Collaborative Game Design: A Bounded Case Study of Undergraduate Students in a Capstone Course

Helen Fake, George Mason University, hfake@gmu.edu
Jennifer Crist, George Mason University, jwhitema@gmu.edu
Brenda Bannan, George Mason University, bbannan@gmu.edu

Abstract: In this deductive qualitative case study, researchers observed the interactions of undergraduate students in a Capstone Game Design Class at a mid-Atlantic University. Referencing the literature, the researchers found that all facets of the collaborative framework to include governance, administration, organizational autonomy, mutuality, and norms were represented in ethnographic observations and focus group sessions. Specific findings regarding the collaborative game design process as well the social and cultural dimensions of game design are discussed.

Game based learning

According to a research report from Ambient Insight Research, an eLearning and mobile predictive analytics firm, the Game Based Learning (GBL) industry is projected to projected to hit revenues of $2.6 billion in 2016 and grow to $7.3 billion by 2021 (Ambient Insight Research, 2016). Coupled with the research firm's prediction of a 22.4% industry growth rate from 2016 - 2021, it is evident, from a business perspective, why there has been considerable buzz and excitement surrounding GBL. With concerns about shortening attention spans and how the internet is impacting our collective ability to focus, GBL and it's potential to engage 21st Century Learners has garnered enthusiastic responses from both Academic and Organizational communities (Carr, 2011; Duncan, 2013).

From a pedagogical standpoint, projections of growth in the GBL industry are not unfounded, especially given the increased interest in GBL in literature. Recent research about GBL suggests playing games as an instructional strategy has positive cognitive and emotional benefits. Research indicates that GBL supports statistically significant improvements in three areas of problem-solving (Akcaoglu & Koehler, 2014), feelings of self-efficacy (Ke, 2014), and higher levels of motivation, critical thinking, achievement and engagement (Robertson & Howells, 2008; Yang & Chang, 2013). In addition to these encouraging outcomes, Mayo (2009) found that when games are well designed, they can improve performance from 7 to 40 percent compared to students who attended lectures.

These findings beg the question what "well designed" games look like. While there is considerable excitement surrounding the GBL movement, research firms have cautioned about the zealous fervor surrounding GBL initiatives, emphasizing the need for solid designs to back these pedagogical and organizational efforts. For example, Gartner, a leading technological research company, anticipates that while 70% of companies will implement a gamified solution, 80% of those initiatives will fail to meet business objectives primarily due to poor designs (Gartner, 2014). Projections from leading Research and Advisory firms, as well as known gamification failures like Google Badges, have encouraged increased interest and focus on the game design process (Lunden, 2012).

While there is a tremendous amount of attention given to the efficacy of GBL as an instructional method, and focus on the process of designing games from an industry and academic perspective, there have been limited studies that specifically focus on collaboration, a critical component to effective design, within game based learning design contexts. We explore collaborative frameworks in more detail below.

Collaboration

Disparate entities working together to achieve one purpose or a shared vision that could not be attained individually is recognized as the defining characteristic of collaboration (Gadja, 2003; Woodland and Hutton, 2012). This complex concept can be examined from a variety of perspectives. The research available on the topic reflects this complexity while also contributing to the challenge of measuring collaborative practices. Our research suggests there is a gap in the current literature regarding collaboration during the game design process. The subsequent review of the literature aims to frame our study within the existing understanding of collaboration while addressing additional gaps and difficulties in researching this topic. Additionally emerging collaborative theories were explored as potential frameworks for our study.

The highly competitive nature of the game design industry lends itself to an expectation that students in a game design program will have an understanding of common practices and knowledge of the field. One way to bridge gaps between these expectations and the realities of student experience is for academic institutions to partner with established industry experts. De Frietas, Mayer, Arnab, and Marshall (2014) present a theory by which these partnerships, in addition to the inherent learning support, can support research funding while accelerating commercial development efforts. Findings from this model are further reinforced by research from Marcketti and Karpova (2014). Their study explores student perceptions of an industry partnership between design teams and an apparel company. Students perceived that they developed highly relevant knowledge and skills by tackling authentic problems.

