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Role Playing Gamification in the Science Classroom

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by

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To my wife, Amanda, who is never in another castle.

"Why do we tell stories? To try to make sense of a world that can be terrifying and enormous . . . I don't know that your story will long be known. I don't know who will remain to tell it. But it did happen, and it did matter."

Brennan Lee Mulligan

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CHAPTER ONE

Dungeons and Dragons was introduced to me in college, during my freshman year. I was playing with a combination of several friends from high school and people who I had just met, and all of us were focused on telling a good story in the mode of this game. We eventually come to the final boss of the story's arc, and I was able to, through good dice roles and player positioning, take the last few health points off of the boss, ending the danger to the town and to us. I simply remember the dungeon master (DM) saying to me, *"Explain how you kill your enemy,"* allowing me to add some flavor to the end of this arc's story. It was amazing to me that all of the things I said, everybody at the table accepted that they happened, without any questions or comments. After this game, I was hooked. I have loved tabletop role playing games ever since.

At around the same time, my friends and I were in an organic chemistry class—CHEM 1051, one of the "weeder" classes for chemistry majors—and we had an organic lab at the same time. Many in my friend group and our lab partners stayed up far too late before tests trying to understand the concepts our professor was lecturing us about that unit. However, it was very rare to hear about anybody staying late to work on the labs. We were performing classic organic lab activities—synthesizing luminol, distillation of different alcohols, and crystallization—and strangely, very few of us had trouble with understanding anything in the lab. I believe this is due to the investigative role playing that naturally happens in a science lab.

Magic: the Gathering is a card game invented in 1993 by Ph.D. student Richard Garfield, which has a library of 25,000 unique cards, and has been shown to be Turing complete, or able to operate like a basic computer (Churchill et al., 2019). I stopped playing two years before the COVID pandemic began because most of my friend group, who I played with, moved away; the

ones who stayed, all had kids and very little time for enjoyable pastimes. I picked it up again this year, just a couple of weeks ago, primarily because of the Lord of the Rings set of cards that was coming out at the end of June 2023. Despite the complexity of the cards and the game, I was able to easily and simply move back into the mindset of a Magic player, even after five years of not touching anything about the game.

We see this again and again, in all modes and ways of life, with all different types of games. Children have been shown to undertake "observational learning" when trying to understand how the world around them works (Rymanowicz, 2015). Games are one of the first ways that young children are shown how to take turns—if you can't wait, you can't play! Waiting is the simplest, as well as the hardest, way to experience a game, and it is integral to the game actually being played to its completion. Many children learn how to take turns from playing games, and this is a valid form of educational gains that all children need to make before they reach adulthood.

In addition, we can see the level of accessibility, or ability to play despite control issues, given to video games. From Stabley, 2023:

> It used to be rare to have settings to adjust anything beyond volume control. Options for subtitles, the ability to completely remap the controller or change the game's brightness were scarce. But now mainstream developers are leveling up – increasingly considering accessibility when designing their games, whether to accommodate a visual impairment, a motor control issue or an anxiety disorder (para. 2).

These levels of accessibility have enabled many differently abled people to enjoy the benefits of video gaming. The fact that they still wish to take part in this pastime - even after

over 20 years of being looked over as video game designers created the games that did not cater to them - shows that the act of playing a game is powerful and comes naturally to many of us.

It is this, then, that I wish to work toward unlocking inside of education. To many students, parents, and teachers, gaming and school are separate things. To my mother, I always had to make sure all of my schoolwork was done before I even thought about turning on my game. I have no doubt that to my students, when they think about the homework that they receive from their teachers, the word "game" does not even enter into their thought processes. This has led to my burning question that I would like this capstone to revolve around—*how can science teachers use the game design elements of role playing games to motivate high school students towards higher level engagement?*

Background

Since my first Dungeons and Dragons game, I have been both a player and the creator of the world (a Dungeon Master, (DM)). Both of these positions have developed new ways of thinking about how to help people have fun while playing with me or at my games, and have polished new methods of how to talk to players and achieve what everybody at a Dungeons and Dragons table wants—a satisfying story.

