# Students' Epistemological Framing of Roles in a Collaborative Game Design Project

Talia Hurwich, Camillia Matuk, and Christopher M. Hovey
th1425@nyu.edu, cmatuk@nyu.edu, chris.hovey@nyu.edu
New York University

**Abstract:** Collaborative design is a promising context for learning disciplinary and collaborative skills, but how students frame their roles impacts their participation, and is an important consideration in designing supports for interdependent, interdisciplinary collaborative activities. We examine grade 7 students' approaches to designing board games for science learning in an out-of-school context. Here, team roles were divided by expertise in science, concept art and game design. Our qualitative analysis of student teams' recorded discussions identified two contrasting cases of individuals' expectations of their own and of others' roles, and their differing collaborative outcomes. Findings illuminate how individual expectations can shape collaborators' epistemological framings and participation, and have implications for supporting interdependent collaboration in other design-based activities.

**Keywords:** collaboration, epistemological frames, middle school, game design

## Introduction

The future of work requires an ability to collaborate across disciplinary boundaries and integrate multiple perspectives (Malone, 2004). Preparing learners to meet this challenge thus requires learning environments that integrate, rather than segregate disciplines (Czerniak & Johnson, 2014). Various curriculum reforms and standards have encouraged greater disciplinary integration (e.g., National Governors Association Center for Best Practices, 2010; NGSS Lead States, 2013). Apprenticeship approaches can moreover instill values, skills and knowledge applicable across domains (Collins & Kapur, 2014). However, such disciplinary integration in school contexts is rife with practical challenges (Applebee Adler & Flihan, 2007). Whereas mirroring professional interdisciplinary collaborations may be more authentic, it also raises the question of what and whether all students are learning when individuals assume different roles. Students' abilities to collaborate thus become pivotal in ensuring cross-curricular learning. Effective collaboration can include such interpersonal behaviors as acknowledging, reiterating, and building off others' ideas (Barron, 2003). Also important is to balance leadership (Bass, 1990) and interdependence (Johnson & Johnson, 2009): Leadership is necessary to encourage collaboration, but leaders must also understand that each member, including themselves, depends on the other. This, we argue, is especially critical in interdisciplinary teamwork.

This study examines how collaborative role structures shaped students' participation within an interdisciplinary context: Designing games for learning. Game design can promote skills in problem solving, creative thinking, and collaboration (Kafai & Burke, 2015). At the same time, it requires coordination among knowledge of the learning content, of games, of pedagogical strategies, and of the design process (Khaled & Vasalou, 2014). While these areas of expertise might be distributed across members of a professional team, individuals' abilities to communicate across these domains is required for such a team to be successful. We explore how students' different understandings of effective interdependent teamwork in game design affected their collaborative contributions.

### Epistemological framing within interdisciplinary collaborations

To understand how students navigate collaborations in an interdisciplinary task, we draw on the notion of *epistemological frames*: learners' expectations of the nature of knowledge and learning, and of activities in which they engage (Hammer, et al., 2005). Learners' epistemological frames influence the knowledge upon which they draw (e.g., of games or science), the decisions they make (e.g., to ask for, or to offer help) and their behaviors (e.g., to be serious or flippant). Epistemological frames thus have important implications for learning, participation and identity. Students often employ framing strategies based on what they expect their teacher wants instead of the best means to solve a problem (Hutchison & Hammer, 2010). Peers also signal to one another how to frame activities. Thus, epistemological frames can greatly impact collaboration; and if productive, they can even help partners to navigate an activity's requirements and goals (Scherr & Hammer, 2009). Different epistemological frames are dynamically activated by different contextual factors, including social and material configurations. Prior research on learning environments has explored various supportive

collaborative structures (Aronson, 2002). Yet, epistemological framing is challenging in interdisciplinary learning environments (Thoma, Deitrick, & Wilkerson, 2018).