While there are many instruments in the literature that measure collaboration, few feature instruments generalizable to a broad population or small groups. In our search for a study that would generalize to game based design environments we identified a study from Thomson, Perry, and Miller (2007). Featuring the responses from a survey sent to 1382 directors of organizations who participate in large national service programs, Thomson et al. (2007) synthesized the existing research on collaboration to to test their multifaceted model. Using a higher order confirmatory factor analysis, they found that their collaboration framework was supported empirically. The collaborative framework proposed by the researchers highlights the importance of the following five factors in the process of collaboration: governance, administration, organizational autonomy, mutuality, and norms. Governance was defined as "understanding how to jointly make decisions about rules that will govern group members' behavior and relationships" (p. 3). While arguably an overlapping term, administration was explained as times where the "focus is less on institutional supply and more on implementation and management" (p. 4). Organizational autonomy is referred to as the "intrinsic tension between organizational self-interest" (p. 4) and achieving and keeping agents accountable for meeting their collaborative goals. In contrast, mutuality is described as the "mutual beneficial exchange based on difference in skillsets, resources, etc." (p. 5). Finally, the researchers explain norms as an "'I-will-if-you-will' mentality based on perceived degrees of reciprocal obligations each have toward the others" (p. 6). These categories provide a robust framework for capturing the overlapping complexities of collaborative efforts.

Research on collaboration within groups or teams designing games was not found. Only one study was identified that addressed collaboration at the team or intragroup level (Colbry, Hurwitz, & Adair, 2014). While the context of the Colbry, Hurwitz, and Adair (2014) study focused on small groups, it was exploratory and lacked the validity and reliability of the Thomson, et al. (2007) framework.

Given the gaps in the literature regarding collaboration in game design, we came up with the following research questions:

1. How do game design teams collaborate internally?
2. How do game designers collaborate externally with university & industry partners?
3. How do game designers created opportunities for collaboration within the game itself?

We hope to increase the understanding of how these three levels of collaboration interact with each other to impact final results in game based designs.

Method

Participants

Eight George Mason University undergraduate students over the age of 18 participated in this study. GAME 490 is the Senior Game Design Capstone course for the Computer Game Design Program at a mid-Atlantic University. This interdisciplinary class is open to students from a range of degree programs in the arts and sciences, providing an excellent opportunity to observe collaboration between multiple operating paradigms in action. Informed consent was obtained from all participating students following a description of the study.

While there were 8 individuals that submitted their consent, only four were a part of the same game design team. In an effort to uphold our commitment to ethical research and mitigate any potential unauthorized observational recordings, we decided to focus our observational efforts towards the members of the intact team. By focusing our observations on the single participating team, we were also able to record the interactions and collaborations between team members.

Procedures

The study was introduced to the potential participants by the student researchers at the beginning of a class meeting. The first observation occurred midway through the semester; therefore, many procedural aspects had been established. The impact of this starting point is addressed in our findings and discussion.

The presenting researcher described her interests in cultivating a better understanding of how the students collaboratively design games. The study introduction was less than 15 minutes in duration and allowed students to take the time to consider their participation in the study as well as a chance to ask questions. Willing participants submitted their consent forms prior to the end of class. Following the attainment of consent, forms were collected and stored in a secured location.

In order to better understand the collaborative practices of students in the game design process ethnographic observations and focus group data were collected and analyzed. We will go into further detail about these data collection methods in the next few paragraphs.

Observations

An ethnographic observational approach was pursued in recognition that, "...there is an intimate connection between a culture and its designed objects leads us to advocate for an ethnographic approach to research design where cultural practices are the focus of inquiry." (Crouch & Pearce, 2012, p. 84). In total, the collaborative practices of students were observed in three classroom sessions in the Arts Building at the mid-Atlantic University campus in Fairfax, Virginia during three sequential class meetings. Ethnographic notes were taken throughout the duration of these sessions during the class's normal hours which spanned a three hour period. The classroom setting consisted of five pods of computers organized in hexagonal arrangements. Screens on the desks consisted of large format tablets. The observed group congregated in a pod near the windows and frequently shared their space with one or two other smaller groups. Occasionally, a group member in the observed group would shift to the most proximal seat at the central pod due to lack of space. To limit interference in the group's dynamics, we sat two to three feet away from their space in unused chairs from the central pod. Due to the hexagonal nature of the pods, we did occasionally change perspective by sitting nearer to the central pod, allowing us to observe different group members in action.