Being a player at a table doesn't simply mean reacting to what your DM does. A good player is always looking for points in the story they can change and make their own. As a player, you have to be able to assume the role of the storyteller. Dungeon Masters are always *hoping* to be interrupted, hoping for a player to put themselves out there and own a piece of the story. I did not understand this during my first time as a player, but this is an integral part of being in a Dungeons and Dragons game.

As a DM, it is your job to make sure that everyone at the table is enjoying themselves, and you need to walk the very fine line of challenging your players as well as allowing them to shine and tell their stories. In addition to all of these things, you need to be utilizing the game rules and your background knowledge of the world the game is being played in such that nobody feels "taken out" of immersion. This is a tightrope that every DM spends most of their time on with their players, and this is simply the time that you are actively playing the game! There is even more time spent outside of the game developing interesting vignettes and battles, creating non-player characters that the players will meet, and writing the overarching plot of the story. This is the reason that Dungeons and Dragons was so engaging for me; every DM spins all of these plates, and the best ones make the plates seem like they are not really there.

Definitions

I now feel it important to talk about what I define games to be, so that I can expound on this definition in later chapters. Ferdig (2008) defines games to be "a set of voluntary activities which has participants, goals, rules, and some kind of competition, physical or mental" (p. ?Ferdig 2008). Each game needs two or more sides, and they must be opposed in some way to each other. This is apparently seen in classrooms all over the world, especially when we see teachers using apps like Kahoot or EdPuzzle; the students are working against each other to try and get the answer first.

Role playing games are much the same in that they have some common elements that exist for all players. The most important one is that every player is playing the role of someone who is in some way different from them. There are many ways to do this: some players enjoy playing characters who are a different biological sex than they are. Some characters tend to use the backgrounds of characters different from their own - rich, poor, gay, straight, devout,

apathetic, whatever any person in the real world could be, there is a way to create a character in Dungeons and Dragons that mirrors it. I had a good friend in college who stayed quiet in every class and at every social gathering—he enjoyed being at them, he just never had anything to say. When I sat down with him at a Dungeons and Dragons table, he was the most talkative one by far! It is truly possible to make any sort of character you like, and one thing I hope to show in this paper is that it is beneficial for every person at the table to see and interact with these diverse characters and understand what caused them to be.

Context

As I began my student teaching, once the main part of the COVID pandemic had ended, I was placed in front of a high school chemistry class who had spent the entire first semester with my certified teacher and had no idea who I was. In order for me to begin to start understanding who they were and what they brought to my classroom, we played a game. I started by clearing the classroom of desks and making a circle of chairs in the center of the room, all of them facing each other, one less chair than the number of people in the room (me included). I began by standing in the center of the room, and saying "I want to meet someone who. . ." and then saying something true about myself: has one sister, is right-handed, has blue eyes. Everybody for whom that is true then jumps up and runs to find another seat. Many chairs are knocked over and students are left breathless in the process, unless you hit the correct number of audience members who have this similarity; the final rule is you can't sit in the seat you got up from, so if you and exactly one other person share this trait, then you are free to walk into the seat they got up from calmly and without a battle. These are two separate ways of playing this game; you can be chaotic and try to get everybody out of their seats, or you can be a scalpel and try and get one of the other players out of their seat.

Positive Impact of Gamification

I have played this game twice: once with my cohort in pedagogical school at Hamline, and once with my eighth grade students at a charter school in Minneapolis. Both times, it was almost like watching a friendship origin story unfold in front of my eyes. It is my one true wish to have every teacher at a school do this with their students on the first day of the year, and then watch how easy everything becomes. We still had problems during my student teaching, of course. Kids still needed as much help as ever, and the material did not magically get less confusing. However, the ease with which students were able to come to me and say, unapologetically, "I need help with this. I don't get it," because they saw me as a person, as another human being in this world, instead of a discipline giver and somebody who was put on this Earth to tell them that they are wrong—that was a powerful experience.

Elements of Gaming

I learned about this game in my pedagogical classes as a good icebreaker for middle school students, but it turns out that all students need to move their bodies to get the most out of schooling. I believe the game worked well in my classes for three reasons: one, that the students were given leave to move, sometimes very chaotically; two, I took part in the game as well, allowing my students to also learn about me; and three, this game allowed all students to meet each other on the same level, each of them being given the same field and importance to their histories and differences so that they were ready to listen to my teaching later and to understand it.

