STRICTLY EDUCATIONAL: AN EXPLORATION OF THE RELATIONSHIP BETWEEN EDUCATIONAL GAME DEVELOPER, CLIENT, AND END USER

by

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A Thesis

Submitted to the Faculty of Purdue University

In Partial Fulfillment of the Requirements for the degree of

Master of Science

Department of Computer Graphics Technology

West Lafayette, Indiana

December 2018

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This paper is dedicated to the Academia Prehistoria team, and by extension the Games InNOVAtion Laboratory. Without them and the support of family members, friends, and loved ones, this paper would not have happened.

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GLOSSARY

AAA Games – Games produced by companies that can have large amounts of funding invested into their marketing or development.

Video game – "an electronic game played by means of images on a video screen and often emphasizing fast action" ("Video Game," 2017).

Software engineering – "the disciplined application of theories and techniques from computer science to define, develop, deliver, and maintain, on time and within budget, software products that meet customers' needs and expectations" (Reilly, Ralston, & Hemmendinger, 2003). This definition can be extended to anything involving the concepts: Game Development and Game Developer.

Sunken Cost Fallacy – also known as: Sunken Cost Bias or Sunken Cost Trap.
"Psychological tactics to reduce discomfort over the investment of either emotional or physical currencies" (Haita-Falah, 2017).

Cognitive dissonance – "conflict between one's actions and the cognition of rational behavior creates a state of mental discomfort. I.e. self-justification of past decisions" (Haita-Falah, 2017).

Loss aversion – "the convexity of the utility function in the domain of losses, i.e. risk-seeking behavior responsible for the escalation on an initial investment" (Haita-Falah, 2017).

ABSTRACT

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Degree Received: December 2018
Title: Strictly Educational: An Examination of Educational Game Quality Assurance
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With the interactivity and immersion of players into video games, rising development costs, and heightened expectations from AAA developers video games need to make sure they hit their target market more than ever. This is something that is less extreme in the educational game development space; but ultimately true with limited grant funding, limited development time within a student developer's schedule, and how rapidly a recently leased student content creator will need to learn the space and needs of the client. When a student is brought on late into a development cycle, it can become troublesome when they are required to meet new developing features on a changing project. This paper looks over how one team approached this issue, with a focus on meeting the needs of a group of American high school teachers. Within this paper, the focus is how they tackled the issue, and how the teachers reacted to the end prototype, with some insight into the older prototypes of the project. Throughout it they had reinforced the ideas that communication, data validity, and set contract goals are important identifiers for project success. Teachers looking at video games care more about the data being valid and clearly communicated more than if a game is fun or laden with features and mini-games.

CHAPTER 1. INTRODUCTION

1.1 Introduction

Video game development is a high-risk area of media that can fall into low reward if the production goes beyond the scheduled amount of time. Failure can be caused by an extended development period that causes the game to go over budget, low review scores from a lackluster experience, and low sales numbers from the target audience due to features implemented into games. Features such as Micro-transactions can cause a game to outright fail, especially if the game is a full priced 60-dollar game, with a season pass and additional versions.

While it is unlikely that an educational game will use these means within their game systems, this monetization model warrants a discussion as to an example of how a single system can disrupt an entire game's ecosystem. This section will go into depth as to what developers have done, how players and critics viewed the games, and how these risks and critiques can be present within an educational work-space.

Within this paper is also the exploration over the development of Academia Prehistoria. This game was created to assist middle and high school students in career-planning courses choose a career. It is a university tycoon-type game where students create their own university and place cavepeople into courses based on their SAT stats and interests. The goal of the game is to graduate cavepeople and place them into careers that match their interests as well. More on the systems at play within the discussion

Figure 1 An example of major choice within Academia Prehistoria

1.2 Problem Statement

The problem addressed in this paper is having quality, meet function within an educational video game. This paper will dive deeper into how the Academia Prehistoria team approached their final year of development for an educational game, and how teachers received said game. Main focus being, how did the teachers receive the game and how did they interpret its classroom utility.

Within the beginning, there was much concern about how many functions can be inserted, made fun, and meet the data restrictions brought forth by the client. A better way to focus being, is the proposed function necessary to the message, and is that message clear? For instance, looking at how the Fable series approached it, they wanted a game that focused more on the perks or benefits of their morality mechanic. Focusing on what action gets you a specific reward or perk rather than the action itself.

The rewards could range from powerful spells, demonic horns/halos, or particularly powerful armor. Fallout 4 focused more on the journey and the interactions that the player has with companions. Their focus being much more on how the player connected with the agents of the Fallout world, and less what their companions can do. The game critic Jim Sterling (2015) stated the following about this system:

> *Companions are scattered throughout the Commonwealth, waiting for you to take them under their wing. They also represent an alternative to the now missing karma system. Doing bad or good things in the Wasteland is no longer governed by the game's own nebulous rules – instead, you'll be judged on your actions by those who travel with you. Individual characters enjoy it when you do certain things – Cait the morally ambiguous pit fighter, for example, loves to see you steal and pick locks...Most companions hate it when you indulge in cannibalism (the philistines) but you might find your ghoul friend is indifferent, or that one particular "person" actually likes it. If a companion enjoys your actions enough, they'll tell you more about themselves, sometimes open optional missions, and eventually confer their own perks once your friendship is maxed out. Naturally, a number of these friends can become love interests – there are no clumsy sex*

scenes, thankfully, but sleeping in a bed near that companion grants a "Lover's Embrace" XP bonus.

The core mechanic being the interactions that the player has with the NPC in question and gaining "points" to increase their relationship with that NPC. Actionable items or conversations can either add or subtract points to push the player's relationship forward. This becomes more complex to test in an open world environment, so what the developer had to plan for was some generic items that can happen in a play session such as a lock pick activity or a conversation that you have with other NPCs. What actions give points is more up to the story designers defining an NPC's personality.

1.3 Significance

This section will look at The Envision Center, another college based educational developer, and its funding and development process as a comparison to the Games InNOVAtions Lab. The company's name being The Envision Center. The Envision Center uses defined rates per employee to determine how much to charge the customer. If the customer is an internal Purdue employee, the rates are baseline. If the customer is external, the rates are increased by 55%.

These rates are planned for under a budget that is presented to the client and approved by them under a set scope. If the scope changes at all, a new budget is planned for, for the additional hours in development. The average project that is kept small will usually cost an internal client $2,500 to $5000. The Envision Center handles around 15-20 small projects a year with some taking anywhere from 2 weeks to 1 full year depending on the client's wants or needs. Bigger projects can go upwards of $28,000 or $44,000 for a 2-year project. The only way the budget will increase is if there is a change in scope. To create a standard starting bar income for small projects, the average the budget would put the small project income around $68,750 annual. Combining the small project income and adding that to the bigger projects, which have an average of $36,000, has an operating budget of $104,750 annual.

The Envision Center must balance their schedules to their student employees and deliver their projects in a timely manner. If the Envision Center is unable to make the end date that is detailed in their contract, then The Envision Center must work until what is agreed upon has

been met. The Envision Center tends to try to hire students either at the beginning of their college career if they can, or as early as they can in their graduate career. Their goal in knowledge transfer is to try and have the new person there for 1-3 months before the other person leaves. This is to give the new hire time to learn the work environment and understand their job function.

However, due to graduation or career opportunities of departing students, or deadlines, they may need to start within the midst of a project or get put onto a project ASAP. This is reported as rare though. Teams for small projects tend to range from 1-2 artists and one programmer, whereas bigger projects can have 4 artists and two or three programmers. This can cause projects to strain a bit and create a problem called "crunch."

The problem that is crunch affects both learning and professional game developers when a promised deadline is very close, which causes stress, anxiety, and overwork. This is created due to the developers having to insert an extremely large amount of overtime or off time into a project just to meet that deadline. It is a mental condition that is still being explored but has been around in this industry and others for a long time. Crunch also carries the risk of burning out those who are students learning game development such as those inside of the Envision Center.

Jason Schreier (2016) gave a great insight into "crunch" time within his opinion editorial in the New York Times article named *The "Crunch" Problem in the Gaming Industry*. Within it, he had interviewed developers and described how development crunch time appears. Crunch time can cause programmer work hours to increase to as much as 20 hours per day, leading to 80-100-hour work weeks. This can go on for days or weeks which tends to cause familial issues (Schreier, 2017), stress, and deteriorating physical and mental health.

In the end, the features that the team had been working on may not be implemented into the game due to bugs or questionable utility and enjoyment. They may also be forced into the game due to the amount of emotional or financial currency invested into the product. Costs of AAA games are steadily rising depending on the amount of marketing, globalization, and game genre being put out. The Witcher 3(2015) was developed at 46 million US Dollars and 35 million US Dollars for its marketing. Its budget is considered at the low end of development costs for AAA Developers.

Another option in the advent of Steam Early Access would be to release the alpha of the game and see how one can balance systems within the game. The problem in this method is it

puts the player's trust in the final product at risk if the player isn't aware of the state of the game, and how early the prototype is. As well as how other players may take rapid change in a game's meta due to rebalancing once powerful tactics that may have been too powerful. Player exposure also becomes a problem depending on the genre of a game.

Online critics such as Dorkly's Miklós Takács (2013) reveal how systems can be mocked when tacked on:

> *Developers really like their extremities, don't they? Not only do they give options in absolutes (and don't forget, only a Sith deals in absolutes), but they almost always give away some sweet special power or bonus attributes if you pick one side at the beginning of the game and then go all the way on that side. A good example is the Karmic Overload in InFamous. That basically takes out the role-playing aspect and the decision-making part of the decision-making gameplay mechanic, reducing it to a simple question of "Which side are you on?". That is, as long as you want to maximalize[sic] the power of your character, but who wouldn't want that anyway?*

With the inclusion of global distribution and marketing of AAA video games, Kotaku writer Superannuation (2014) cites several games with costs of production reaching roughly $200 Million. With an average production time of 1 to 2 years, provided by Prinke (2016), it would be preferable to get it right the first time so that the developer doesn't lose face within the community and remains as a joke for not understanding their player-base.

1.4 Purpose

The purpose of this experiment is to explore what are the main factors of interest that this group of middle and high-school teachers found most valuable in choosing an educational game for their classroom. What we want to look at is if the teachers are interested in using the game in their classroom. What we also want to see is what, if any, factors are more important to those teachers.

The goal being to explore what are the main factors of interest that a group of middle and high-school teachers found most valuable in choosing an educational game for their classroom.

Unreal Engine 4 was used to make an educational game, which was built, rebuilt, reimagined, and tested over the course of four years. AAA Developers are within this paper to show a comparison between educational game development and games that serve a more entertainment focused purpose. The two realms have similar problems and audiences such as the development "crunch" issue and user retention.

1.5 Research Question

The central question presented by this paper is, what are the main factors of interest that a group of middle and high-school teachers find most valuable in choosing an educational game for their classroom? This paper seeks to inform of one process that an educational game team used when designing a game for use in a high school, classroom environment. What the paper will attempt to do is help advise future studies or approaches for designing educational games for in-classroom use.

1.6 Assumptions

Going into this experiment, the researcher will be making multiple assumptions. One is that the development method can be emulated for multiple educational game development teams of various sizes. Explanations for approaches and reasoning provided by the team will back up their approaches. The other assumption is that these teachers in Midwest United States are of a similar mindset as their colleagues at other institutions in other parts of the world, or even the state.

1.7 Delimitations

This study is one that focuses mainly on the teachers' perceptions of the end product that is Academia Prehistoria. Prototypes will be covered but will not be the focus of this paper. Funding for educational game development will not be a subject of this study due to time constraints. Mental health within game development will not be a subject for this study but will be given some coverage. It is covered due to the risk that crunch poses to learning developers that are typically hired for educational game development.

1.8 Limitations

Due to the lack of funding and personnel, the feedback gained was gotten through a questionnaire sent to the teachers following a workshop styled as a lecture. As such, responses were voluntary, but ample opportunity was given for any questions or further feedback before final data collection was done.

