performing teams

Percentage of Successful Designs

Although success on the Earthquake task was defined as building as tall a structure as possible that would withstand a 20-second simulated earthquake, it was of interest to know whether teams who may not have built the tallest structures, but still had a high proportion of successful trials were engaged in different types of verbal interactions. Teams were once again evenly split into high and low performing groups, this time based on the percentage of successful designs they built and tested. The high performing group consisted of teams with a percentage of successful trials within the range of 38%-100%. The low group was comprised of teams with a percentage of successful trials within the range of 0%-33%. This categorization scheme resulted in a number of teams changing high/low status. Of the 16 total teams, 6 teams (38%) changed high/low status.

There were no significant differences between high and low performing teams in the frequency of use of the *Accept B, t* (14) = 0.19, *p* = 0.43, the *Accept BDM, t* (14) = -0.63, *p* = 0.27, or the *Discussion* pathways, *t* (10) = 0.61, *p* = 0.28. Table 4 provides a summary of the verbal interaction pathways used by high and low performing teams.

With regard to design success, there were no significant differences between high or low performing teams in the percent of successful designs over all trials when their verbal interactions followed the *Accept B* pathway, *t* (9) = 1.13, *p* = 0.14. However, there was a marginally significant difference in the proportion of successful trials within *Accept B* pathway only trials, *t* (8) = 1.44, *p* = 0.09. There was also a significant difference in the percent of successful design trials when the verbal interactions followed the *Accept BDM* pathway over all trials, *t* (10) = 3.62, *p* = 0.00. When the analysis was narrowed to focus only on the proportion of successful designs within trials that had verbal interactions that followed the *Accept BDM* pathway, high performing teams did significantly better, *t* (14) = 2.20, *p* = 0.02. For verbal interactions that followed the *Discussion* pathway, there was a marginally significant difference in the percent of successful designs over all trials, *t* (9) = 1.72, *p* = 0.06, however, there were no significant differences with the success of trials within *Discussion* pathway only trials, *t* (14) = 0.61, *p* = 0.28. Table 5 provides a summary of the design success and its relation to verbal pathway use.

Finally, there were no significant differences between high and low performing teams in the number of modifications made per trial when the verbal interactions followed the *Accept BDM* pathway, *t* (10) = 0.34, *p* = 0.37, or the *Discussion* pathway, *t* (10) = 0.61, *p* = 0.28, (see Table 5).

Table 4: Verbal interaction pathway use by high and low teams as defined by % of successful designs.

	High Performing Teams (*M* proportion of trials)	Low Performing Teams (*M* proportion of trials)	Effect size (*d*)
Accept B	.24	.22	0.07
Accept BDM	.58	.69	-0.32
Discussion	.18	.10	0.30

Table 5: Design success by verbal pathways for high and low teams as defined by % of successful designs.

	Accept B	Accept BDM	Discussion
Successful Designs (all trials)	M_{high} = .21 M_{Low} = .07 *d* =0 .58	M_{high} = .63 M_{Low} = .16* *d* = 1.81	M_{high} = .39ˇ M_{Low} = .10ˇ *d* = 0.86
Successful Designs (pathway specific trials)	M_{high} = .31ˇ M_{Low} = .07ˇ *d* = 0.74	M_{high} = .63* M_{Low} = .18* *d* =1.12	M_{high} = .25 M_{Low} = .13 *d* = 0.29
Modifications (per trial)	*N/A*	M_{high} = 28 M_{Low} = 25 *d* = 0.14	M_{high} = 7 M_{Low} = 3 *d* = 0.49

* Indicates statistically significant difference (p<0.05) between high and low performing teams
ˇ Indicates marginally statistically significant difference (p<0.10) between high and low performing teams

Discussion

The verbal interactions within both high and low performing teams followed one of three pathways, *Accept B*, *Accept BDM*, or *Discussion*. Overall, teams' verbal interactions followed the *Accept BDM* pathway. That is, once an initial design idea was posed, teams tended to begin building a structure that encapsulated the initial idea, and then as they were building, engaged in verbal exchanges wherein proposals for ways to modify the structure were made. Eventually, after a number proposed modifications were accepted or rejected, teams arrived at a structure that they deemed worthy of 'testing' to determine its ability to withstand the 20-second simulated earthquake. Overall, there was no statistically significant correlation between the verbal pathways used and the percentage of successful designs teams built.

However, when team performance was analyzed by looking at high performing and low performing teams, there appears to be a relationship between the verbal interaction pathway followed and how successfully teams were able to complete the design task. Teams that were considered high performing based on the highest successful structures they built engaged in verbal interaction that followed the *Accept B* pathway more often than did the low performing teams. In addition, the high performing teams had marginally significantly more successful designs when their verbal interactions followed the *Accept B* pathway than did the low performing teams. This result suggests that the verbal interaction pattern of: (1) proposing a design idea, (2) accepting the design idea, and (3) building the design idea without further discussion or modification of the idea prior to testing, can result in productive collaboration and success on the Earthquake task. The fact that the teams did not further discuss or modify the original design idea is the distinguishing difference between this pathway and the *Accept BDM* pathway during which modifications were made.