In other work, students creating of multimodal science fictions assumed flexible, complementary roles intended to mimic the interdependent responsibilities within real-world design teams (scientist, designer, writer) (Smith & Shen, 2017). The ambiguity in roles appeared to encourage students to negotiate responsibilities and time, which are important skills in authentic collaborative design processes. Such ambiguity, however, can also be frustrating and uncomfortable for both students and teachers, particularly as teachers hold commanding authority in most students' formal educational experiences (Donnelly, McGarr & O'Reilly, 2014). This study explores interdependent collaboration in an out-of-school context, and asks: What was the impact of students' epistemological framings on their collaborative efforts within an interdisciplinary game design environment?

## Methods

Participants were eleven grade 7 students (4 females, 7 males) from a diverse public school in United States. Most students were either white or East Asian; two were African American or Black. We designed a week-long elective board game design workshop, which took place at our university during the final week of the academic year. On any given day, 2-5 members of the research team facilitated the workshop. Two teachers from the students' school chaperoned and advised on team formation based on known social dynamics.

We tasked the three teams of 3-4 students with designing educational games based on *Carnival of Contagion* (Hall, West & Diamond, 2017), a comic book story on the history and pathology of measles and the importance of vaccination (See Figure 1, Left). Students were to expand, through their game designs, on elements of the comic's plot, characters, and aesthetic, and teach some aspect of its science content. Workshop activities guided students in becoming familiar with the comic and science, as well as the game design process. On the fifth and final day, students shared their games with peers at their school. To approximate professional interdisciplinary collaborations (Jiang, Shen & Smith, 2016), we had students in each team choose from among three interdependent roles, created to support their integration of science, narrative creation, and game design: A *Concept Artist* developed a compelling game narrative aligned with the comic; a *Science Wizard* researched and incorporated science into the game mechanics; and a *Play Engineer* ensured a positive player experience through the design of game mechanics. Students in each role were instructed to work together to align their respective visions for their game.


Figure 1. Right: Two pages from the comic book *Carnival of Contagion* (copyright Bob Hall 2017); Left: The game created by *The Terracotta Players*.

Data include audio recordings of each student team's conversations. Two authors read through all transcripts of students' conversations. Through a grounded theory approach, we applied open coding and constant comparison to identify salient themes related to (Miles, Huberman & Saldaña, 2014). Authors met regularly to refine themes based on discussion of the evidence and comparison to existing literature. In this process, we focused on the manners by which students participated, moments of conflict, and language that encouraged, invited, or excluded group members' collaboration. We present descriptive cases of two teams, selected because they contrast in how members' different role framing impacted individuals' participation.

## Findings

### Interdependence among *The Musketeers*

Two members from *The Musketeers*, Adam and Gerardo, approached their game design as an interdependent collaboration. They recognized the need to rely on others' contributions to achieve their team's goals. While

Adam offered ideas, he was open to others' perspectives, and invited them by diminishing his own contributions (e.g., "Mine was pretty bad, but…" or closing a suggestion with "I don't know."). He was moreover grateful for facilitators' assistance ("Thank you for helping us." "I love how they (provided an alternative game mechanic) for us. The chips helped so much."). Gerardo also embraced an interdependent approach. He discussed with Adam to clarify ideas and offer alternative perspectives, and self-initiated work on necessary tasks. Eli, however, appeared to not understand his role, and showed resistance to collaborating. When a teacher asked Eli about his responsibilities, he responded, "To be quiet." On noticing Eli's inactivity, the teacher, Christina asked him to name his role. Eli answered "Concept Artist," but struggled to identify the appropriate tasks associated with this role, and how they work in conjunction with the tasks of his teammates:

| | |
|---|---|
| Christina: | And what did the Concept Artist have to do? |
| Eli: | Had to, like, make the storyline. |
| Christina: | How did you do that? |
| Eli: | Uuuuh, by making the rules. |
| Christina: | How do the rules link to the story? |
| Eli: | Well there's not really a story to this game. |
| Adam & Gerardo: | Yes there is. |