R**edefining Success and Failure**

The most important thing here is that by using games in educational settings, we are defining two states—a success state and a failure state. I believe, and hope to show in this thesis,

that a failure state in regards to games is taken much more softly and with much more tenacity than, say, getting a failure grade on a test. Schooling does not have to be a win/lose, zero sum game. Whether or not a student gets a good grade or a bad grade on an assignment, they are still learning something if they choose to. When a student gets a failing grade, it is not the same thing as losing a life on a video game. This enables teachers to use those failure states more readily and more effectively than simply failing our students out of their classes. Failure states, or the summation of things you are generally trying to avoid in games (game over, try again, you lose, etc.), can be powerful motivators; the key is making sure that the state is not so evident that it causes a desire to stop trying to understand.

Teaming

When I was in high school, games were used in education much less often, but *Jeopardy!* had been around for many years by that point, and it had already become a favorite for reviewing before tests in school. Our teachers made some adjustments to the games, like allowing us to take turns when answering questions, letting the students be on teams, and not forcing us to answer in the form of a question, but the skeleton of *Jeopardy!* was there, and many students benefited from its usage in school. I have tried to use *Jeopardy!* in class as well, and while very few of my students have heard of the original game show, it has shown benefits as well. There are many websites that allow teachers to create *Jeopardy!* quizzes online for free, and this has enhanced my teaching ability.

Movement and Motivation

The other game in my high school was equally revered. Everybody who played or referred to it simply called it *The Game.* In this game, generally also used for reviewing, our teams would trade off the answerer position, and when a question was asked, each team's

answerer would sprint up to the board and write the answer legibly on the board with a piece of chalk or a whiteboard marker, whatever we had in the classroom. Many, many markers were broken in the process of this game, but the important thing is that everybody was into it. One of the best respondents we had was a student who usually needed the most help with completion of academic goals, but he was good at listening and he was quick. This enabled him to have an edge over smarter, but slower students, and that caused him to become more engaged in the activity we were doing.

Importance of gaming. It is in this way that games can be shown to have importance and weight to everyone, even students who don't get many answers correct in class. This student was always so hyped up for the days when we would play The Game, and every student deserves to be excited about school in some way. The fact that students have developed such animosity towards schooling is a cry for help, especially when it is shown to have such a life changing beneficial effect on the rest of the students' lives.

Rationale

Gaming is a powerful tool in education, and it can be used in science education as well. There are a lot of places in science education that I believe benefit from a love of art, of beauty, of aesthetics. Gaming has all three as a part of it and more, whether that love of art comes from a dungeon master's verbal painting of a scene, a video gamer's optimization of a macro, or a laboratory scientist's discovery of a new law. No other discovery in physics was as beautiful as Newton discovering that a force accelerated what it worked on, and it did so according to its mass. F = ma is a gorgeous, simple, astounding discovery, and its beauty is masked if all we do with it is make students memorize it and take tests using it. Lots of researchers have looked at

gaming inside of educational contexts, and now I hope to show the reasons we have seen more and more "educational games" pop up in the zeitgeist of our classrooms and beyond.

Summary

To return to the beginning, *how can science teachers use game design elements to draw high school students towards learning?* Gaming has been life changing to me and is important in the world of education as well. I have also defined what a game is, as well as the importance of gaming as a part of education and how I believe it can change what students think about learning in general as well as specifically how they interact with their teachers. Gaming is such a large part of my life, and I truly hope that I have at least changed the reader's mind from "what is this doing in a collection of education theses" to "okay, he might have something here."

Future Chapters

In the next chapter, I will go into common throughlines of gamification research. We will begin by talking about exactly what has been found to be useful in schools, and then we will move into both the SEL benefits of gamification in schooling, as well as some of the past problems that the explosion of Dungeons and Dragons has had among society at large. I hope to fully lay out what I have already completed with my students, as well as my plans for expanding the idea of role playing while my students are still in school.