1.9 Summary

The objective of this review is to examine how a group of middle to high school teachers approach and evaluate games that they use to supplement their lessons. In this we are using the example of a middle to high school, career-advisement course and a game designed to supplement their lessons. The risk of producing a poor game can result in a loss of funding or revenue for the department associated with the development of the game. The other risk is a chance of student burn-out if the development crunch becomes too much. Following this section, there will be a discussion of the literature used in producing this experiment

CHAPTER 2. LITERATURE REVIEW

2.1 Game Development Practices and How Users Interact with Games

Kasurinen, Palacin-Silva, and Vanhala (2017), in their paper, discuss development of games within recent years. Within the paper, developers lament over the "Good old days" of development, which according to the researchers, hasn't changed much. Providing further information, they detail:

> According to the data, 61% of respondents do not follow any systematic development methodology. Consequently, 39% of the respondents follow a software development methodology, which could be characterized as "systematic", and out of those organizations, 67% (26% of the total) identified "Scrum" or "Partial Scrum" as their method, 33% (13% of the total) "Prototyping" or other agile approach. (Kasurinen, Palacin-silva, & Vanhala, 2017)

This methodology becomes problematic since without planning, or check-ins of some sort, no one in the company knows what the other is doing. As deadlines start to approach, everyone begins to wonder what the other is doing and if they are close to having a finished product. And if a problem arises with a feature or a bug is being particularly hard to squash, it may be missed or left in due to time constraints. If the programmers are working on a feature that QA testing has identified as a broken, unenjoyable mess, and they have spent several months just trying to get it to work, then a sunken cost begins to appear.

They become invested in keeping it and may try to just pour more money at the feature in trying to figure out a way to make it work better. At the very least, it may just be left in the game as an option. If it is a highlighted promised feature, then they really want to keep it as it is something that was promised, and they worked hard on.

A common thought line being, much of the funding had been spent to make sure that the feature is there. The sunken cost here is two-fold in with emotional and financial investiture. It is a feature that someone is emotionally invested in, and the company has put a lot of money in to make sure it works and is there. It may be buggy or unentertaining, but it is there.

Within video games, there are multitudes of player types. One such person can either to try to seek out the critical path, trying to beat the game as quickly or efficiently as possible. Or they can play at their own place and know that whenever they beat it, they will have had a good

time. But as games are an escapist medium, that many may want to view as fun like in Toma's (2015) paper Self-Reflection and Morality in Critical Games, "...we must mention the fact that not all players relate to the ethical dimension of the game. As we will further see, some of them chose to treat This War of Mine, hereto referred to as TWOM, as a game despite its realistic approach, while others critiqued the game for not being fun." (Toma, 2015)

The most common morality system is ones seen in games such as Fable or Fallout 3. The player is either good, or bad and without going to one side or the other, they will not see any real benefits in staying in between. The developer's intent in these cases is to give punishments for taking one side over the other, rather than spend development time in creation of a neutral setting. The benefits of Good result in good feelings and perhaps some items that only "good people" get. The benefits of Evil can result in things like a quicker level advantage, and again some items that would only be obtainable by "evil people."

But you encroach upon a player's immersion with this system as detailed by Takács' (2013) article:

> Making my own decisions is awesome and all, but when I think about the +3 Dexterity my Sith Assassin could get for free if only I killed everyone the game lets me kill (even those I don't want to), and were mean to everyone in my group (even to those I really like) then my sense of justice and fair play overrules my judgement[sic].

So, a person's enjoyment of a game is at stake when you focus on a purely rewards system of morality. Another system would be Fallout: New Vegas, in which there isn't strictly morality, it's based on the player and their relationship to a settlement. What does or does not benefit a settlement or clan will result in how they feel about a player, those actions can be morally gray or be bad in the sense of our society. But, to note, the game is set in the apocalypse, where the player's character must survive raiders, monsters, and radiation.

Fallout 4's system is a bit of a more toned-down version of this. While New Vegas focuses on the community at large, 4 focuses on the player's companions. These companions travel with the player and observe their actions throughout the game and will either agree or disagree with how they approach situations. This varies from companion to companion and can result in more fleshed out people.

For instance, one companion likes it when you pick locks, another likes witty commentary, with another just liking the fact that you wear heavy armor. It speaks to the

companion's personality and helps the player to form a more rigid relationship with those companions. Weaver and Lewis, (2012) state in their paper Mirrored Morality over their intentions to experiment over how gamers make moral choices in games. The game of choice was Fallout 3 in this case, and only the first chapter was chosen to test how the moral choice was made. (Weaver & Lewis, 2012) had several hypotheses:

> Does a player's moral intuition guide their choices? Are their moral foundations salient enough to influence decisions? Does enjoyment in a game increase when the player remains within their moral foundations, or when they instead violate them? Does the player feel less guilty when adhering to their code, or more guilty[sic] when they violate them?

Within this experiment they had discovered several metrics to measure such as care, fairness, loyalty, authority, and purity. Their first two hypotheses were found to be significant enough, in that the players believed that the players' intuition guided their choices, and that their actions were consistent with their moral code. They had found their third and fourth hypotheses to be not significant enough to prove their hypotheses. The problem with the experiment was with the possibility of positive impression affecting the subject.

2.2 System Health and Development

Monteith, McGregor, and Ingram (2014) investigated software ecosystems and evaluated an ecosystem health framework. To this end they mirror the company Bosch's workplace ecosystem calling it a "modified Bosch ecosystem." According to them, this system is a platform, a set of external and internal developers, and a dedicated community of experts. To this, they included the organization that owned the intellectual property and innovations created by collaborators (Monteith, McGregor, & Ingram, 2014).

The reason for this proposal being that sharing work and rewards with those within the ecosystem can be a benefit. Rather than a competitive environment where one tries to gain the benefits for themselves or a smaller group. To this end they investigated actor health, actor network health, software component health, software platform health, software network health, and orchestration. In shorter terms, they looked at the organizations and how they interacted, actors, how software develops and is updated, and how the organization formed and

implemented strategies for road mapping, support, and intellectual property management, orchestration.

Within game development, parallels can be drawn from how those in a development house can track their internal ecosystem to ensure a finer product. How their internal teams interact with the roadmap of the game's systems, how players can interact and modify the system if things such as game mods are allowed within their framework, and how the system handles these changes. If the ecosystem within the house is strong, then the software stands to remain strong. While player interaction is a later step, the internal ecosystem can begin to be stabilized with automation of things such as quick, rapid Q.A. systems.

Amorim et al. (2017) researched several related studies about system architectural health and had found that the studies they covered had not addressed adopted practices and what specific parts of the ecosystem contributed to the stability of the system. To that end they proposed for further study that:

> Our research proposal must understand how and what practices impact on the productivity, robustness, and niche creation. The first step is to raise all architectural practices used on software ecosystems, and after investigating the connections and their effects on the health aspects.

They propose that for a system ecosystem to be considered healthy, how a system's architecture interacts with everything connects to it must be considered. While a specific part can affect the architecture, the overhead of tracking every single part from the smallest to the largest part may produce too much data for the developers in question to sift through.

2.3 Educational Games in Classrooms

Bers and Portelance (2015) did a study where they created and used an app called Scratch Jr. to assist 2nd graders in learning the basics of computational programming. Within their study, they had found a level of enjoyment and expansion of learning using this app. Within a single subject they the subject:

> …after careful deliberation and with the iPad facing away from the camera, delightfully shows the interviewer an example of how to use the "Say" programming block in a personally meaningful way. He then reuses the "Say" block in a new way to demonstrate his knowledge of what it does. The video captures the student's knowledge and demonstration of a specific computational thinking practice, reusing, an important

> practice for efficiently choosing and returning to the right tools to perform a certain computational expression.

They also report two other cases within their study where the students engaged with the material and began to experiment its limits. They began to display skills such as sequencing, space cost and parallel programming. Within the interaction that a student has with a game, they form bridges between concept and application of the material. It allows them to learn something for a reason other than the reward of a good standardized grade, it instead motivates them as an intrinsic reason.

Intrinsic motivation is a behavior that is defined by an internal feeling of being rewarded rather than an external one. This method typically is the reasoning behind the implementation of games within classroom material. The reasoning behind this being that the enjoyment factor or emotions behind learning something intrinsically sets an emotional goalpost that a person can call back on when they are trying to do information recall. The benefit of tying this to games is that it can create a safe space for the student to "fail" without the fear of external punishment.

Another thing that games can inspire is a sense of suspense and exploration of concepts. Abuhamdeh, Csikszentmihalyi, and Jalal (2014) explored the concept of uncertainty and suspense's link to intrinsic motivation. Within their study they presented a game with one group that was given an end time for their play session, and the others were not. This, according to them, created a sense of suspense that increased their enjoyment of the game.

This could be compared to the exploration aspect of learning something new. They also reported that when their "performance concern" was at their lowest, the subject was performing at their best. So, when these testers felt comfortable or that their results would not affect them harshly, they performed better as their minds could focus on the content rather than the outcome.

Lobo (2015) explored the use of an atom learning board game within a classroom. The game was made of a set of pins that represented the parts of an atom and an interactive board. While the children found the board game fascinating, and useful for those in the classroom that were blind, the teachers were found wanting in the experiment. "Teachers felt that the model could be further explored to bring it closer to the scientifically accepted model (e.g. orbital lines do not really exist; pins could represent the positive, negative and neutral charge)," was the chief concern.

So, the focus for this teacher at least was the presentation of the data to their students through the game. It certainly makes sense, but is something easily forgotten in educational games, that while these games are meant to make a subject fun that the core value is that the data or lesson presented is accurately presented to their students.

2.4 The Development Path to Academia Prehistoria

This project was started around the middle of 2015, the client had hired the Games InNOVAtion Laboratory to develop a game that would assist students in pursuing careers, and by extension university majors, that matched their interests and skills. The lab then formulated a team to handle the project which was at that time called “The Places You’ll Go,” hereon referred to as TPYG. The documentation for this version is a little sparse, but from going through the old tutorial documentation and a couple minigame documents it appears to have been an amalgamation of other games. One type of game was a *Plants Vs Zombies* type game that included some sort of rhythm-based gesture game.

