Structural Mismatches in Academic Game Development

Gal Fleissig
gfleissi@andrew.cmu.edu
Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

Morgan C Evans
morganev@cs.cmu.edu
Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

Avonelle Wing
agwing@andrew.cmu.edu
Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

Jessica Hammer
hammerj@cs.cmu.edu
Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

ABSTRACT

In this paper we share academic game development challenges from the digital game *Bloomwood Stories: Block Party* [4]. We introduce the main characteristics of our game, as well as the theories it is based on and its transformational goals. We then describe our game development process, which took place over nearly two years, and what each of its phases included. During this process, we observed many problems of structural misalignment between game development and academia. We therefore share the challenges we observed in this area, strategies we used to address them, and ideas for how teams might mitigate these challenges in the future. Finally, we share our vision of opportunities that arise from developing games in academic contexts, and how the two institutional contexts can come to complement one another.

KEYWORDS

game, health, game design, academia

1 INTRODUCTION

Bloomwood Stories: Block Party is a visual novel, developed at our university, that casts the player as a community leader in the fictional neighborhood of Bloomwood. As a transformational game, *Bloomwood Stories: Block Party* seeks to increase players' health self-efficacy [2] and their willingness to use health resources at their local library. The game aims to support players who have justifiable reasons to be skeptical of traditional healthcare provision, for example because they have experienced medical racism. As the game will be distributed through a national library network, our team needed to make sure that the game supported librarians' needs as well.

Designing transformational games is challenging in any context [1, 7]. For example, game design that is poorly aligned with the

game's transformational goals can actually distract from learning. In many of our past projects we have mitigated this challenge by aligning the development process with academic timelines - for example, scoping game development to semester-length projects and using existing academic deadlines (e.g. midterms) as milestones. However, in *Bloomwood Stories: Block Party*, we were unable to use this strategy for two reasons. First, we sought to capture a range of health challenges by creating five different non-player characters (NPCs), each with 20 minutes of playtime. Creating a game with 100 minutes of gameplay was beyond the scope of a fifteen-week semester. Second, we were not in control of our own deadlines. Because of funder constraints, we often had to deliver game prototypes during winter break or in the middle of finals week, which limited students' ability to contribute.

We therefore report on the challenges of *structural misalignment* when doing large-scale game development projects with students [6]. In reflecting on our process, we identified the following issues: *Working with Students*, *Time Management*, *Research Context*, and *Different Work Practices and Goals*. We share these issues, our thoughts on the structural reasons why they came about, and some of the strategies that we used to address them. We also reflect on the positive opportunities that the intersection of these contexts provided. In particular, the academic context gives us additional room to nurture and support each team member - to define and identify their goals early on and lean into their strengths and interests, unlike an industry project where individual needs fall second within the constraints of profitability, marketability, and consumer engagement. Our ability to serve the students and their needs shapes and influences the project; our final product was not only the finished game but rather the growth and development of the team alongside the finished game which went beyond our initial expectations.

2 GAME DEVELOPMENT

The design and development of *Bloomwood Stories: Block Party* can be broken down into the following five phases (see *Table 1* at the end of this section for a timeline).

2.1 Phase 1: Defining Constraints

To define our approach to the game, we used the Transformational Framework, a pre-production tool for transformational games [3]. Some of the constraints we developed were inherent in the problem we chose (e.g. supporting play at a local library), while others came from a literature review and theory-building process (e.g. aiming

to improve player self-efficacy). We supplemented these sources with focus groups to better understand how our library partners currently supported historically marginalized communities. In two one-hour long focus groups, we used a collaborative board with prompts where focus group participants responded individually followed by a group discussion. The resulting topics from focus groups were then integrated into the design of the game.

2.2 Phase 2: Game Design

Based on our Transformational Framework document, we generated a set of game design sketches, a process which iteratively continued until the team decided sufficient coverage on the guiding themes and goals from the literature was achieved. We then integrated elements from multiple sketches into our final game concept: a visual novel where the player helps NPCs in their neighborhood. Throughout the game, the player encounters health literacy topics related to the NPCs' lives, and helps address their problems using community and library resources.