CHAPTER TWO

What Gamification Does

Many, many teachers have dealt with the looming problem of the lack of interest in their classes. To the majority of high school students, school is not a place where they chose to be, and many of them would rather be anywhere else than sitting in science class trying to understand what is in an atom. This causes a great number of problems when we, as teachers, ask them to continue to do the work of learning in our classrooms every day. How can we possibly expect students to synthesize new information, assemble projects or quality papers, or argue a position on a modern topic if they are falling asleep in class? In this portion of the chapter I will go over what researchers and scientists have found so far when it comes to boosting the motivation of students using gamification techniques. *How can science teachers use game design elements of role playing games to motivate high school students towards higher level engagement?*

Types of Gamification

When we talk about gamifying elements of school, what exactly do we mean? Games have evolved in many ways since the start of the arcade craze in the late 1970's. Mechanics and controls have gotten more complicated, relationships and fan bases have developed, and much more of the younger generation plays games every day. When we talk about applying these game elements to education, we can talk about doing so in one or more of three ways: (a) dynamics, (b) mechanics, or (c) components.

Dynamics

Dynamics are the highest cognitive level of game concepts in a system. This categorization contains elements like progression and narrative, fairly high-level pieces of a

game (Dichev and Dicheva, 2017, p.9). When games started out, with *Space Invaders* in 1978, very little dynamics were happening behind the scenes. The idea of progression wasn't there, because of the limited space in the technology at the time, and narrative was neglected for the same reason as well. As games became more technically complicated and gamers were exposed to more of them, dynamics began to take off. Now, with many story elements available, we should be sure to claim some of them if we wish to hold teenagers' attentions (Werbach & Hunter, 2012).

Mechanics

Mechanics are the middle pieces of a game's anatomy; when put together, they can create dynamic changes in how the player experiences the game. They include concepts like "challenges, chance, competition, cooperation, feedback, resource acquisition, [and] rewards" (Dichev & Dicheva, 2017, p.9). Without at least one or two of these, there is no game to be played, but the more of them we have in our gamifying goals, the more inclusion and cohesiveness there should be.

Components

Components are the basic building pieces of a game, and stripped of any context, they generally do not tell you anything about the game's readiness for its use in school. This category contains things like points, avatars, and leaderboards. If there are "levels" in a game, that is another example of a game component. It should be apparent that any game can use any number of components, but when there are no accepted components in a game, it also ceases to be a game, and simply becomes a task—something we are trying to avoid here (Crawford 2003). It is also important to convey how components can assist in the creation of mechanics, which can then assist in the creation of dynamics. As Dichev & Dicheva (2017) say, "points (components)

provide rewards (mechanics) and create a sense of progression (dynamics)" (p. 9). We can create any number of these elements by thoughtfully using the base elements, and therefore can construct an enticing game of our choosing.

Usage of Components with Motivation

Several studies have been done comparing the usage of components of gamification and how well this process helps motivate the users. Hamari looked into the usage of badges, or collectable completion tokens, to understand how much more completely the users used one specific sharing economy service. If you chose to post a trade proposal, accept a transaction, or post a comment, you would get a badge saying that you did that, with different "levels" of badges the more you chose to do these things. Hamari found, over two years, that users were seen to be more likely to use the service once the badges had been implemented. However, as they clearly accentuate, these findings are not simply because of the gamification of the economy, but they have many theoretical mediators that would say the same thing, such as goal-setting (Hamari, 2017, p.476).

Goal-Setting and Leaderboards

Landers, Bauer, and Callan (2008) found a correlation between goal setting and and the presence of leaderboards on a created application where the users were told to list uses for a knife (p. 511). In this study, humans were given a chance to use this app and were placed in one of five categories before starting: either an easy, difficult, or impossible goal condition, a do-your-best condition, or a leaderboard condition. Landers, Bauer and Callan (2008) hypothesized that the leaderboard, consistently updated with points during the trials, would function similarly to a difficult goal, due to the users' brains trying to make it to the top. This

was exactly what they found in the study—the users of the app saw using a leaderboard as a difficult goal, and their performance reflected that (p. 512).

Limitations. Some of the problems with this study were the simplistic nature of what the researchers asked the participants to do—the gamification of brainstorming, while an important type of scientific endeavor, may not extend to other scientific tasks, like the process of elimination (p. 513). Also, it is important to note that it was specifically unclear which goals the leaderboard presented that its users followed in order to score so high on the completion criteria. As Landers, Bauer, and Callan (2008) say, "participants may have targeted the lowest level and then revised their goal up progressively as their performance improved," or "participants may have ignored the leaderboard until they had performed to a particular level, only paying attention to it once they were aware of approximately where they would score" (p. 513). I feel that this particular limitation is less important to my field of study because my goal is to bring the interest in a class up from basically zero, and any amount of additional attention paid to class material or my teaching would count as a win for me.