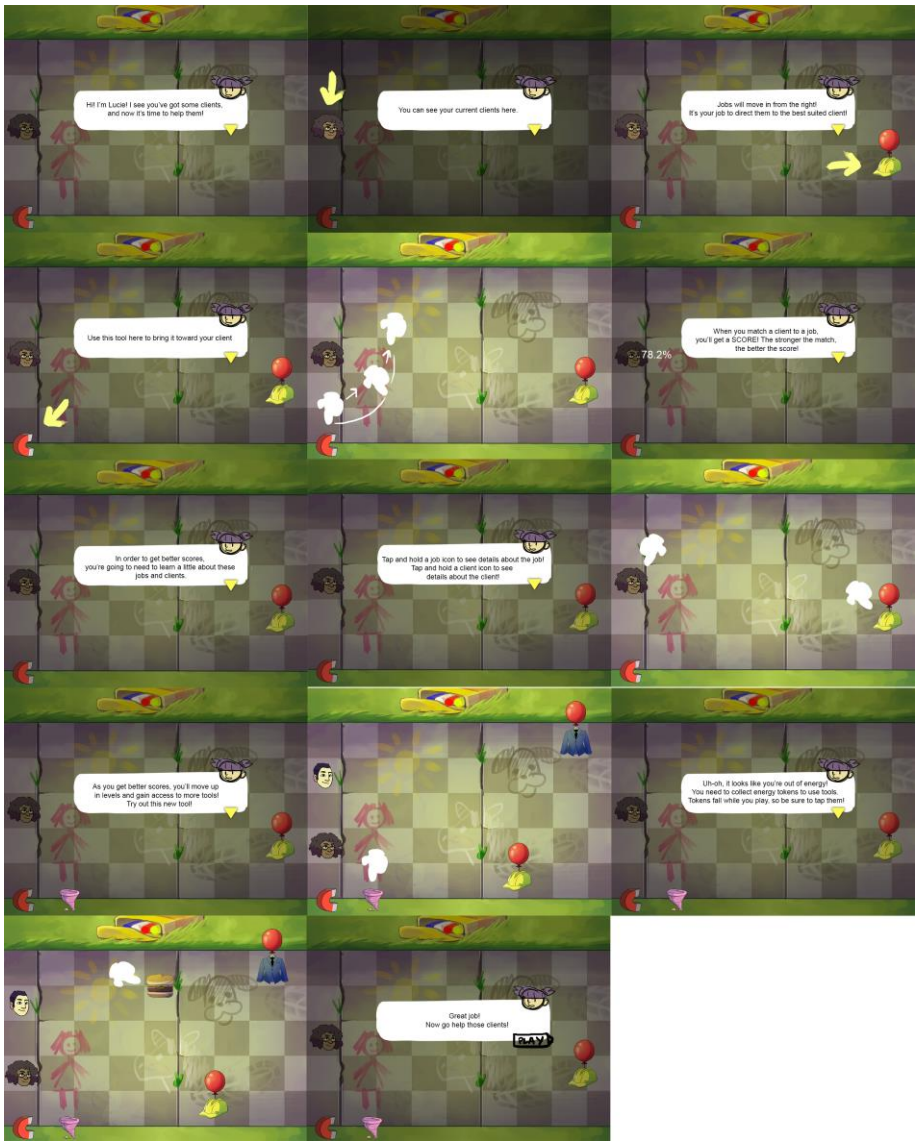


Figure 2 TPYG: Plants vs Zombies Clone type

Figure 3 TPYG: Marble Roller game

Figure 4 TPYG: Example of the counseling rhythm minigame

The student controlled a counselor trying to ask questions and give advice to students on what career would suit them. Another game type in TPYG appears to be a type of "marble roller" physics game based on the artwork where the student would be helping a client get to a career that would match their interests based on what the client was saying. They would need to avoid bombs, spikes, and the edge of the map and collect these jobs. The results from usability testing found these minigames lacking in the overall goal of career advisement and found them to be too complex.

Testers reported that they would need assistance from another person to explain these games. They needed the assistance since the concepts within them were far too abstracted for any information to be obtained. With the feedback from the original tests and prototypes the team decided to rethink their approach as to what kind of game this game would be and attempt to narrow the scope. Around Purdue University's fall semester of 2016, they began to design what would be the first form of Academia Prehistoria.

Figure 5 Academia Prehistoria: Original Unity Mockup

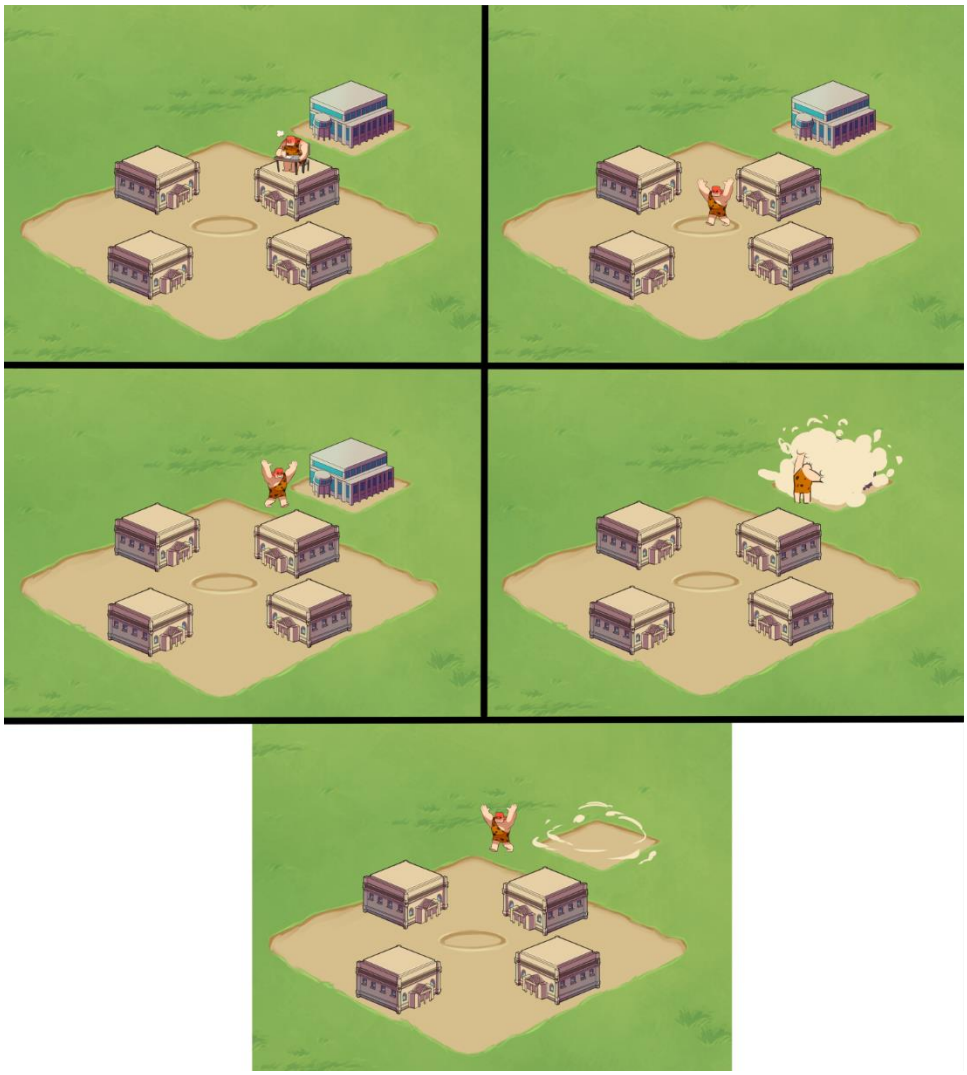


Figure 6 Academia Prehistoria: Unity version with “Rampage” state

The idea was to emulate a tycoon type game based around a university setting. The player would play the part of a university president and build their university and place cavepeople based on their statistic scores into majors that would lead them to their dream career. The statistics would be determined by real world, reported interest data from the client as well as SAT data provided by a data team from said client as well. Originally the game was based out of the Unity game engine but was eventually switched to Unreal in fall semester of 2017.

The reason behind this switch was engine stability for the large amount of real world data that would need to be streamed into this game. Unreal handled data streaming better than Unity at that time which inspired the switch as Unity bugs began to sprout when data had to be

updated. The switch happened after results from the Unity feature testing resulted in more bug reports than feature tests. While bug testing is important, the core features of the game were largely unlooked at.

To resolve this oversight, the researcher was brought on as the former two graduate programmers were leaving the project in the spring 2017 semester. The researcher had designed a paper prototype of the game and made a board game of the final product with a focus on the core gameplay. The prototype was tested with two high school educators with two seasoned professors, one being an economics professor and the other being a game design professor, leading the test. This yielded positive information in how the users could interact with these items in the game.

The feedback was overall focused on how the core gameplay could affect the data for better or worse and enabled a more refined, focused approach for the final game. Their focus being on how cavepeople interacted with the campus and their major and career path. This prototype overall only took the researcher two weeks to refine into a presentable state.

Figure 7 Academia Prehistoria: Paper Prototype

Subjects seemed to be collaborating over getting the cavepeople through college. Talk of "What careers do we have? What one would work out for Steckel [character in the game]?"

dominated the test. Of another note enjoyment appeared to be high, with one of the testers stating, “This is so simple to understand, way better than the other prototypes.” One tester suggested, and the rules of the game changed on the spot, simply without much difficulty:

S1: “Could we draw three careers instead of just one? It seems like that would help us have more options for this person.”

Researcher: “Of course, let’s just change that rule now.”

This was something that wasn’t considered before but made sense and has become a part of the final game. Another feature considered was remediation due to another subject stating,

S2: “The students seem to fail a lot, couldn’t there be a way for them to come back from failure? Like remediation?”

S3: “I like that they fail a lot, seems realistic.”

While some of these features were considered, the scope of the project, in tandem to what needed to be achieved, was already large. So, what the team sought out to do was to seek out the key things that the teachers latched onto. One thing was to make sure that the students had more choices in majors/careers, but to make sure those choices were focused to the data for majors and careers. Teachers wanted to make sure that the students knew that there were more options than what they considered first as a career. Eventually it was discovered that with the feedback, “What one would work out for Steckel [character in the game],” may be best investigated through putting the student through two introductory courses first to better gauge their options.

Work had begun on the final form of the game, meaning no further engine changes. The unfortunate thing being that it meant having to rebuild the code from the ground up as Unreal is based within a C++ workspace whereas Unity is based within a C# workspace. Work began to get the game up to an interactive state for the second pilot test happening in December 14th, 2017. While all the features may have not been present within the build, the researcher wanted to make certain that interaction and controls of the game would be understandable to teachers and students.

This process overall took much longer for the researcher to program in tandem to their responsibilities to their assistantship and coursework. The prototype was made in time with some emulated functions to emulate the final product as software bugs appeared nearing the end of the development cycle for this pilot test. Within this test the game and controls were explained

thoroughly to the students before giving them control of it. The main goal was interaction refinement, but feedback related to some of the core gameplay re-emerged.

Most feedback tended to be what wasn't there or what could be added in relation to either Civilization VI (Firaxis Games 2016) or The Sims (The Sims Studio 2016). In fact, the feedback was more spread out, rather than focused on the features. For instance, some feedback from the test focused on gameplay features not there in relation to the game not being difficult enough, hints for what they should be doing, there being a lack of music or sounds in the prototype. Things that are planned for the final game, but have not been implemented yet, due to the nature of the test being focused on the above features.

Some feedback included things like the current art direction, confusion over word choice for the skills or careers, story, with one being about wanting micro-transactions. Below is a bit on the feedback provided by the students:

- Would like, "Other missions to collect money and more buying options"
    - Things like quests or challenges would be implemented to meet this need
- "The talking they do should be in speak[sic] bubbles, otherwise there[sic] voices would get annoying"
    - If they wish the cavepeople to have some sort of feedback to give them a bit more life. They do seem to think that grumbles may get annoying.
- "Have some ways to tell most of the characters apart"
    - Customization/randomization is planned in the final product with hairstyles and clothes.
- "Type of economic efficiency…Unit Cap on buildings"
    - True this prototype lacked some economic efficiency, as at the time of this prototype, further buildings/upgrades had not been implemented. Perhaps some of the currency should also be dropped to a lower amount.
- "This game gets boring after a while just clicking."
- "replace some of the harder vocabulary with easier so it is not as hard to understand (in stats: enterprising, realistic, conventional)

Figure 8 Academia Prehistoria: RIASEC(Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) Score examples with image identifiers.

The stats in question would either be SAT scores, or interest scores named Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. Students needed an intro for these interests and what they meant, so the skills were given an image to associate with the skill visually and a note to the curriculum team was made to make certain that the skills were flushed out in the intro material. This is due to the deeper data of the interest set being too vast for it to be inserted into the tutorial of the game. It would need to be covered in the supplementary material or the students risk losing interest in reading tutorial documentation.

2.5 Summary

This study focuses on a group of Indiana middle to high school teachers and what they will find most valuable in an educational game. With that in mind the course of action chosen for recording their preferences was a Likert system with room for feedback. Due to the client's request however, it needed to be a calculated random factor based on their formula. The ecosystem of the game needed to feel alive and enable the teachers to feel that their students can relate to the agents on the screen. The game needed to look and feel attractive to both the teachers first before the students. If the teacher finds the game unappealing, they may think that their students will as well.