At first glance, this result is counter-intuitive because it would suggest that accepting and implementing ideas without discussion is a good strategy. However, we must be cautious when interpreting this result, as it is possible that high performing teams began with "better" ideas, and thus discussion or modification of those ideas was not necessary. In addition, teams that were considered high performing based on the highest successful structures they built, engaged in verbal interactions that did not follow the *Accept B* pathway the majority of the time. Rather, high performing teams most frequently engaged in verbal interactions that followed the *Accept BDM* pathway. Interestingly enough, high performing teams also experienced great success when their verbal interactions followed the *Accept BDM* pathway. High performing teams had significantly more successful designs when their verbal interactions followed the *Accept BDM* pathway. The primary difference between the *Accept B* and *Accept BDM* pathway is that within the *Accept BDM* pathway, teams engage in a cycle of proposing modifications to the initial design idea – and either accepting or rejecting those proposed modifications – before completing building of the structure and testing it against the simulated earthquake. Thus, it would appear that the added benefit of engaging in verbal interactions that are characteristic of the *Accept BDM* pathway is that the initial design ideas become more refined and consequently "better" which results in the building of more structures that are stable enough to withstand the simulated earthquake. Success on the earthquake task appears to be related to the articulation and modification of design ideas within the group. However, results suggest that it is not the number of proposed modifications that matters, as these were essentially the same for both high and low performing groups. Rather, it is likely that the quality of the proposed modifications is what makes a difference. Additional analyses will need to be done to explore this possibility.

If we look at the verbal interaction patterns of teams that were considered high performing based on their percentage of successful designs, a somewhat similar pattern emerges as is seen when teams are considered high performing based on the highest successful structure they built. While teams that had a high percentage of successful designs verbal interactions did not use the *Accept B* pathway more frequently than did the low performing teams, they did have marginally significantly more successful designs. This suggests that regardless of the definition of "high performing" that is used, verbal interactions that follow the *Accept B* pathway lead to success on the Earthquake task, and in turn, are characteristic of productive collaboration. This pathway suggests that the process of "rapid-prototyping," building and testing design ideas with minimal discussion of those ideas can be effective and lead to success in on this design task. Based on this finding, perhaps a helpful strategy would be to encourage teams employ this "rapid prototyping" process, to take advantage of the unlimited opportunities for testing. In addition, the *Accept BDM* verbal interaction pathway appears to be one that is characteristic of verbal interaction that leads to productive collaboration. Teams considered high performing due to their percentage of successful designs, had significantly more successful designs when this pathway was used, than did the low performing teams. Again, the number of proposed modifications made does not appear to make a difference to the effectiveness of this verbal interaction pathway to lead to productive collaboration.

Surprisingly, verbal interactions that are characteristic of the *Discussion* pathway do not appear to foster productive collaboration or success on the Earthquake task. The only significant difference between the *Discussion* pathway and the *Accept BDM* pathway, is that prior to building a structure the design ideas are discussed amongst the group members. Once the initial idea has been discussed and proposed modifications considered, building of the structure commences until it is ready to be tested against the simulated earthquake. Overall, teams rarely engaged in verbal interactions that followed the *Discussion* pathway. However, when teams' verbal interactions did follow the *Discussion* pathway, those that were considered high performing based on their percentage of successful designs, had marginally significantly more successful designs than did the low performing teams. This was not the case for teams that were considered high performing based on the highest successful structure built. Because all teams used the *Discussion* pathway minimally it is difficult to assess whether verbal interactions of this type do indeed lead to productive collaboration.

The results of this study lend support to the claims in the literature that successful verbal interaction while collaborating involves: (a) clear presentation of ideas, (b) elaboration on ideas by group members, and (c) reasoning and evaluation of ideas collaboratively (Hoek & Seegers, 2005; Mercer, 1996). Teams that were high performing engaged in verbal interactions that allowed them to engage with each other's ideas, refining and improving upon them, until an ideal solution was reached. In some regards, the Earthquake task was an ideal task for promoting productive collaboration, because the physical component of the task allowed individuals to make their ideas clearly visible to their team members simply by building their idea. Barron (2003) highlights the creation of a "joint problem-solving space as being particularly important for achieving productive collaboration. It can be argued that the Earthquake task in particular, and design-based learning tasks more generally, are particularly effective at facilitating this process for students because it requires the creation of an artifact that represents the thinking of the team. Teams that were highly successful on the Earthquake task were likely able to take advantage of being able to make their thinking "visible" through their design. This explanation may also help account for why teams did not make extensive use, and had less success with, verbal interactions that followed the *Discussion* pathway.

Future Research

While it was already noted that the average number of proposed modifications did not differ between high and low performing teams for either the *Accept BDM* or *Discussion* pathways, it is possible that there was a qualitative difference in the modifications proposed that may have contributed to the overall success of the team. What types of modifications were proposed during the verbal interactions of the high performing teams and did the types of proposed modifications influence the outcome of the trials? Alternatively, it is possible that high performing teams began with "better" ideas, and thus discussion or modification of those ideas was not necessary. These questions will need to be answered to provide greater understanding of the verbal interactions that foster productive collaborations.

Finally, in an effort to further understand collaboration within teams, an additional future study could look more closely at specific team participants who may have dominated a team's overall performance by verbalizing more than others. Examining the group dynamics, and the influence it has on the teams' overall performance will help further elucidate the characteristics of teams and their verbal interactions that lead to productive and successful collaborations.

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