In parallel with our design work, we set up our technical platform. To support cross-platform development, we chose *Unity* for our core development platform. To make the visual novel elements easier, we added *Fungus*, an external library that supports interactive storytelling; we implemented research data collection using *Google Firebase*; and we wrote and tested our game scripts in *Inky*. We focused on two platforms (desktop and browser) as they best reflected the technology available in a library setting.

2.3 Phase 3: Interleaved Stories

The first version of the game featured interleaved stories. We wanted players to see how the same character could both need help from others, and offer help, as a way of improving player self-efficacy. To accomplish this goal, we had the game take place over five days leading up to a local block party. The player needed to complete a quest from each of the NPCs every day to move their storylines forward, which meant we could create a richly interdependent game world and showcase mutual community support. We took this game all the way to a digital playable prototype. Unfortunately, our playtesting with the prototype indicated in the library context only the most enthusiastic players would get through all five days - and that players did not find completing an in-game day satisfying, since there was no resolution to any of the NPCs' problems.

2.4 Phase 4: Unweaving the Interleaving

We pivoted to structure our game around 20-minute play sessions. In each play session, the player chose one NPC to help. They learned about that person's challenges and completed four quests to support them. That NPC would then join the weekly Block Party. Our playtesters reported that solving a character's problems was much more satisfying than finishing all the tasks in a day. This redesign also meant that the player could come back later and help a different character for a new, satisfying experience. In turn, this served our design constraint of being playable by an audience of library users, accessing the game through shared public resources.

On the back end, while we were able to keep using the same technical platform, this change required substantial changes in almost every other aspect of the game. We needed to redesign our interface, rewrite all of our character scripts, and change technical aspects to accommodate for the new session structure, in particular the way that the player's resources were built earlier.

2.5 Phase 5: Logging, Versioning, and Polish

In the final stage of our game development we created two parallel versions of the game: the original game, intended for deployment, and a version of the game for research purposes. The deployment version included all five NPCs, while the research version focused on a single NPC and included two experimental conditions. We also deployed and tested our game logging mechanisms, conducted a DEI review with an external team, added a dictionary of health terms, and created a tutorial.

3 CHALLENGES AND RESPONSES

To characterize the challenges we faced during this project, we held a reflective post-mortem discussion with key team members across design, production, tech, interface, narrative, and research design. Team members who were unable to attend the meeting had the option to contribute asynchronously. The authors then collected the challenges and identified those that stemmed from *structural mismatch*, rather than from something specific to our team. We iteratively sorted these challenges into four different categories: *Working with Students*, *Time Management*, *Research Context*, and *Different Work Practices and Goals*. We report here on these challenges, as well as some of the strategies we used to mitigate them.

3.1 Working with Students

Working in an academic environment naturally involves working with students, which presents challenges of a unique kind. First, students have limited time to commit to game development projects. During the semester, students are limited to 10 hours per week of paid work; even then, work competes with their classes, exams, community obligations, and of course their social lives. Second, students commit to working on a project semester by semester. Even students who are enthusiastic about continuing may not be able to because of the requirements of their degree. This creates frequent turnover and a heavy training burden. Finally, students tend to be inexperienced. Even students who have prior professional experience often want to use academic projects to stretch themselves and demonstrate new skills.

These structural issues create challenges for the game development process. For example, students' limited availability makes it hard to handle the need for quick and often time-sensitive answers, edits, or changes from them when developing a digital game, which often causes delays in the process. Scheduling meetings also becomes difficult, particularly as it needs to be redone every semester as the team's composition and class schedules change.