Usage in Biotechnology Education

Since gamifying educational goals is so nascent, it makes sense that the majority of studies on what kinds of things happen are done in the realms closest to most people's ideas of what games are, i.e. computer science and cybersecurity classes. This has been the same when looking for reasonable games to teach in any of the classes I offer—in physics and chemistry, the choices for games are a lot slimmer than in my computer classes. However, in biotechnology education, Bonde et al. (2014) found a fantastic example of laboratory simulations being gamified to express help to the lower level students in a number of US and Danish high schools.

In these studies, two laboratory exercise games were tested by Bonde et al. (2014)—a crime scene lab and a genetic engineering lab. These two exercises were added to using several different classical game theories, like story points, conversations with fictional characters, and a scoring system intent on informing the users how well they performed in their class as well as across the world (p. 695). They found, in their qualitative study, that

> [a] high level of motivation was measured, as 97% of 149 students found it interesting to use the simulation; 86% indicated that the laboratory simulation was more interesting compared with ordinary exercises; and 97% felt that the course content was more interesting when working with gamified simulations. (p. 695).

As well, the actual learning outcomes were measured with the test as well as without the test, to check to see if the gamified version of learning about the crime scene lab taught the same things that a nongamified version of the teaching taught students. They gave everybody a pretest, and the divided a class into two groups—one group received a traditional lecture and group activity, and the other group utilized the simulation activity. Students were then administered a mid test with the same questions as the pretest, and then in the second lesson, they then reversed the groupings, giving the first group the simulation instead. Students were then post tested once after the second lesson had finished as well as 40 days in the future (Bonde et al., 2014, p. 696).

The researchers found that all students' scores went up by more when they used the Labster simulation than when they received a lecture, to the amount of a 76% higher score. However, the important thing to take away from this is that after both ways of teaching the class had completed, all students scores were higher than they had been either at the beginning or during the mid test, suggesting that a combination of these two teaching methods is the best for most students (Bonde et al., 2014, p. 696).

It certainly seems that gamified classroom goals, as well as gamified assignments in the biotechnology sector, have much to say when it comes to the interest of students as well as how much they learned in class. I would like to turn now to some of the other outcomes that researchers have found common when looking at gamification of various schoolwork tasks.

Outcomes of Gamification

When looking at gamification of educational criteria or goals, we can group the outcome of adding game elements to an educational task, much like how Dichev & Dicheva (2017) did. They chose to group these games into four categories based on the nature of help the gamification gave the task: (A) affective, (B) behavioral, (C) cognitive, and others, or miscellaneous. Under this category, many different game elements fall into two separate categories, so the classifications were extended to binary groupings, i.e. studies were looked at that had a B + C grouping, or A + B. The previous study, Bonde et al. (2014), was one of those studies that had both an affective and a cognitive—A + C—component. This study was affective because it had a mood or motivational component, stating that the students tested had more motivation to complete their assignments, and it was cognitive because it had an effect on the learning outcomes of the students tested—all of them did better with the simulation as a part of their learning.

A number of studies with one classification (A, B, or C) were looked at, as well as a smaller number of studies with two classifications (A+B, B+C, etc.). The main thing that Dichev & Dicheva (2017) found was that the greatest number of studies that they looked at were inconclusive for one reason or another (p. 22), from problems like multiple variables to short study times to small sample sizes. Indeed, it seems that with 62% of studies having inconclusive findings, there is no way to definitively state that gamification works, but they state in their

conclusion that this "does not mean though that gamification cannot be used with success in a learning context" (p. 26). It simply means that more tests should be done to prove that gamification works well with the majority of students—especially those students who already have a relationship with games and can pick up on their shorthand.