Focus groups

A semi-structured focus group was held following the first classroom observation. The focus group was in a small cramped study room within the student community center. Three attendees participated in the focus group. A second focus group planned for after the last observation was cancelled due to lack of participants.

After reading the protocol aloud, participants were instructed to respond to questions posted on the walls of the meeting room. Using post-it notes, the participants responded to the research questions during the first 20 minutes of the session. The questions included the following:

1. What challenges of collaborating on a design project have you faced?
2. In your opinion, what have been the advantages of collaborating with a team for this game design project?
3. How has your team integrated collaboration into your game design? If applicable, have you collaborated with any external stakeholders in this project?
4. How does your team collaborate?
5. What is collaboration?

At the end of the allotted twenty minutes, the participants were asked to rejoin the group and discuss their answers question by question. During this facilitated discussion, observations and notes were taken. This debrief allowed the researchers to ask clarifying questions and dig deeper into the collective meaning-making of the group as a whole.

Results

Given our small sample size, we pursued a bounded deductive case study approach to our data analysis process (Glesne, 2011). The data collected during the ethnographic observations and focus group was coded line by line while referencing a code manual based on the Thomson et al. (2007) theoretical framework of collaboration. The predetermined categories we looked for included governance, administration, organizational autonomy, mutuality, and norms. Data was aggregated into an Excel spreadsheet and then each researcher individually coded the observational and focus group data using a line by line coding approach. Following our individual coding, we compared codes for emergent themes and to also to ensure inter-rater reliability. Findings from our data analyses are presented in the paragraphs below. Addressing our multi-tiered questions, these are framed within three levels of context: the group, the course, and the university.

Governance

As stated previously, governance is "understanding how to jointly make decisions about rules that will govern group members' behavior and relationships." (Thomson, et al, 2007) Our interpretation of this terminology combined with the analysis of observation data resulted in three findings at the group level during observations. The focus group revealed additional constructs provided within the course structure and game design profession that support decision-making processes.

Observations

The first finding was that governance within the group was fluid. Decision-making appeared to occur naturally, with one group member eliciting feedback at the moment of need. When the activity appeared critical to the overall game design or was significant in scope, such as the addition of lighting effects, all group members that were present would stand up to view the screen in question, review the information, and provide input. Decisions with less impact such as minor edits to graphics elicited the formation of dyads or triads. Occasionally, seemingly random comments inspired movement around the pods so that members could view each other's computer screens.

There was no evidence of clear leadership within the group, although it appeared that the individual in charge of the task being reviewed would implement or reject recommended changes. This supports the second finding that the team as a whole respected the domain expertise of the individual members. The artists and programmers made the final decisions in their respective specialities. Decisions in areas which crossed domains were made collaboratively by members of both domains. For example, the implementation of graphic tilesets within the programming software occurred through a dyadic dialogic interaction in which a programmer moved the mouse while an artist used the stylus to draw on the tablet screen.

The final finding was that governance was driven by anticipated results. The observed group maintained a focus on the course objective as evidenced in the course stand-up procedures in which progress and effort were reported. Besides the stand-up reporting procedures, the course provided additional constructs that guided governance within the group, such as the professor's process for circulating and checking in with groups and the scheduled deadlines of specific assignments.

The environment established by the professor was casual. At this level, an overlap between governance and norms was identified. As such, this theme is further explored within the analysis of norms.

Focus group

During the focus group, additional constructs provided by the course and the group were identified. Group members expressed that game design documents are a critical governing process in the industry. Created at the beginning of a project, the group revealed that they relied heavily on the game design documents to guide their processes and progress. They shared that the game design document helped them establish group consensus on a shared final goal early in their game development process. This documentation also served to guide the creation of a portfolio piece with a defined scope (the vertical slice required for the course) and narrowed the team's focus on their end goal which also drove their decision-making processes. Participants referred to experiences in previous classes in which differences in group members' goals or intentions led to difficulties or challenges. They felt that these experiences contributed to their current practices in collaboration.