In response, we combined synchronous and asynchronous communication methods. One staff member was responsible for a daily asynchronous check-in on the team's Slack, to identify anyone who was stuck. While students might check in anytime during the day, it meant that we learned about problems within 24 hours. To speed up time-sensitive work,

Table 1: Work on Different Phases across Semesters

Phase	Fall 2020	Spring 2021	Summer 2021	Fall 2021	Spring 2022
Phase 1	X	X			
Phase 2	X	X			
Phase 3	X	X			
Phase 4			X	X	X
Phase 5				X	X

we hosted co-working sessions (typically held online) where students could drop in as their schedules permitted. A staff member in attendance - who was primarily using the time to complete their own work - made sure students connected directly. We found these methods to be effective in speeding up our iterative process without creating too much additional burden on the team.

The frequent turnover of students requires extensive on-boarding processes and documentation of the work in order to ensure continuity between semesters. The on-boarding process is time-consuming not only for the students who need to learn the work, but also for the team leads who need to spend time writing and teaching it. This challenge is amplified by uncertainty: when team members are documenting their work at the end of a semester, they often do not know who will be working on the project in the next phase, what their skills will be, or even if the team will be able to recruit people to fill the roles. This uncertainty also makes it hard for team leads to plan project milestones across semesters with any degree of accuracy.

In response, we made sure to put people who made longer-term commitments to the project into team lead roles. These people knew very well the work that was performed and the project resources, as well as what the next steps are, and they helped train and on-board new team members, which helped with the continuity that the project needed. Additionally, because of the frequent turnover of students, we made sure to organize the project documents well so students can use them as references when they were looking for clarity.

3.2 Time Management

Time constraints and allocation in academia can be very different than those in organizations outside of it, and impose challenges of different kinds.

First, we did not have a single person working on the project full-time. Students were taking courses, staff members usually work on multiple projects at the same time, and mentors supervise more than one project per semester. This makes it very hard to schedule workshops or time to work together, over and above the challenges of scheduling with students, which can reduce clarity and communication among the team members.

Second, the semester schedule creates constraint on project timelines. Our university uses a fourteen-week semester, with a one-week break. Even when it is possible to align game development timelines with the semester schedule (and hence minimize turnover), there is a steady stream of other commitments *within*

the semester - midterms and finals for students, paper submissions and doctoral student review for faculty. While staff are less affected by these commitments directly, the whole team's capacity ebbs and flows as the semester does.

Third, there is an ongoing tension between research cycles and development cycles. While the former are often slow, due to different constraints on research activities (recruiting participants, interviewing participants, writing findings, analyzing and studying results), the latter usually has to be more rapid since feedback on all elements - writing, design, and development - is needed on a more frequent basis in order to move forward efficiently. This creates a challenge especially when research is an ongoing process, and not an activity that has been finished before the development work had begun. For example, we needed the research team to provide design direction before formal analysis of our focus groups were complete, while the data that drove our removal of interleaved narratives came later in the process than we would have liked due to research timelines.

One way we addressed this issue was to use a "whole-person" planning process. In addition to research and development milestones, our project planning calendars included exam dates, conference submission deadlines, and staff PTO (paid time off). By asking group members to identify weeks when they were likely to have less focus or time for the project, we were also able to identify times when we could push hard as a team, making the ebb and flow of the academic semester work for us.

Another way we addressed the tension between the research cycles and the development cycles was to try and complete all the work that does not depend on research results first, hence saving time later in the process.

3.3 Research Context

Designing and developing a game when research is a main factor can be very different than designing and developing a game without such context. For example, as a requirement of participating in human subjects studies, academic research institutions must have their research protocols approved by the Internal Review Board (IRB). The process includes the reporting and approval process of all study materials. If IRB approval is delayed, the development team may need to reconfigure their plans to ensure that data can still be collected on the new timeline. Even then, the uncertainty of participant recruitment can generate further problems and pull development resources away from game production when they are needed most.

Oftentimes there is a mismatch between the research goals and needs, and the game design and development goals and needs, and maintaining an alignment between the two can get challenging. For example, with *Bloomwood Stories: Block Party* we had to allocate development time for creating a separate version of the game solely for research purposes. Such thing takes time from the main branch of the game, which in our case had a time-sensitive deadline, funder-driven release deadline unrelated to our research goals. This complicated the process for all teams involved.