To this end the team explored a colorful, cartoony look to make the game appear appealing aesthetically. They also pursued emulating popular tycoon type games to balance the receiving of currency. Another tactic taken was to make the university feel more personal by allowing them to place the buildings and decorative monuments where they want. As well as enable them to choose which buildings they wished to pursue and build first so that they can immerse themselves into their own university.

Something that was a heavy hit to the development of Academia Prehistoria was the amount of change in such a short amount of time. It affects the health of both the system and the development team. Within the health of the system, some leniency is required for feedback from the development team, the client, and the end users. The feedback can help to enhance the systems that are there, but there needs to be a limit to how extreme the change is. The timing of the project towards the end with a comparison to how extreme the change was caused the team to impose more crunch time into the development schedule.

The game needed to feel good to the end users too, so the input from the pilot tests helped to give the team insight into how the user would “touch” and interact with the final product. It also gave great insight into what they expected out of the final game. The methods of development for the game was more of an agile/scrum hybrid type of development. These meetings helped to flesh out ideas and mechanics as well as enabled the team to discuss problems they may have been having so that another member can offer some possible resolution.

The agile part of development allowed them to build, test, then rebuild and get a more refined product by the end. With these thoughts in mind, the finalized game was a Real-Time Strategy, hereon referred to as RTS, tycoon-type game that would allow for the players to build and interact with a virtual college campus with GPA and career score data provided by the client. Overall the questionnaires will be useful in defining whether they found the game useful and if the presented features affected their decision.

CHAPTER 3. METHODOLOGY

3.1 Introduction

The main question for this examination is:

- What are the main factors of interest that this group of middle and high-school teachers find most valuable in choosing an educational game for their classroom?

Within this question, two pilot tests were run in preparation of this study. These studies involved two sets of subjects, one set was a set of four education designers with a paper prototype, board game of a university tycoon-type game. The goal of this game was to place cavepeople into the correct majors and careers, based on their statistics and interests. The other test involved 22, high-school aged 9th graders at a local high school. The goal was the same as the previous test, but in this version, it was a software prototype. These tests will be explained in further detail within the discussion section of this paper.

The first pilot test prototype took approximately 80-hour development cycle. This included 1 artist/project manager producing digital assets for printing and 1 developer/designer producing the ruleset, gameplay, and game pieces. The gameplay feature being tested was that of viewing caveperson statistics and placing them into a major. An additional Test of getting one caveperson through to graduation and placing them into a career was the other objective.

Within Pilot Study 2, the researchers had an approximately 140-hour development cycle with 1 artist/project manager and 2 developers for 48 work hours. Unfortunately, due to one of the developers being called away on an urgent academic matter, the team dropped to 1 artist/project manager and 1 developer for 52 work hours. The features being tested were the same as in the paper prototype. The main intent of the test was to test these two features and see where the game could be improved within these features.

In the final form of the product, proper care was given to ensure that terms were more clearly represented in the interface of the game, and that the tutorial covered these topics. Overall, definitions of the terms and what they meant to the player, were items meant to be covered by the teacher over the course of their lectures. Caps were imposed on buildings, and, and cavepeople were given more identity in their names. Other items were slightly out of scope, or items that were of a subjective manner.

3.2 Research Approach

The approach was an observational usability study. The subjects were to be observed during a lecture-style introduction to the game. Subjects could ask questions and were given a survey, post-lecture.

3.3 Experimental Design

The subjects were teachers invited to a lecture style instruction seminar in July 2018 for two hours. This seminar was over an offered educational module that included career visualization data and Academia Prehistoria, it was hosted on Purdue West Lafayette campus. They were observed during the lecture and allowed to ask questions that they or their students may have. All were offered two questionnaires about their experience or willingness to use said product. Their enjoyment and feedback were measured across multiple questions on a Likert-type scale to give insight to how they were processing their actions.

The teachers behind the workshop were two seasoned professors, one of which an economics focused professor and the other a games studies professor.

3.4 Population & Sample

The population of this study was Indiana middle school and high school teachers. The sample gotten for one part of this population was 44 teachers who attended the in-person workshop. 19 others filled out a similar survey for deeper feedback purposes. All were asked for verbal feedback as to confusion, likes/dislikes, etc. There was no random sampling performed in choosing who attended the workshop or who performed the survey of the game. All were done on a voluntary basis.

3.5 Variables

Dependent variable – Teacher preference/affinity

Dependent variable – Teacher usability/enjoyment testament

Dependent variable – Personal entertainment assessment

Dependent variable – Teacher estimate of student career planning utility

Dependent variable – Teacher assessment of content relevance

Dependent variable – Teacher interest in using in own classroom

Dependent variable – Teacher reasons for lack of interest in using game

Qualitative measures – Discussion

The game was played within a Windows 10 environment, with a 32-bit build for to emulate the conditions that these teachers would have within a classroom environment.

3.6 Data collection

Two post-experiment questionnaires were given to the testers with the multiple Likert scales. One ranged from 1 - 5 from Strongly Agree to Strongly Disagree (N=19), with exception to question 10 where an attempt was made as to why someone may not use the utility. The other questionnaire ranged from 1 - 5 from Strongly Disagree to Strongly Agree (N=44), which featured feedback questions as well. A section for feedback was also provided on the final measure. This was used to examine how much they enjoyed interacting with the game, as well as provide feedback for the feature and prototype in their own words. Observations of the subject's actions were recorded during the end of the workshop if the user had questions or comments.

CHAPTER 4. DATA ANALYSIS

4.1 Data Recording

Two Qualtrics surveys were provided to attendees at the end of the workshop session. The recording method was a Likert-type scale ranging from 1 (strongly agree) - 5 (strongly disagree), with exception to question 10 which tries to delve into possible other reasons that a teacher may not use the game, for the small 16 user group. The recording method for the 44-member group was a Likert-type scale ranging from 1 (strongly disagree) - 5 (strongly agree),

4.2 Data Conditioning

Usability of the application was evaluated by a sample of teachers (N=19) and (N=44) who attended the workshop.

4.3 Analytical procedures

For comparing the results, the approach chosen was a Fisher's exact test. This was chosen due to the small sample size and the ability to compare two groups for most of the questions in the questionnaire. Also, the researcher wants to see if there is a difference between perception of game entertainment and how they like the look of it. As with the data, the point the researcher is looking for is how well the user interacted with the game, it either having them agree to enjoyment or no enjoyment.

Another measure of examination will be an examination of the means and standard error for the teachers' answers. As the purpose is to examine what this group of teachers find most valuable within the proposed game, something that shows their mean choice should give insight as to agreement or disagreement over the scales. Especially if the error or deviation is small.

4.4 Findings

Interest: n=44 $\bar{x}$ = 4.3864 s = ±0.6547 on a 5-point Likert-scale, with 1 being no interest and 5 being high interest.

Usefulness: : n=44 $\bar{x}$ = 4.1136 s = ±0.6912 on a 5-point Likert-scale, with 1 being not at all useful and 5 being very useful.

Table 4.1 Survey of 44 teachers who attended the workshop on expected classroom use of the game

Expected Use in Classroom	Slight	Moderate	Extensive	Unsure
Frequencies	2	16	23	3
Percentage	5%	36%	52%	7%

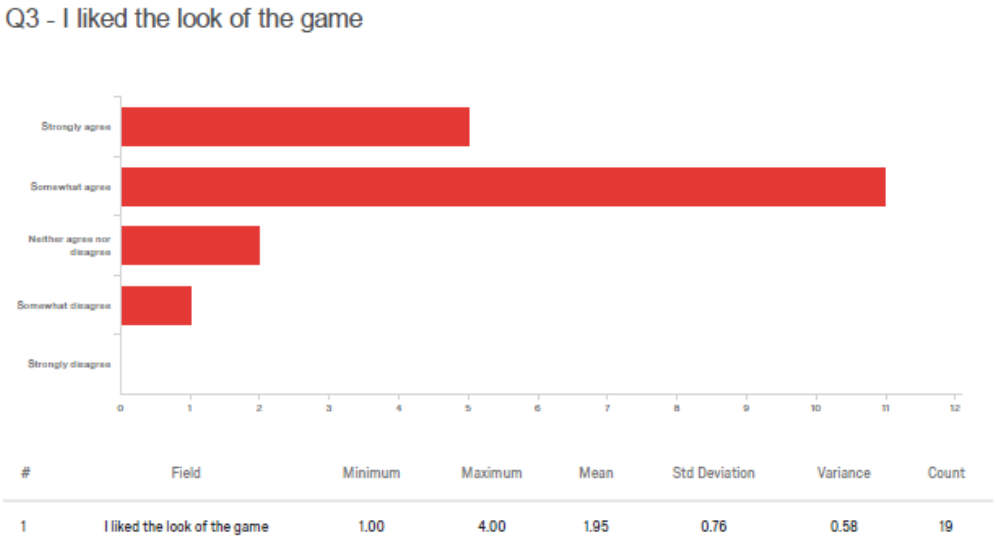
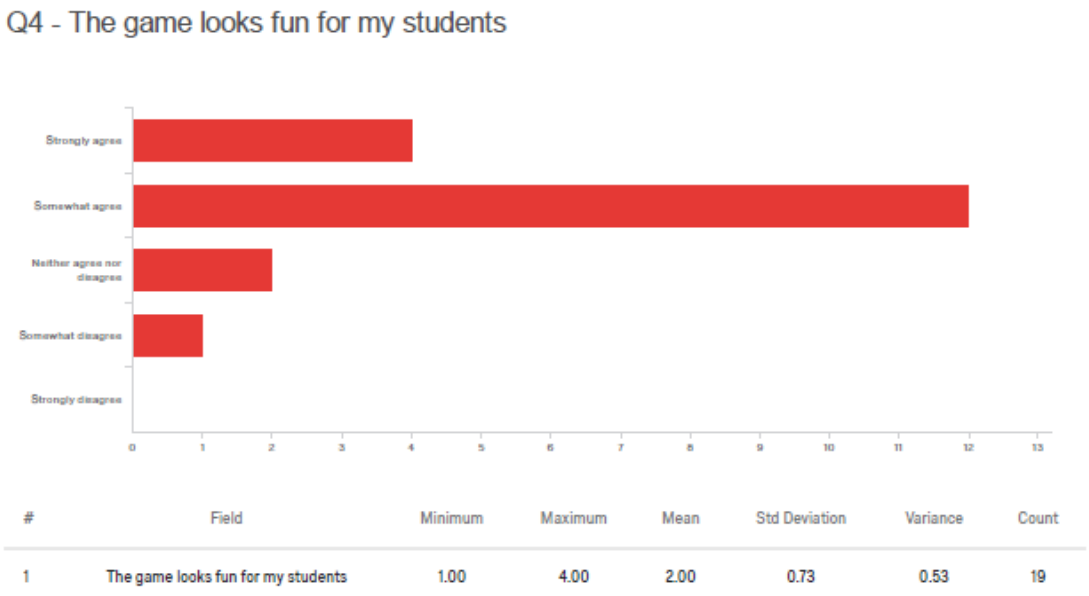