Had Eli conferred with Adam and Gerardo, he would have recognized that the game's story was already present within the game's goal and characters. Instead, he framed his job as a discrete task independent of his teammates' contributions. His dissociation from his team undermined Adam and Gerardo's efforts at interdependence, as it excluded him from their conversation. Eventually, Eli's and Adam's differing epistemological framings regarding group work led to conflict. Adam once admonished Eli, "Stop being lazy and get your butt up. All you know how to do is be lazy," to which Eli replied, "So annoying, he just keeps talking." Without understanding Eli's confusion, Adam tried to instruct Eli, who in turn undermined Adam's leadership by not justifying his actions, and avoiding directly responding to Adam. On the final day, Eli asked Adam how he could help, Adam, frustrated, replied that Eli should have helped earlier. Adam and Gerardo successfully navigated their interdependent collaboration, to the surprise of their teachers, who typically viewed them as struggling in class. This suggests that interdisciplinary activities that offer opportunities for agency within collaboration can benefit student engagement. However, Gerardo's confusion and resulting disengagement from his team indicates that certain students may rather thrive with more explicit direction.

### Sequential independence among *The Terracotta Players*

In contrast to *The Musketeers*' view of game design as an interdependent process, *The Terracotta Players* framed it as a sequence of processes intended to build incrementally into a whole. Gregg described his role as Concept Artist as the start of an assembly line, at which he was to independently formulate a game idea, hand it to the Science Wizard for fact checking, and then to the Play Engineer to be prototyped. Rather than encourage Gregg to be more collaborative, facilitators acknowledged that his view captured certain team approaches, but not all. Gregg's interactions with facilitators and teammates moreover demonstrated his confidence in his science and game design abilities, and a desire to pursue *his* game design idea. He took a domineering role: He devised the game's story and aesthetic without consulting his peers, and bullying them into submission when they challenged his ideas. For example, while in speaking with facilitators, Evan proposed a world conquest game as an alternative to Gregg's idea. He asked Gregg whether there would be any NPCs (non-player characters) in it, to which Gregg responded agitatedly, "NO THERE IS NO NPC. Evan, do you even know what an NPC is? Name it. Name what an NPC stands for." At this sudden challenge to Evan's game knowledge, their teacher Connor, passing by, noted, "I just walked into this conversation and it sounds really aggressive." The facilitator affirmed Evan's idea was a good one, but not before Evan admitted to Gregg, "I don't know what an NPC is." So possessed was Gregg to pursue his idea that he neither shared his ideas, nor requested his teammates' contributions except to assign them menial tasks (e.g., to make clay figurines based on ones he already designed; see Figure 1, Right). Thus, although Gregg initially articulated his role as the head of an assembly line, he ultimately monopolized all the roles, and allowed limited opportunity for collaboration.

## Significance

Our findings suggest that different epistemological frames for collaboration can lead to different collaborative experiences. Our attempt to structure students' interdependent collaborations to be similar to professional interdisciplinary teams had varying success. The manners by which students framed their individual and group

responsibilities appeared to have implications for the quality of their collaboration. Certain students thrived in their roles, but others floundered. While we cannot be certain how much our observations may be due to factors in partners' pre-existing relationships, we believe that they are at least partly due to students' expectations for how to participate within informal vs. formal environments.

Overall, this work contributes an understanding of how epistemological frames can shape a group's collaborative experiences. In our data, for example, different epistemological frames assumed different visions of leadership and power, as well as expectations around idea sharing, which ultimately led to more and less positive collaborative interactions. Within authentic, interdisciplinary design activities that differ from traditional schooling, adopting productive epistemological frames is especially critical in creating positive collaborative experiences. Our ongoing work explores how to explicitly foster interdependence among students by framing the three roles as lenses through which to view design-based problems. Roles thereby become fluid and flexible, changing as the teams' design tasks change. Ideally, this approach will offer explicit guidance for students who need it, with room for individuals' trajectories toward expertise, and agency in their roles.

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