Administration

The administrative processes which set the stage for implementation and management were heavily guided by the course construct. This was evident during observations and the focus group. Technology also played a critical role.

Observations

In a sense, the professor acted as an occasional team member through the stand-up procedures, check-ins, assignment definition, and deadline scheduling. The casual atmosphere and interactions helped create a seamless environment between the dynamics of the group and the expectations of the course. Evidence of the casual environment included instances in which group members arrived late to class bearing gifts of food for the professor. Laughter and humor ensued.

In another example, in one class session the professor, looking to conduct a check-in with the team, found that a majority of the of the group's members had left for a smoke break. Instead of expressing concern or frustration, the professor engaged in a relaxed conversation with the remaining teammate until the students returned. This interaction may indicate that a mutual understanding between the team members and professor had been reached. Some evidence was observed that students had previously demonstrated their ability to meet implementation and management expectations. There was clear evidence during check-ins with the professor that

the students had been highly successful in their efforts to date and were exceeding assignment expectations and deadlines.

At the group level, administration was highly procedural. Communication from absent or late group members was prompt, with reports of illness being shared early in the classroom session. Edits and revisions to the game design document provided a tasking system in which progress was checked against the proposed design. Future tasks and iterations were assigned by the group as deemed appropriate, including to absent members. It is possible that a more robust understanding of administration would be obtained through a more thorough research study, in which work and efforts outside of class could be observed.

Focus group

The results of the focus group reinforced the findings from the observations. Participants highlighted procedural activities and the technology used to carry out those procedures. Team Members relied on the capabilities of Google Drive to work collaboratively on a document as well as email and texting for communication. Again, much of their reflection on this theme was in terms of past experience in which administration was lacking. Examples were cases in which group members were non-communicative or did not contribute to the implementation of the project.

Organizational Autonomy

At stated earlier, organizational autonomy refers to the "intrinsic tension between organizational self-interest" (Thomson, et al., 2007, p. 4) and the obligations to the group. This tension was apparent in the interactions between members as they completed individually tasked portions of their work.

Observations

Throughout the game design and development process, team members worked on their own segments of the project. Also, possibly due to the intensive nature of development, individuals were given the personal latitude to come and go as they pleased with several team members disappearing from the classroom session for several minutes at a time.

The tensions inherent in organizational autonomy were observed when team members questioned each other about the status of certain game assets and deliverables. In one instance, a team member was developing music and sound effects for the game. It was clear the group member's commitment to creating high quality sound effects, specifically in the quest for the perfect rat sound. Despite this dedication to quality, another group member indicated their anxiousness for incorporating sound edits as soon as possible. The other team member felt that the sound effects chosen were sufficient for meeting the project's needs. The group member in charge of sound effects quickly acquiesced to provide the audio files needed to move the project forward.

Focus group

Our ethnographic observations regarding the game design process were reinforced during our focus group conversations. Group members indicated they were extremely selective in forming their groups and looked for specific characteristics which are discussed in more detail in the norms and mutuality sections.

Previous negative interactions and experiences from prior classes flavored group member expectations in relation to organization autonomy. Challenges brought about by organizational autonomy included working with "lone rangers" or group members who were "not doing work". Organizational autonomy, therefore, could result in unfavorable outcomes with participants who did not pull their weight or those who were not open to working with others.

Mutuality

In contrast to organizational autonomy, mutuality refers to the "mutual beneficial exchange based on difference in skillsets, resources, etc." (Thomson, et al. 2007, p. 5). Lachmann, et al. (2013) referred to the concept of "flow" in which people become absorbed in their activities to a high degree. The observed group demonstrated both mutuality and flow in their ability to work together toward a common goal, achieving their collaborative goals.