Figure 9 Question 3: I liked the look of this game

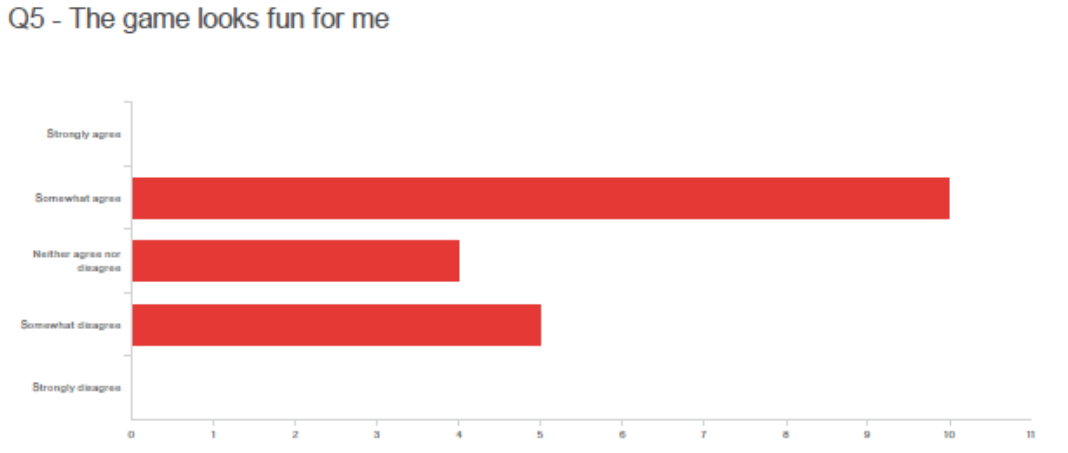
Q3: Of the smaller Qualtrics survey group of 19 teachers, 84.21% of the user feedback identified as enjoying the aesthetic of the game, with 10.53% undecided, and 5.26% disagreeing somewhat.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	The game looks fun for my students	1.00	4.00	2.00	0.73	0.53	19

Figure 10 Question 4: The game looks fun for my students

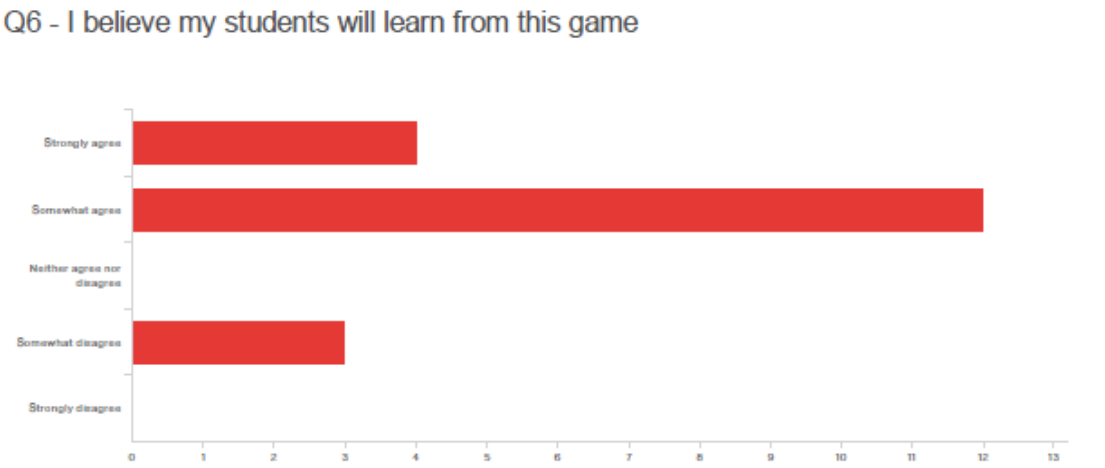
Q4: Of the smaller Qualtrics survey group of 19 teachers, 84.21% of the user feedback identified that the game would be enjoyable to their students, with 10.53% undecided, and 5.26% disagreeing somewhat.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	The game looks fun for me	2.00	4.00	2.74	0.85	0.72	19

Figure 11 Question 5: The game looks fun for me

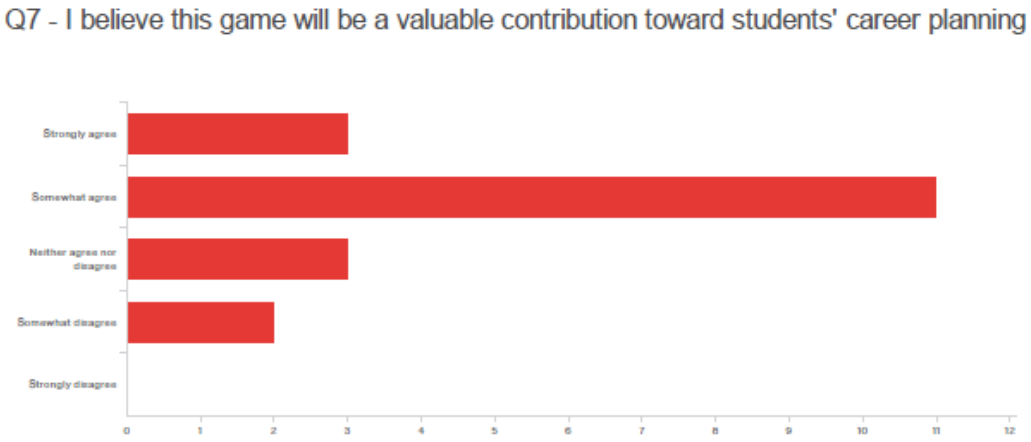
Q5: Of the smaller Qualtrics survey group of 19 teachers, 52.63% of the user feedback identified that the game would be enjoyable to them, with 21.05% undecided, and 26.32% disagreeing somewhat.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I believe my students will learn from this game	1.00	4.00	2.11	0.91	0.83	19

Figure 12 Question 6: I believe my students will learn from this game

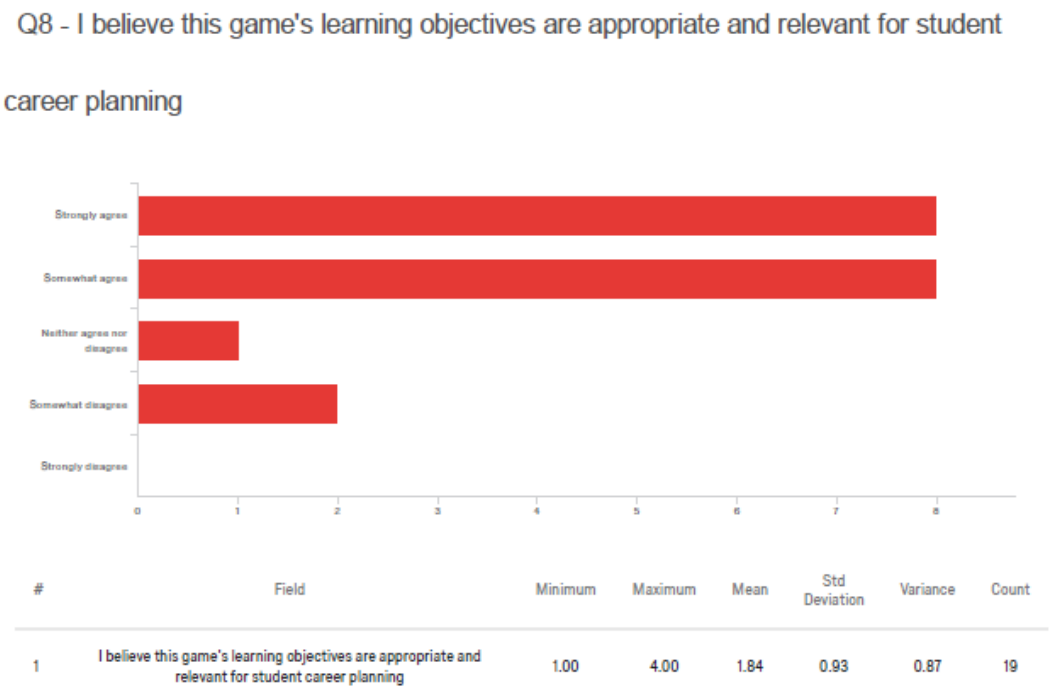
Q6: Of the smaller Qualtrics survey group of 19 teachers, 84.21% of the user feedback identified that the game would be educational to their students, with 15.79% disagreeing somewhat.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I believe this game will be a valuable contribution toward students' career planning	1.00	4.00	2.21	0.83	0.69	19

Figure 13 Question 7: I believe this game will be a valuable contribution toward students' career planning

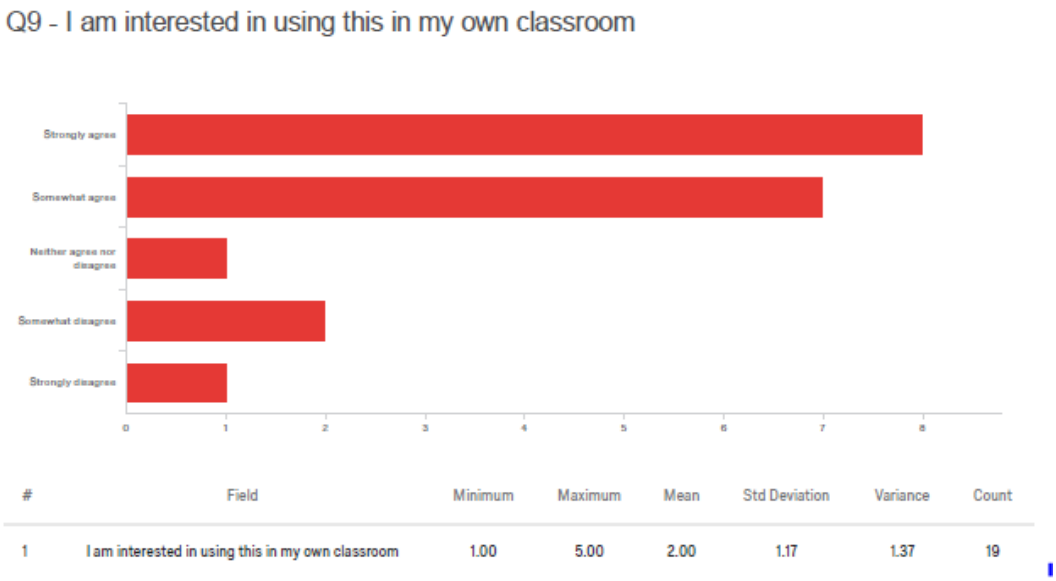
Q7: Of the smaller Qualtrics survey group of 19 teachers, 73.68% of the user feedback identified that the game would be valuable in career planning to their students, with 15.79% undecided, and 10.53% disagreeing somewhat.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I believe this game's learning objectives are appropriate and relevant for student career planning	1.00	4.00	1.84	0.93	0.87	19

Figure 14 Question 8: I believe this game's learning objectives are appropriate and relevant for student career planning

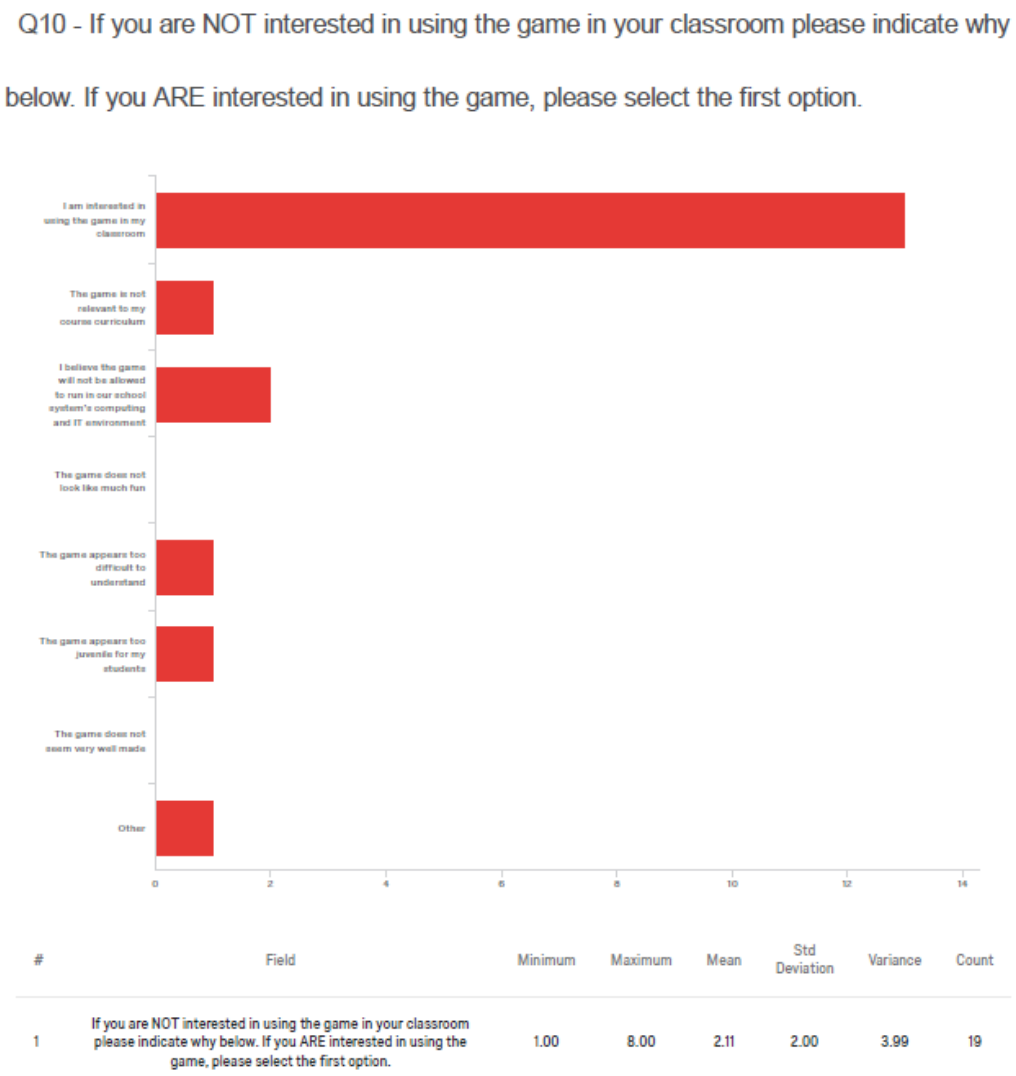
Q8: Of the smaller Qualtrics survey group of 19 teachers, 84.22% of the user feedback identified that the game would be appropriate and relevant to their students' career planning, with 5.26% undecided, and 10.53 % disagreeing somewhat.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I am interested in using this in my own classroom	1.00	5.00	2.00	1.17	1.37	19