One way we approached this problem was to draw a distinction between *user* research and *scholarly* research. We typically collected data under conditions that would allow rigorous analysis and eventual publication. However, we learned that if we were smart, we could use preliminary data analysis by the research team to inform design quickly, while leaving time to validate the insights against more rigorous analysis later in the process. For example, we began asking our research teams to debrief after each data collection opportunity, and to use the debrief process to write reflective documents about their experience. These reflective documents served two purposes. First, they became research artifacts that were later analyzed as part of a more detailed process. Second, they were discussed by the entire team as a potential source of design insights. By pushing up the timeline for creating these documents, we not only had a ready source of user-centered design insights, but we also captured data about our users that might otherwise have been lost to time.

3.4   Different Work Practices and Goals

Working in an academic environment involves different people with different roles and backgrounds coming from different places within the academic institution. There are professors who act as mentors in the project, there are PhD students who act as research leaders, there are staff members who have different roles in the design and development, and of course there are students who work on the project part-time and support all tasks.

This naturally creates a situation where different team members want or need different things out of the experience. They have different goals for themselves, beyond the obvious shared goal of the team. Some would like to build their portfolio or focus on launching the game, whereas others would like to learn a new skill. Undergraduate or graduate students may focus on getting a good grade, whereas PhD students may focus on executing a successful study. The challenge here is to address these wants and needs in a way that ensures the project is successful while still helping everyone get what they wish to get out of the experience.

To address this issue, we worked with students each semester to answer three questions. What could they contribute to the team? What would they like to learn? What outcomes did they care about? For example, one student wanted to practice her qualitative research skills and contribute to an eventual publication, while another wanted programming credits on a released game. While collecting this information up front was an investment, it helped us align student assignments with their goals. It also made students more

willing to contribute in areas where they were already relatively expert, rather than always asking to try something new, because they could see how it would align with their personal goals as well as contribute to the team.

Additionally, different people who come together to work on a project in an academic context may have different work practices that they are used to. The challenge here is to create harmony across diverse teams, and to create shared cultural expectations. Everybody should know what they are working on, but also how they are going to do that in a way that is both effective and communicative.

We addressed this by creating cross-team standards. For example, we asked every team member to complete their research ethics certification, even if we had no plans for them to participate in research activities. This process meant we could ask any member of the team to fill in on research in an emergency, but it also helped us align on a single set of ethical standards and expectations for our project. Similarly, we required team leads to align on what tools they wanted to use in their teams, but also to get buy-in for those tools across *all* teams. For example, the narrative and programming teams worked together to select *Inky* as the narrative prototyping tool, since it produced outputs that the programming team could easily adapt. Team leads were then empowered to enforce the use of those systems and tools within their own groups.

4   DISCUSSION

As challenging as developing digital games in and for academic contexts can be, it presents unique opportunities too.

Working on projects in an academic context creates an opportunity for students to improve their skills in any aspect they choose - from research, writing, design, and development, to skills like teamwork and communication. They gain experience for future projects that they will work on, as well as their future jobs. For beginner students, working on projects in academia can be one of the first opportunities to gain work experience, which is more often than not a requirement in job applications. Great students, who do their work very well and are very talented, can shine in the right environments, gain more confidence in their abilities and skills, and often lead others. They also contribute a lot to the project, and can see the result of their work relatively quickly.

Creating games for research within an academic context rather than outsourcing development allows close collaboration between developers and researchers, some of whom are even the same people. Despite the challenges of mismatched timelines, this closeness helps adjust the design of the game to be more effective, and improve the quality of the finished product altogether. For example, *Bloomwood Stories: Block Party* was designed and built around self-efficacy theories, which informed game design decisions at every stage of the process. Additionally, because the research has a finished product (i.e a built game), future researchers can not only read the papers that were written on it, but also examine and play the game, to get a better understanding of the research insights.