Conclusion

We have looked at several methods that we can use to gamify our studies, like leaderboards and badges. More examples of gamification exist, having to do with ideas like points, competition, stories, and virtual goods, but those are still in question as to how well they act positively on students' mindsets and motivations. I have placed the best examples in this text to prove that this is a worthwhile venture. We have, as well, looked at the different outcomes of gamification on motivations and learning outcomes, and have shown that while there is still a lot to learn about what makes students want to complete their schoolwork, having gamified lessons is wholly better for students than subjecting them to endless lectures and group projects that they could take or leave. Next, we can examine the benefits of gamification from a slightly softer side; social emotional learning (SEL) has much to say about the headspace that science students find themselves in, and we can benefit them a lot more with gamifying the work that they have to do as well.

Role Playing Games and SEL

While role playing games and the players playing them have often been the archpiece of jokes saying that this pastime is lazy, unimportant, or actively blocking good mental health, the truth is that role playing helps build soft skills commonly absent in lots of modern schooling. Role playing can help players develop the skills of collaboration, cooperation, and problem solving—as well as provide judgement skills and time management abilities to those who know how to play them best (ManPowerGroup, 2023, p.4). Manpower Group (2023) is a workforce solutions company, and has gotten in on the ground floor of gaming and how it can help its players achieve in the workforce, as well as in schools. “Gaming fosters the skill of continuous learning—and this ability to adapt one’s skill set is increasingly critical as people adjust to the ever-changing landscape of work” (Manpower Group, 2023, p.6). As teachers, we are always working at building these skills in our students.

However, my anecdotal evidence of the soft skills and SEL training done in school is done in writing intensive classes and college or career courses, instead of being done in scientific thinking or science based classes. I would like to begin this section of the literature review by going over some of the changes in science education that take away from data and observation to display the importance of SEL education specifically—as well as the ways in which I feel like role playing and game design can further enhance and guide these methods of learning.

Transversal Competences

In the European Union, 21st century competencies have been developed that adequately allow students to have a better chance to take part in our rapidly changing world. In Finland, these competences are called transversal competences, and Thuneberg et al. (2022) has said that they “are stated to form an entity of knowledge, skills, values, attitudes, and will” (p. 442). These

attitudes towards learning are hoped to give all of their students an edge over their peers who did not take part in Finnish education, and though there are seven of them, several of them have direct relation to the types of learning we would hope to see in role playing groups.

Thinking and Learning to Learn

T1, or thinking and learning to learn, encompasses problem solving, critical evaluation, and observation (Thuneberg, 2022, p. 442) This is inevitably one of the first things you learn in a role playing game with the correct dungeon master (DM)—the DM cannot lie to you, but they are not there to make your game easy and they generally do not tell you much more than you need to know at any given moment. This is both for your benefit as well as the table's—as much as you would like to know the presence of all enemy groups, everywhere, forever; this is not a fun nor a valid request at a Dungeons and Dragons table. The DM is making you use all of your skills and abilities—like problem solving, reasoning, and observation—to help you overcome the obstacles put in front of you. Evaluating and managing your own abilities and learning is an essential part of DMing, and it is also an essential part of this first transversal competence (Thuneberg et al., 2022, p. 442).

Taking Care of Oneself and Managing Daily Life

T3, or taking care of oneself and managing daily life, is an important set of soft skills that teach students how to best navigate modern life. It can range from informing students about the finer points of public transportation to showing them how adults complete their tax forms and balance their checkbooks. It can even teach them how to be a critical consumer—one of the most important skills in this age of excess (Thuneberg et al., 2022, p. 443). While most DMs stray from the actual rules as written while parties are out adventuring, and thereby ignore rations, carry weight, and more of the tedious portions of the game, some groups feel this is a necessary

part of planning and removing it removes choice from the player. Some groups have even developed rules to remove the dull parts of adventuring and "homebrewed" rules to give the players back some choice, but keep the pressure on the players there as well (Rhea, 2009).

Participation, Involvement and Building a Sustainable Future

Finally, T7 is a set of skills that push students to begin the process of owning what they learn and using it in the real world. The high school teachers at Cyber Village Academy would agree that the majority of their students need to participate more in class and involve themselves with many more clubs and activities both in and out of their school. This also bleeds into social science, because we are really teaching students to be more active citizens—this skill "develops with others and only through practice" (Thuneberg et al., 2022, p. 443). This links into Dungeons and Dragons because when you play, if you are not talking and narrating what your character is doing, then your character is by default doing nothing. It is necessary to put yourself into every DnD game you play, or you are necessarily wasting everyone's time.