Figure 15 Question 9: I am interested in using this in my own classroom

Q9: Of the smaller Qualtrics survey group of 19 teachers, 78.95% of the user feedback identified that they would be interested in using the game in their classroom, with 5.26% undecided, 10.53% disagreeing somewhat, and 5.26% disagreeing strongly.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	If you are NOT interested in using the game in your classroom please indicate why below. If you ARE interested in using the game, please select the first option.	1.00	8.00	2.11	2.00	3.99	19

Figure 16 Question 10: If you are NOT interested in using the game in your classroom please indicate why below. If you ARE interested in using the game, please select the first option.

Q10: Of the smaller Qualtrics survey group of 19 teachers, 68.42% of the user feedback identified that they are interested in using the game in their classroom. 5.26% declared it was not relevant to their course curriculum, 10.53% said that it was unlikely that the game would not be allowed to be run within their I.T. dept., 5.26% state that they think the game would be too difficult to understand, 5.26% state that they think that the game appears to be too juvenile, and 5.26% placed their statement into the “other” category.

Did it look Fun?	
To Teacher	To Stud.

Agree	10	16	$R_1 = 26$
Disagree	9	3	$R_2 = 6$
	$C_1 = 19$	$C_2 = 19$	$N = 38$

Table 4.2 Fisher's exact test on teacher feelings on enjoyment

Did it look Fun to the teacher?
vs Visual appeal

	Teacher Affinity	Visual Appeal	
Agree	10	16	$R_1 = 26$
Disagree	9	3	$R_2 = 6$
	$C_1 = 19$	$C_2 = 19$	$N = 38$

Table 4.3 Fisher's exact test on teacher feelings on enjoyment vs visual appeal of the game

4.5 Summary

In running a Fisher's exact test, the researcher aims to see if there is a difference in how the teachers view their experiences with the game. Within this test, they were grouped as having an affinity towards the items detailed in the above questions or having no affinity for them. The cutoff calculates as a $p = 0.0789$. The result is significant at $p < .10$, which says that their perception of this game will differ to how they think their students will view it. When comparing the effect size of how much fun the game looks to teachers and if they think their students would find the game fun, the effect size is large at .5821.

This implies a strong relationship between how much a teacher would think their students would enjoy the game based on their own opinions of it. When comparing the effect size of how relevant the game would be to their students and how valuable it was in contributing to their career planning, the relative effect size is small at .2035. This means that the relationship between how much the teachers think that the game's relevance and contribution to the students is relatively low.

In running a Fisher's exact test on teacher affinity for the game and the visual appeal, the cutoff calculates as a $p = 0.0789$ as well. The result is also significant at $p < .10$, so their perceptions of how it looks and whether it looks fun differs as well. The scales appear to reveal a trend of interest in the material and wanting to use it within their classroom.

Within the smaller group, the users seem to see the game as useful and want to use it within their classrooms, but they may not necessarily find the game as fun. It may be that the teachers may not find the game very fun but believe their students would instead. This may be a case of preference or to games not being wholly appealing to the teachers in question. More on this in the discussion.

CHAPTER 5. CONCLUSIONS

5.1 Introduction

Our question is: What are the main factors of interest that this group of middle and high-school teachers find most valuable in choosing an educational game for their classroom? Within this section we will explore these thoughts further, as well as some of the process in getting the game to this finalized stage. But first we will go lightly over some of the feedback received in the latest workshop.

In this the researcher sought to discern how much certain factors would play into the teachers' needs within an educational game. A few examples of these factors are representation of educational data, how the game is presented artistically, integration within their local IT group, as well as overall enjoyment over playing the game.

Within feedback of the larger group there was a trend in feedback over how important the data for the career portion of the game was to them. Most of the feedback focused on how much the users wanted or needed that raw career data alongside the game. In the smaller group, many were interested in the game, but some did note how they were uncertain if their IT team would allow it to be installed onto their school machines. Implementation onto a web-based solution would be a good solution for this item, but that can bring along further questions on implementation, usability across different browsers, and server storage.

They seemed to get the concepts within the game based on the feedback but seem to desire the raw data as well to supplement the information being passed along by the game. Some also made a note about fear over the concepts being too complicated for their 8th grade class.

5.2 Discussion

Approaching the end of the project where the team had approximately 8 months left to finish the game, a second programmer needed to be brought on as the team had 8 months left to get the game into a polished state. Over the course of 7 months the two programmers and one artist/project manager dedicated themselves to bringing the game as close to client and teacher expectations as they could. This included updating the data as it had arrived to them from the client data department and making sure the presentation matched the planned material from the

module planned for by the education team. Items such as redesigning HUD elements to match phrasing in the material, expanding on definitions for what each of the provided statistic scales meant had been adjusted or overhauled constantly throughout the 7-month time frame.

Due to Unreal's programming method of "Blueprints" being what is called a "binary" file meant that communication between programmers and artist were required to be constant and consistent. Explicit documentation needed to be recorded on what had been adjusted in the blueprints to that the master copy could be updated to match and merged to the most up to date version of the game.

Figure 17 Academia Prehistoria: Caveperson Spawns

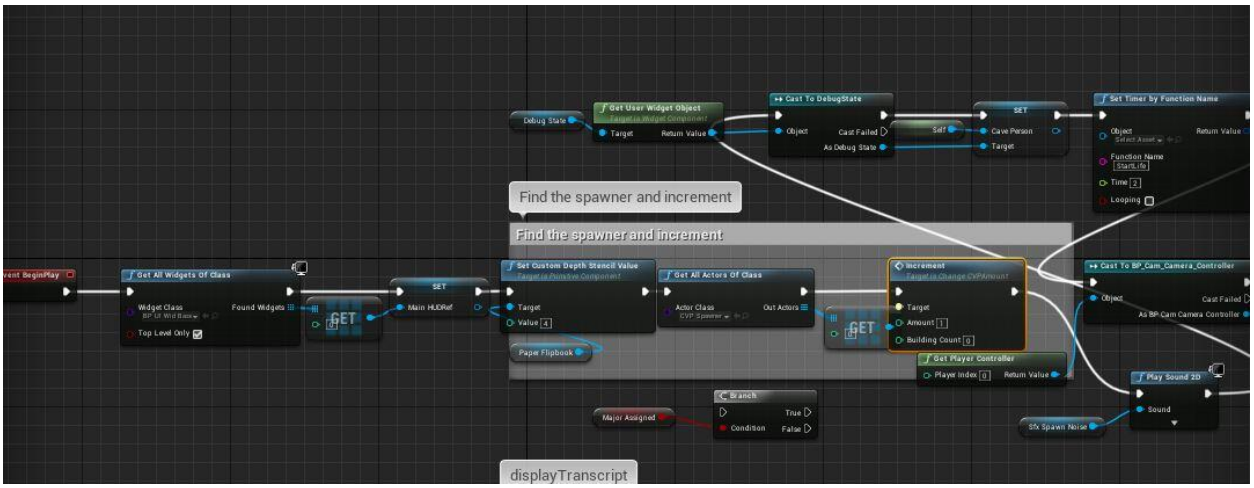


Figure 18 Academia Prehistoria: Stat Generation event 1

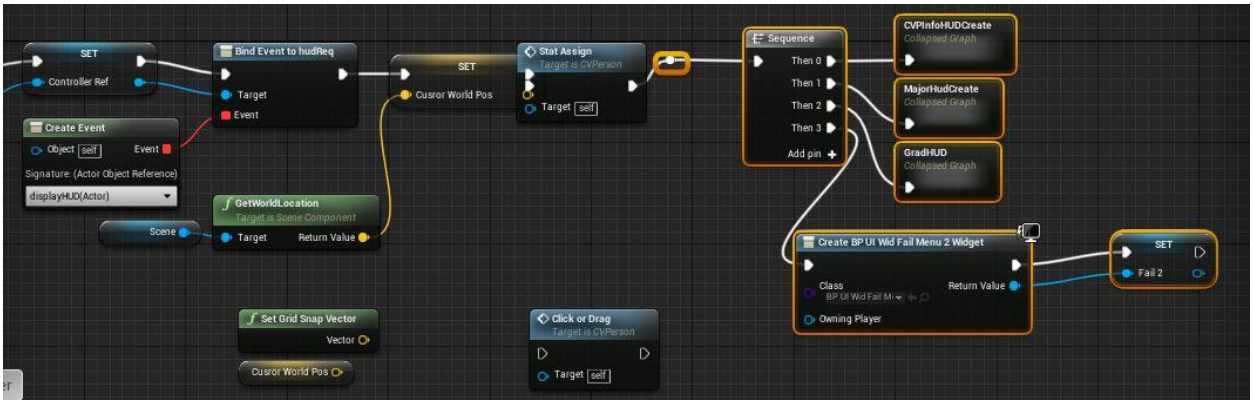


Figure 19 Academia Prehistoria: Stat Generation event 2

For example, in the figures above is the event for stat generation of the SAT stats, the names, and the interest scores. It would start with spawning a random caveperson from the spawn point on the center of the map, then assign them a sprite, a name, SAT scores from a data set, interest scores from a data set, then generate the caveperson's HUD elements. If a value was changed or a node was moved inside of this blueprint, it would render as a change and if the programmer saved it, it would proc that change into the commit of the project file.

So, both programmers had to be careful when they saved and be specific about what they changed so that the other programmer knew what to move around or protect when they updated their file. Since, if the receiving programmer changed something in that file and pulled down the

file, they risk having their change overwritten entirely by old code. This is the major risk in working with binary files that can be worked around if used carefully.

Eventually the school semester ended and only one programmer and the artist were left to the project to finish it. An overhaul needed to be performed on the grading system as the client had updated their formula for how grades were graded, how much the SAT scores of the agents played into that formula, and how careers would be rewarded to those agents based on their GPA. This was slightly problematic and time consuming as the formula translated into the blueprint workspace was a largely complex web.