We mentioned that projects in academia draw different people from different backgrounds with different work practices that they are used to, which could be challenging. However, there is also an

upside to it. According to research, cultural diversity has a positive effect in the workplace [5]. Different people bring to the table different perspectives, different ways of thinking, and different opinions. Team members could get exposed to different, more efficient processes and tools to work with, that their coworkers introduce, and that can help them not only with the project at hand, but in their career moving forward.

Finally, we have mentioned that often when different people come together to work on academic projects, each of them has different wants and needs out of the experience. Though it can be challenging to satisfy everyone's needs in the process, when done right this could be a great opportunity where one project serves many purposes, beyond just research. This could be a project where a specific student learns a unique design methodology, a staff member learns a new programming language, and a PhD student learns what a great research process should look like - all at the same time.

5 CONCLUSION

In this paper we presented the story of the digital game that we developed - *Bloomwood Stories: Block Party*. We started with introducing the game as well as its goals, in which the main one is to increase players' health self-efficacy and their willingness to use health resources at their local library. We moved on to talk about our process of game development and in particular how we chose what to develop. We then presented the challenges that we faced in the process, that are specific to working on projects in and for academic contexts, and how we mitigated them or think teams should. Lastly, we talked about opportunities that arise from this unique work environment, as well as lessons that we have learned along the way.

We believe that this paper could be useful to any team that works on projects in academic contexts, and in particular teams that design and develop digital games. We are certain that the challenges that we faced and presented in this paper are shared amongst numerous projects in academia every day, and we hope that different teams could benefit from our insights and our suggestions for mitigating these challenges.

6 APPENDIX

6.1 Gameplay Information

The game begins with a prompt to enter player information: *Name*, *Pronouns*, and *Language*. Then comes up an animation which gives the player some background and context for the game, including their role in it as well as the main goal. At this point the player chooses one NPC to help during the first week. Every week the player is focused on helping a different NPC, for four quests. The gameplay is built in a way such that for each quest, the player goes through four conversations with the community members. The first one is with the NPC they help, when the quest is delivered. In this conversation they understand what kind of help the NPC needs. The second and third conversations are with different NPCs, who give the player insights and help as to how to solve the quest at hand. Then, in the fourth conversation, the player returns to the first NPC and chooses a piece of information they have learned that they think can solve the quest. In between those conversations,

the player can check their phone, where they can find multiple resources: a to-do list for the quest, their contact list, their journal, a dictionary that is used to look up unfamiliar terms, and a settings app. Each quest takes place during one day. At the end of each of these days the player gets to reflect on that day, and at the end of the week there is a block party. Additionally, the player's progress gets saved automatically when completing each quest.
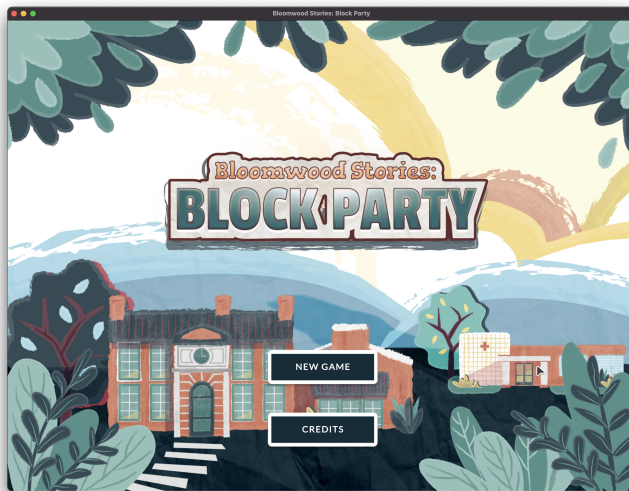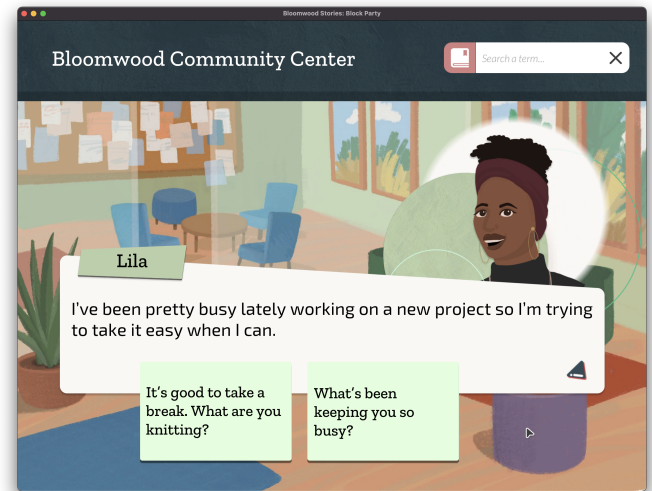
Figure 1: The opening screen of the game