Learning Through Doing and the Nature of Science

As I went through pedagogical studies to become a teacher, we were taught that the lecture, teacher centered method of teaching was far worse than the inquiry focused, student centered method of teaching. This directly relates to the nature of science, because it turns out that the best way to understand how a scientist thinks is by doing science—through testing and making sure that the data backs up your conjectures. Eren-Sisman and Koseoglu (2019) talk about how to model this for secondary students, through the creation of a "magic flask, which is kind of a black box activity" (p. 108). I have done something similar to this activity, where my students watch me pull ropes through an opaque tube, and then—most importantly—we talk about *what* we thought happened in the experiment and *why* we thought that initially. This is how

SEL is incorporated into this lesson, generally done early on in the year—we run an academic circle, with a talking piece, listening before talking, and making sure that all of us are both speaking and listening from the heart (First Nations Pedagogy Online, 2023). This shows our students how to talk to each other, and then eventually, when there is a communication breakdown, we show them how to repair the bridge also.

The reason this teaching method is included here is because I argue that this method of inquiry is, in and of itself, role playing. The students are role playing as themselves, but the game is in the aspect of thinking about something that is normally invisible to them—in this case, the nature of science and why they think the way that they do. This method of teaching removes the main barrier to learning—the embarrassment of being wrong. Because everybody in class is *pretending to be* a scientist, the actual science comes to them easier.

Context of Nature of Science

This is incredibly important to show students who are coming of age today because of how our society interacts with science and technology. As Carl Sagan said in his final interview with Charlie Rose (as cited in Rose, 2012), “Science is more than a body of knowledge, it’s a way of thinking. A way of skeptically interrogating the universe with a fine understanding of human fallibility. If we are not able to…be skeptical of those in authority, then we’re up for grabs” (c. This is an important point to teach to middle and high schoolers because it is at this point in their lives where they will begin to be lied to about life—where they will begin to be enticed by YouTube video ads or their friends who don’t know any better. In the most severe of cases, they will begin to be lied to by their parents. It is our job as teachers to prepare our students for the life that awaits them outside of our school, and teaching our students about how to think like a scientist is the best way that I have to prepare them for life.

Other Types of Role Playing To Learn

There are more examples of this "role playing without role playing" in evidence today. Fioravanti et al. (2022) have a lengthy example of role playing to teach students about entrepreneurship—the portion of a computer course that involved the soft skills of communication and problem-solving (p. 384). In this course, four different role playing games are involved:

1. A business model development game, where the students are divided into groups and tasked with brainstorming sessions and coming up with a minimum viable product and a business plan (Fioravanti et al, 2022, p. 387).
2. Communication skills games, where the students were learning how to talk to potential investors and asked to sell unusual products, like "a disposable baby bottle, a plot of land on Mars, and so forth (Fioravanti et al, 2022, p. 387).
3. A negotiation workshop, where the students were taught negotiation skills and asked to perform a faux negotiation, based on two pharmaceutical companies negotiating usage of the gabi fruit, a rare fruit found only in the Amazon (Fioravanti et al, 2022, p. 387).
4. A final pitch, a 20 minute display of their business models based on SharkTankEDU, a role playing game based off of *Shark Tank,* a business reality television series (Fioravanti et al, 2022, p. 387).

This final role playing game was further modified through giving each student group $1,000 dollars which they were told to give to any business model except their own, in order to work against the passivity of the viewers during the model showcase. Many students came up with interesting business ideas, such as a virtual laundry platform, where people who wish to wash their clothes are linked with those who have room and are willing to have laundry done at their

house; as well as a group shipping cost platform, where users can split shipping costs among themselves and others who wish to have the same item shipped in their area (p. 388).

The most important part of this game is that these role playing games were able to cause the students to reflect on the knowledge of the world around them, and further ingrain the newly learned negotiation and communication skills they learned in the class for use with their projects (Fioravanti et al., 2022, p. 389). This imagining of business models and how they work in the real world is the quintessence of "role playing without role playing," where the students are asked to envision themselves as businesspeople, and asked what they would do when faced with the real issues that modern day businesspeople have to deal with all the time. Risk taking, teamwork, and creativity are very important once you leave college, and this set of games gave away key ideas and takeaways in spades for each student (Fioravanti et al, 2022, p. 387-389).