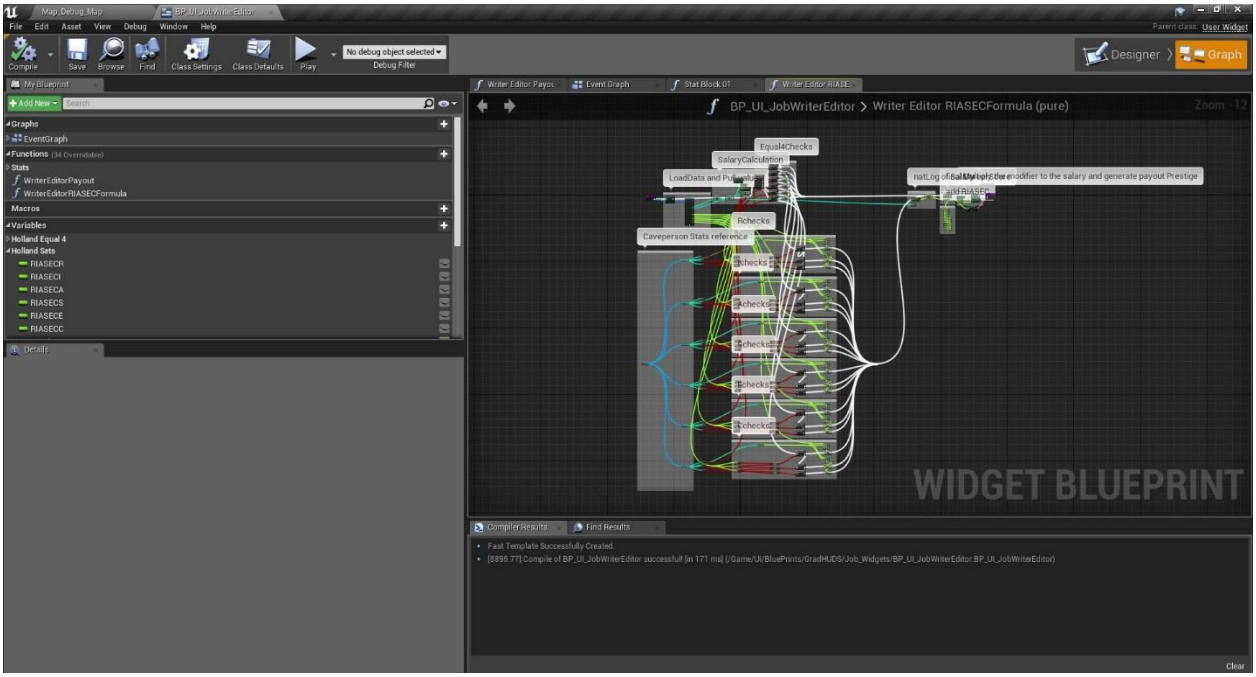


Figure 20 Academia Prehistoria: Currency generation event. Based on GPA, interest score, and job placement.

Figure 21 Academia Prehistoria: Career Choice

The team had roughly a month and a half to redo this system to make it compliant with the client's new request. This lead to a heavy amount of crunch time for the workers to meet with this new goal post, as well as polishing the tutorial to make it more user friendly. The week before the end time of the project, a student was brought on to assist the artist in making assets for the tutorial and re-imagining it for the sake of making the tutorial more robust.

Below is an example of how they implemented this tutorial through a sort of mock intractable slideshow all done inside of the game. Laying out the instructions and detailing the movements that they would need to emulate assisted in user understanding of the tutorial and helped resolve issues in previous tutorial versions. Most issues from previous versions of the tutorial arose out of missed queues from the system and multiple entries of the tutorial being entered.

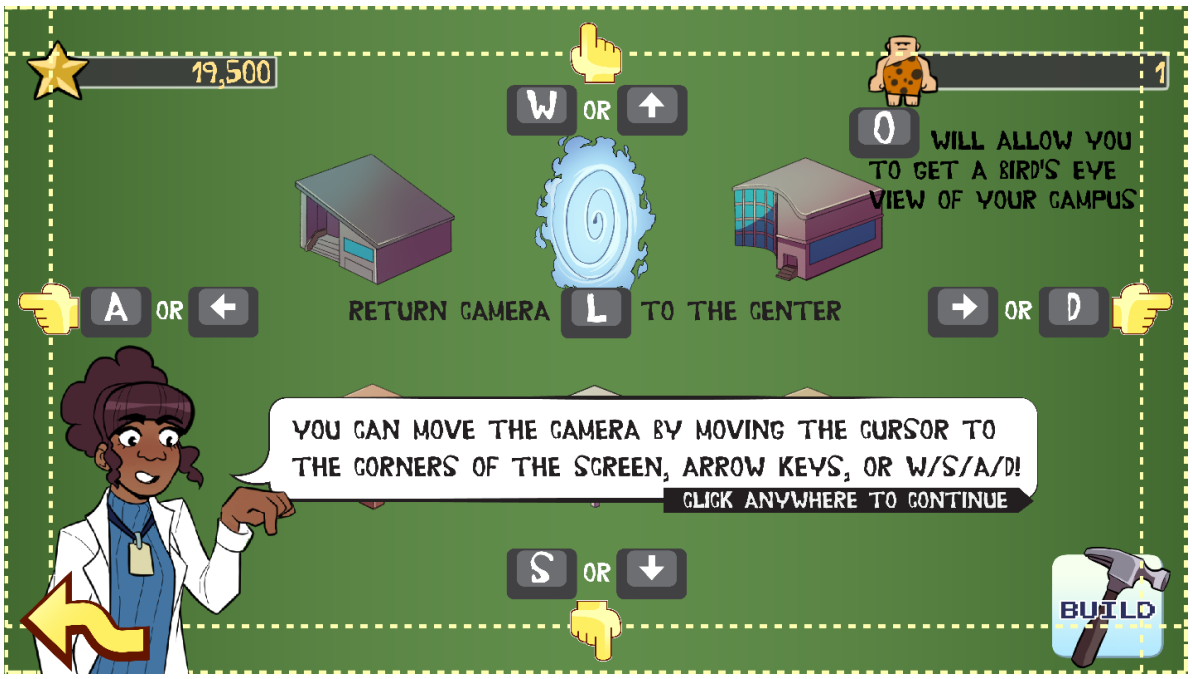


Figure 22 Academia Prehistoria: Tutorial on movement

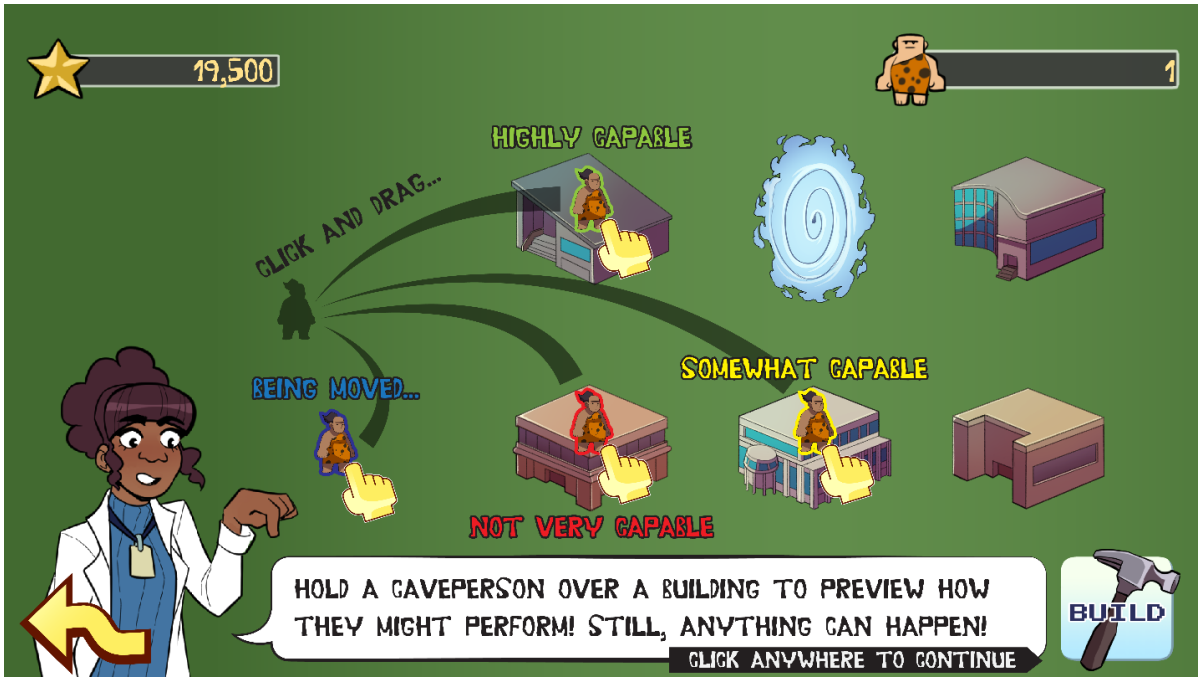


Figure 23 Academia Prehistoria: Tutorial on information halo, the back button enabled the user to revisit information.

Alongside this student, the programmer was fixing the major bugs that had been present in the final version of the game. The team had met their deadline.

When looking at the opinion data collected from the two questionnaires passed out at the seminar, overall there appears to be a high interest in using the game. When looking at the larger group's results there was a 4.3864 mean at ±0.6547 which keeps the teachers within an interested range. Within the smaller group, the group was almost split between thinking the game looked fun and not. But in contrast to this, a larger number appears to think that the game would be fun to the students. Likely when it comes down to the affinity for the game it may be a case of personal interest.

If the teachers are not really into games or just not into tycoon types, that could explain the difference in their numbers for the smaller group. Another comparison within their perceived affinity for the game is how they view the aesthetics of it. The results of the Fisher's test seem to show that there is a difference between the two groups. Drawing upon this can imply that while someone may enjoy the look of the experience or game, it does not necessarily mean that they will think it is fun themselves.

Moving on into utility of the game itself, the larger group had a mean of 4.1136 ±0.6912, which would imply that they do see a use for this game within their classroom if they are able to install it to their machines. In diving deeper, roughly half, 52%, of the user base stated that they would expect an extensive use of the game within their classroom. Another 36% stated that they would expect at least moderate use within the classroom in tandem to the curriculum. So, the users obviously want to give the game a try, but some may be restricted in doing so.

In looking at the smaller group, two users reported that it would be unlikely that they would be able to use the software due to their local IT helpdesk. With helpdesks keeping a lock on their devices, the need to convince the local IT that the software is safe is paramount for educational games. Another method that could be explored would be to implement the game within an HTML5 web space, this would allow them to just run the game in a web browser and not have to worry about appealing to their local IT. The downside being that developer and client would need to define who would be hosting the game, which can bring further questions on compensation of the host.

All in all, these talks need to happen at the creation of the contract between developer and client. Another thing that needs discussion is the importance of data to the teachers. The teachers in the larger group were reporting how much they valued the data that was being showed to them from within the optional feedback section. This makes sense as when these teachers are trying to

pick out an educational game, they want to make sure the information reaching their students is important.

If the information is wrong or conveyed in a confusing manner, then the students are not going to get the information they need to succeed in their coursework.

5.3 Recommendations

During the development of educational games, it becomes paramount to make certain that the game that is being developed is clear, quick, and correct. Data provided through the game needs to be presented well and the data given to the team needs to be correct and complete as soon as possible. Part of the pitfalls that happened during development of Academia Prehistoria involved inconsistent communication between the development team and the data team. For example, if the development team begins work on a feature or display the feature in a certain way, and the data team makes a tweak to the formula, or alters the data by adding a column, or updates the numbers in the data it can cause a major overhaul to be required for the game's systems.

So, a finalized dataset and formula as early as possible and one that is agreed upon by both client and developer is a must. Another item recommended is making certain that any change in scope is planned for within the development contract. If the data needs to change or be updated with examples from above, then it is very likely that the scope of the game or development time needed to complete the game may need to change. If the final goal keeps changing, then the likelihood that the game will be complete becomes diminished.