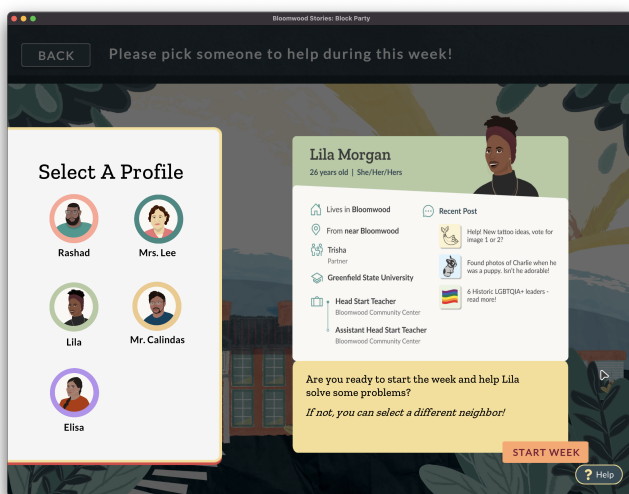Figure 3: A conversation with an NPC

Figure 2: Selecting an NPC to help during the week

Figure 4: The main map of the game, where players can start conversations or check their resources

6.2   Game Screenshots

Figure 5: The phone view of the game showing the 'My Journal' app, where players can view information they have learned from talking to NPCs

ACKNOWLEDGMENTS

REFERENCES

[1] Vincent Aleven, Eben Myers, Matthew Easterday, and Amy Ogan. 2010. Toward a framework for the analysis and design of educational games. In *2010 third IEEE international conference on digital game and intelligent toy enhanced learning*. IEEE, 69–76.

[2] Albert Bandura. 1982. Self-efficacy mechanism in human agency. *American psychologist* 37, 2 (1982), 122.

[3] Sabrina Culyba. 2018. *The Transformational Framework: A process tool for the development of Transformational games*. Carnegie Mellon University.

[4] Morgan C Evans, Adela Kapuscinska, Maya Greenholt, Junchao Lin, Xuanyuan Liu, Tianyi Zhang, Jessica Hammer, and Geoff Kaufman. 2021. Designing a Self-Efficacy Game for Health Literacy in Marginalized Communities. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems*. 1–6.

[5] Gillian Coote Martin et al. 2014. The effects of cultural diversity in the workplace. *Journal of diversity management (JDM)* 9, 2 (2014), 89–92.

[6] Emerson Murphy-Hill, Thomas Zimmermann, and Nachiappan Nagappan. 2014. Cowboys, ankle sprains, and keepers of quality: How is video game development different from software development?. In *Proceedings of the 36th International Conference on Software Engineering*. 1–11.

[7] Alexandra To, Elaine Fath, Eda Zhang, Safinah Ali, Catherine Kildunne, Anny Fan, Jessica Hammer, and Geoff Kaufman. 2016. Tandem Transformational Game Design: A Game Design Process Case Study. In *Proceedings of the International Academic Conference on Meaningful Play*.