Observations

During the ethnographic observations, we witnessed several times when group members completed each other's sentences. This level of sync between group members was inherent in their interactions. In one instance, two group members with different specialties discussed adding new features to the artwork that would later be integrated into the game. During this interaction, one group member stated that it was "hard when you have…". The other responded immediately, "very few pictures to work off of". Both quickly agreed and moved

to the next task. This interaction suggests that conversations between the two members had progressed to a level of mutual understanding wherein the development challenges and landscape was well defined and known despite the differences in each team member's specialty.

Another example in which disciplines combined to reach a mutually beneficial solution appeared when the group explored new features within their game development software platform. In one instance, one of the artists discovered a new "sprites" or graphic element that could bring light to objects within the game design. It was unclear, however, if their game would support this feature. Once this feature was discovered, the artist and one of the programmers worked together to investigate whether or not they could integrate the "sprite" into the game design. Each team member recommended different potential buttons or settings that might garner the hoped for results. After a short while, both stopped to research existing literature on the internet. This challenge eventually became a group wide endeavor. Check-ins with the professor in the following class revealed that the team was embracing new methods of resolving the issue to include trial and error tinkering and by submitting a help request to the software company.

A factor that appeared to contribute to and enable mutuality is the innate socialization that occured within the group. Members consistently looked to each other for affirmation and humor. Side conversations and laughter were frequent. At the end of our final observation as students were wrapping up their conversation with the professor, one member explicitly stated that "everyone is engaged and helping out", "it's been a good experience", and "I'm happy with the team we have" followed by an invitation to the other group members to go get pizza and hang out. This is in line with evidence gathered during the focus group which we examine next.

Focus group

During the focus group, clear evidence emerged regarding the social factors at play in mutuality. Participants expressed that they perceived the group formation and selection process had a strong effect on their collaborative success. Students clearly defined their criteria for group selection, with one student expressing that they were "really really really careful about who we picked". "Attitude", previous collaboration, social dynamics, "work ethic", and "communication skills" were all cited as critical attributes of potential team members. Additionally an off topic conversation on the perceived importance of socializing beyond the demands of class emerged. Team members felt it was important to spend time together, to stay friends, and keep it "fun and comfortable" as opposed to other groups who "only meet and talk during class". It was evident that the commitment to the design process and the final product were driven by the social experience of the group. Thomson, et al. (2007) acknowledge that "commitment is unlikely without the presence of the final defining dimension of collaboration: norms of reciprocity and trust" (p. 6).

Norms

Like Gajda (2004) noted, it is quite possible that by the time we began our study, that the team of interest was far along in their process of assembling/forming, storming/order, norming/performing, and transforming/adjourning. By the time we began our study, the project teams were in the "performing" stage, actively editing and adding elements, functionalities, and details to their game design. Therefore, our observations may be less robust than if we began observations earlier in the game design process. Since we did not enter until the "performing stage" of team development, it is unclear if the team's established norms were naturally emergent or if they were explicitly established through conversations with team members. Norms were additionally influenced by the structure of the class, the professor, and the aforementioned development environment (Hartson & Pyla, 2012).

Observations

As stated earlier, our observations within the classroom environment suggested that the development of game assets was a fluid process. Multiple times throughout the allotted class meeting, team members would leave for smoke breaks, food, or to take phone calls. Given the flexibility associated with the team members and their movement, it appeared that there were no formal requirements to be in certain places at certain times.

Norms additionally stemmed from the technological choices team members made. Team members knew where to find documents based on mutually agreed upon locations. For instance, we witnessed several exchanges of team members directing others to working files in Google Drive.

Fluidity of movement extended to the game development process. Group members tended to get up and observe their team members' new developments and make comments. On several occasions, team members were called over to comment on a new design, game asset, or interaction. This type of iterative development characterized by continually feedback is consistent with commonly documented agile development methodologies referenced in the Agile Manifesto (Beck et al., 2001).

Focus group

The focus group built upon our ethnographic observations of norms within the game design context. In response to the focus group session questions, participants described what characteristics they found desirable when selecting fellow team members. Focus group participants were interested in working with team members who had varying skillsets, but similar goals. The participants looked for teammates who exhibited "empathy", "discipline", "attention to detail", flexibility, and who had "strong communication skills". They also looked for team members who "communicated challenges early on", were "interested in more than just one artistic style", were constantly "testing things", adhered to a "schedule and project documentation" and were open to constructive criticism.