A set schedule and contract such as with the Purdue Envision Center and its clients can help to mitigate sunken costs and crunch issues that may face the team especially if students are involved. It helps as a barrier against a client making drastic changes to architecture and expecting the same deadline to be met. It also helps the development team to set an expectation as to when they will receive the data and how much time they will have to dedicate to core systems that rely on that data. It gives some accountability to the client and the ability to bring some backing to the developer's claims.

Constant communication is key for a game development team, especially if the team is working from different regions and unable to meet in person. Communications tools such as Skype and Slack were in heavy use for meetings or to just touch base on development. Alongside

these programs, Visual Studio Team Services' repository service was utilized to keep track of what files were updated and in what way. Comments tended to detail what nodes were updated in the blueprints or what links had changed in in related blueprints.

If a team is working in a purely coding sense, then tracking changes like this and branching can be a simpler process. But when the engine in question bases its files on binaries that are programmed through nodes and links, then you must be careful and back up or branch where you can, as you risk overwriting a file completely and undoing work from a previous commit.

Overall, teachers care about the data they receive with a game as it pertains to their coursework first and everything else second. So, if the information presented is accurate and backed up by up-to-date information they are going to be happy. If the presentation is too complex or abstracted, then the teacher will have concerns if the students will even understand the lessons being taught. The material of the game needs to supplement the material presented, not overshadow it.

Proper scoping is important in this regard, features such as remediation were wanted in the final game, but timing and lack of data resulted in it being cut. The main items of the data such as career preference statistics and GPA rewards were more important to the overall goal of career planning in high school through college. To this end, paper prototyping becomes a very useful tool as one can change the rules of a paper prototype quickly or on the fly as needs dictate. This is something that can happen much faster in a paper prototype than reprogramming an entire system.

Paper prototypes are also things that can be produced cheaply and by fewer people than a video game implementation. They enable a designer to better inform developers on what needs to be in the game and what features work without bugs or glitches in the game getting in the way.

APPENDIX A. SURVEYS

Survey 1 – Small Group

Q3 - I liked the look of the game

	High				Low	
Agree	1	2	3	4	5	Disagree

Q4 - The game looks fun for my students

	High				Low	
Agree	1	2	3	4	5	Disagree

Q5 - The game looks fun for me

	High				Low	
Agree	1	2	3	4	5	Disagree

Q6 - I believe my students will learn from this game

	High				Low	
Agree	1	2	3	4	5	Disagree

Q7 - I believe this game will be a valuable contribution toward students' career planning

	High				Low	
Agree	1	2	3	4	5	Disagree

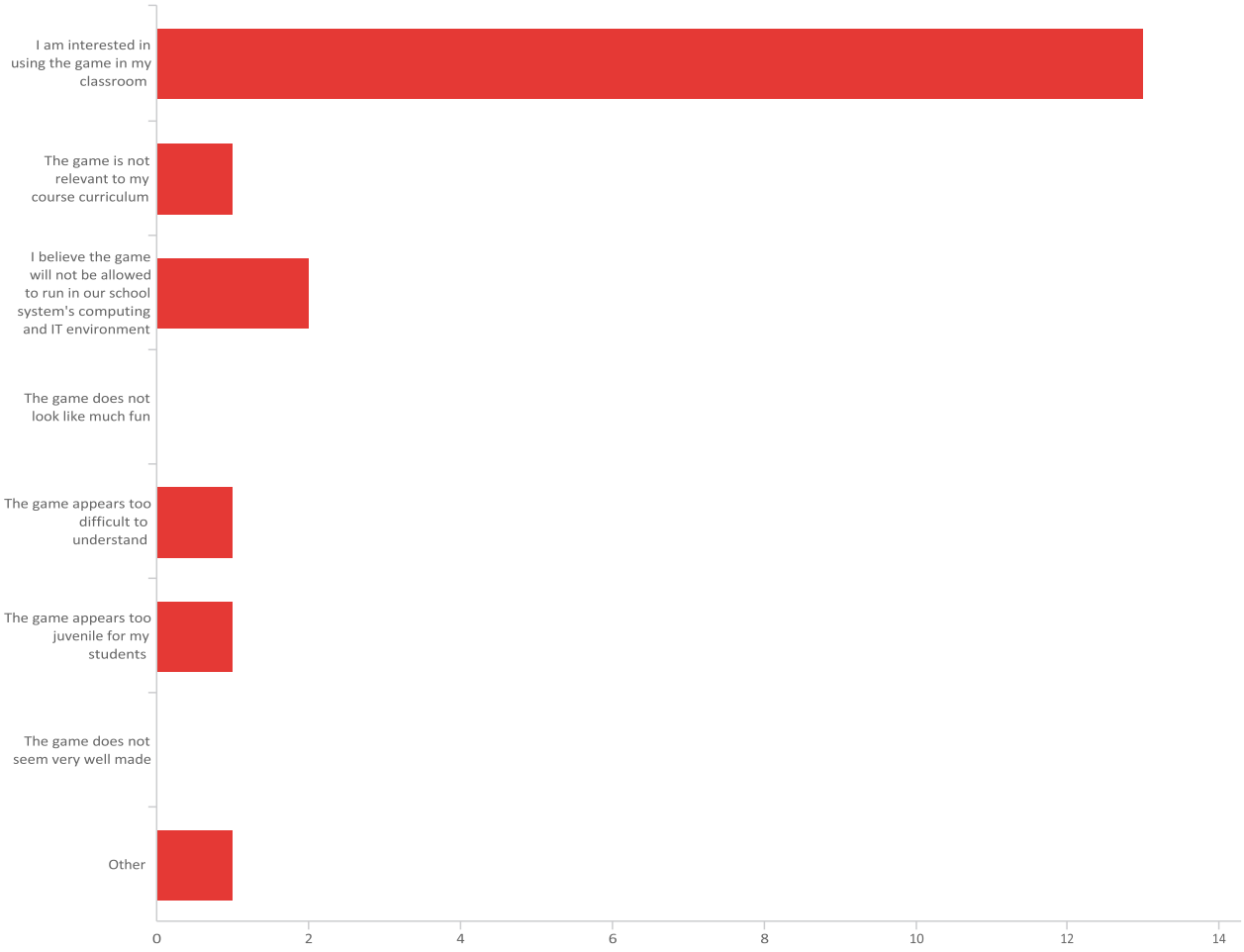
Q8 - I believe this game's learning objectives are appropriate and relevant for student career planning

	High				Low	
Agree	1	2	3	4	5	Disagree

Q9 - I am interested in using this in my own classroom

	High				Low	
Agree	1	2	3	4	5	Disagree

Q10 - If you are NOT interested in using the game in your classroom please indicate why below. If you ARE interested in using the game, please select the first option.



Q11 - Please share any thoughts, feelings, criticisms, and suggestions you would like to share regarding the game.

Survey 2 – Large Group

1. **Please evaluate Session 1, Holland Interest Codes in terms of the following:**

RATING

	Low				High
A. Interest	1	2	3	4	5
B. Usefulness to you	1	2	3	4	5
C. Presentation	1	2	3	4	5

2. **Please evaluate Sessions 2 and 3, Visualization Tool:**

	Low				High
A. Interest	1	2	3	4	5
B. Usefulness to you	1	2	3	4	5
C. Presentation	1	2	3	4	5

3. **Please rate Session 4, Demonstration of Game:**

	Low				High
A. Interest	1	2	3	4	5
B. Usefulness to you	1	2	3	4	5
C. Presentation	1	2	3	4	5

COMMENTS

A. What has been most useful to you about this workshop? Why?

B. How could the workshop be improved?

C. To what extent do you plan to implement the Holland Code Curriculum?

Extensively Moderately Slightly Not Sure

D. To what extent do you expect to implement the Data Visualization Tool?

Extensively Moderately Slightly Not Sure

E. What is your opinion of the length of time for the workshop?

Too Short Just Right Too Long

F. Is there anything else you'd like to add? Your feedback is very important to us.

APPENDIX B. FORMS

RESEARCH PARTICIPANT INFORMATION SHEET (Students)
A Serious Game for Career Education and Exploration

Dr. David M. Whittinghill, Principal Investigator
Computer Graphics Technology
Purdue University

What is the purpose of this study?

This study will investigate the usability of a serious game that was developed to help students select a major that fits their skills, values, and interests. Students and teachers beliefs and perceptions about video games are key factors that influence their use of this technology. Therefore, the aim of this study is to test the usability of a serious game that was developed to help students find the right major that meets their personal and academic goals and interests, and leads to a satisfying career.

What will I do if I choose to be in this study?

During the session, you will be asked to play an educational game, and think aloud to provide statements on what you are thinking while playing the game. Your answers/feedback will be recorded. The testing session will be videotaped just to record your input/interactions while you are playing the game. The videos will be used to help us accurately transcribe your responses, and improve the usability of the game. Your face will not be recorded, so you will not be identified. You will complete a survey after playing the educational game in order to determine your attitude towards the usability of the game.

How long will I be in the study?

The surveys will have a duration of approximately 10 minutes each.
The gameplay will have a duration of approximately 40 minutes.

What are the possible risks or discomforts?

There are only minimal risks associated with this study. The standard for minimal risk is that which is found in everyday life. However, breach of confidentiality is a risk associated with research. We have taken the following measures to protect and maintain your confidentiality: assigning a code instead of names to the data collected during the study and locking any research records in an office where only the investigators have access.

Are there any potential benefits?

There are no direct benefits for participating in this research study.

Will I receive payment or other incentive?

You will not receive any incentives for your participation.

Will information about me and my participation be kept confidential?

Yes, your participation will be kept confidential. No one outside the research team will have access to the information collected during the duration of this study. Data will be anonymized and only the investigators will have access to the data. Random number identities and pseudonyms will be assigned to keep the data confidential. Participants will not be identified by name in any report of any research reports in connection with any type of data connected with this study. All research records will be kept on campus in the locked office of the Principal Investigator.

Who can I contact if I have questions about the study?

If you have questions, comments or concerns about this research project, you can talk to one of the researchers. Please contact Dr. David Whittinghill, principal investigator at dmwhittinghill@purdue.edu or you might call him at 765-494-1353.

If you have questions about your rights while taking part in the study or have concerns about the treatment of research participants, please call the Human Research Protection Program at (765) 494-5942, email (irb@purdue.edu)or write to:

Human Research Protection Program - Purdue University
Ernest C. Young Hall, Room 1032
155 Grant St.,
West Lafayette, IN 47907-2114

RESEARCH PARTICIPANT CONSENT FORM

A Serious Game for Career Education and Exploration

Dr. David M. Whittinghill, Principal Investigator
Computer Graphics Technology
Purdue University

What is the purpose of this study?

This study will investigate the usability of a serious game that was developed to help students select a major that fits their skills, values, and interests. Students and teachers beliefs and perceptions about video games are key factors that influence their use of this technology. Therefore, the aim of this study is to test the usability of a serious game that was developed to help students find the right major that meets their personal and academic goals and interests, and leads to a satisfying career.

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to keep the data confidential. You will not be identified by name in any report of any research reports in connection with any type of data connected with this study. All research records will be kept on campus in the locked office of the Principal Investigator. Signed consent forms will be kept in a separate location from the research data, and will be kept for 3 year once the study is closed.

Who can I contact if I have questions about the study?

If you have questions, comments or concerns about this research project, you can talk to one of the researchers. Please contact Dr. David Whittinghill, principal investigator at dmwhittinghill@purdue.edu or you might call him at 765-494-1353.

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Human Research Protection Program - Purdue University
Ernest C. Young Hall, Room 1032
155 S. Grant St.,
West Lafayette, IN 47907-2114

Documentation of Informed Consent

If you wish to participate in this study, please sign the form below. A signature will indicate agreement to participate. Your participation is voluntary and you can withdraw from the study at any time without penalty.

Participant's Name: (Print) _____

Signature _____ (Date) _____

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