During our focus group, "crunchtime", a term used to describe an all-night or an intensive development session, emerged as a norm for the game designers. When describing these sessions, it was clear that these were not only times that yielded productive results, but also incorporated social elements like ordering pizza, playing other games, and drinking beers. Participants described "crunchtime" as being both challenging, fun, and a bonding session between teammates.

Another norm that emerged was the lack of a clear decision-making process. Participants stated they had an equal say in "decision-making, scheduling, and house-keeping". The flexibility associated with the organizational hierarchy was exemplified in our ethnographic observations when the team members worked to set a time to meet during the weekend. It was clear that each team member was free to come in when they liked, however, there was an expectation that each team member would do their part in meeting team goals.

Overlapping codes

In the validation processes of their framework, Thomson et al. (2007) were able to define the five categories of collaboration through statistical analysis. The need for this clarity was due to the inherently complex and interwoven nature of collaboration. Overlapping codes were anticipated given that the Thomson et al. (2007) analysis showed high interrelationships between the terms in a higher order confirmatory factor analysis. We feel it is important to acknowledge observed overlaps between the codes with some occurring more frequently than others. The observed ebb and flow between these different categories warrants a deeper exploration that is beyond the scope of this paper.

Validity

As Maxwell (2013) states, "the researcher is the instrument of the research" (p. 45). Researcher experiences were seen as an asset in the analysis of the data, however, we attempted to be as aware of our inherent biases by using a code manual, employing interrater reliability during our coding process, and incorporating formative respondent validation during the focus group sessions. We also ensured that all observation sessions were conducted at the same times during the day.

Limitations

Given the nature of the participant's consent, we were only able to observe the collaborative dynamics of one group. It was clear that other participants and their groups faced collaborative challenges and successes, however, we were not able to observe why and did not feel comfortable documenting those trials and tribulations without the consent of the group as a whole.

The timing of the experiment also served as a limitation in a variety of ways. To begin with, we began our study late in the group's development, missing rich information about the formation of the group's dynamics, their governance structures, and their formation of norms. It was also clear that a majority of the design work occurred outside of the classroom and during all times of the day and night. Future, in-depth studies could benefit by increasing the number of observations, specifically during "crunchtime" sessions or other group meetings outside of the designated class time.

Domain knowledge was yet another arena in which we struggled. As instructional designers, we did not have the same lexicon and vocabulary as the participants we studied. Words like "baked", "sprite", and "crunchtime" all required further clarification. It is quite possible that without a baseline knowledge of game design and game design culture, we may have missed many rich observational opportunities, particularly during the focus group sessions.

Discussion

Like Gajda and Koliba (2007), we found that group dynamics and interpersonal relations play a large role in collaborative game design. It was apparent from our focus groups that group members were concerned with who should be included as a team member from the onset of the design process.

Also, similar to Gajda and Koliba (2007) concerns regarding individual confidentiality and consent made this study difficult to implement. As researchers, we found it challenging to observe consenting individuals involved in a collaborative context since their contributions and interactions were tied to the larger group. Therefore, we were limited to observing a single team and their interactions. Future studies may wish to consider alternative approaches to observing collaborative practices in light of the difficulties associated with securing individual consent.

While we were able to observe all attributes of the Thomson et al. (2007) framework in our limited observational and focus group sessions, future research could be amplified by following game designers throughout their game design process, from group formation to project completion. Specifically, it would be important to observe game designers during "crunchtime', late night sessions, and more frequently over the design and development timeframe. Observations conducted outside the classroom times could yield rich findings into game design as well as its organizational culture.

Conclusion

"Practice is not just doing, but also thinking about actions" (Crouch & Pearce, 2012 , p. 39). As designers, it is important to be reflective about practice especially in consideration of different design contexts. Our review of the literature revealed that although game design was a critical component to the success or failure of an organizational game based initiative, few studies focused on the game design process and specifically the role of collaboration in design. Continued design research will be critical in enhancing our understanding of how successful game design teams collaborate to achieve and fulfil the promising potential of new approaches to teaching and learning.

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