Mixed Reality, Augmented Reality, and the Usage in Schools

This is further seen in the work done by Zikas et al. (2016) where mixed reality is looked at in a game set in the palace of Knossos, an archaeological site in modern day Heraklion on the northern coast of Crete (p. 805). In this mobile virtual reality game, visitors to Knossos are greeted by an archaeologist and asked to find five lost artifacts, which takes them around the archaeological site and to several important discoveries made by real people in the palace (p. 806). This is an example of an MSRG (Mixed Reality Serious Games and Gamification), which teaches the viewers about the Greek mythology present in the area of Knossos. Specifically, the viewers learn about the Labyrinth of Knossos, Daedalus and Icarus, Mount Ida, and Theseus, the killer of the minotaur from the labyrinth (Zikas et al, 2016, p. 807).

> The feeling of presence in a VR game can enrich the learning elements as [the] user will perform tasks in a digital environment very similar to the real world. By creating this

> experience, the learning ability of a game have a greater effect on user as the gameplay stimulates the brain the exact way it is done in real life conditions (p. 809).

While this game does not specifically talk about soft skills or SEL, the act of learning about the existence of Knossos and the actual presence of archaeological pieces in the real world is an example of learning through doing, and fits with the previous point of envisioning how the original finders of Knossos began to understand the ancient people of Crete and how they lived their lives. With primary school students, whom this game was created for, this is a valid and esteemed way to enhance their enthusiasm for learning about archaeology and history.

Conclusion

In this chapter, I have opened up the idea of role playing and games into something that we can use in schools in order to help awaken the learning possibilities in students. The idea that role playing can be simply *you* in a new place with a job to do is not so wild when you have been playing video games for your entire life and you can slip into somebody else's skin easily, but I can understand how for most people, this is a brand new idea. I believe that this is the reason behind the CER push in science classes—by making a claim, and then backing it up with evidence and reasoning, you actually are role playing as a budding scientist. We all have the desire to show students that they can and will be doing the new work that they are reading about in our classes, and this is a perfect way to show this to them.

Drawbacks to Role Playing

As it is with everything, there are some who believe that role playing is evil or not good, and would have major problems with the idea that it can help you to learn science more efficiently and easily. For my final topic of this chapter, I wanted to move into how this "Satanic panic" came to be, and also look at the reasons I believe it isn't true—role playing and the idea

of becoming somebody else is a positive thing for everybody to do. I have shown here that it can be good for social emotional learning, but next I want to show that it can be helpful for everybody at the table to see and do.4

Satanic Panic

Dungeons and Dragons (DnD) was invented in 1972 by Gygax and Arneson. DnD's publication is widely regarded as the beginning of modern role playing games and the role playing game industry (Michaud, 2015, para. 2)—in years since, there have been many more role playing games printed and many more rulesets developed, but DnD and the d20 (the type of dice most commonly used to decide what happens in a game) started it all off (Gygax, 1980). The game began as a very limited budget release: the budget was only $2000 and the rulebooks created assumed that the reader was familiar with past wargames, but by ten years later, the game had more than three million players around the world (Michaud, 2015).

Negative Effects

However, with this popularity, there came negative attention as well. There were parents who had trouble understanding why their children would *pretend* to go outside instead of actually going outside. Add to this the several horror stories that originated in 1979 and 1980 about DnD, and you will begin to see why nonplayers started to view this game in a negative light - two of them, Pulling and Radecki, started an organization called B.A.D.D. (Bothered About Dungeons and Dragons) with several close links to Christian fundamentalist groups (Waldron, 2005. Para. 6).

The Steam Tunnel Case. In 1979, James Dallas Egbert III went missing from MSU. Egbert was a child prodigy, and he had joined MSU as a computer science major his final year of high school. Brownfield (2019) writes, "He was a fan of science fiction, fantasy, and Dungeons

and Dragons". His parents, worried about him, hired a private investigator, William Dear, to try and find their son. Dear, after some sleuthing, found a hiding place in the steam tunnels under MSU that held clues that Egbert had been there, and reported to the media that he thought Egbert had been live action role playing a game of DnD down there with his friends. Reporters jumped on this immediately, and DnD was determined by the court of public opinion to be the reason that Egbert went MIA. Egbert was eventually found and returned to his uncle, and stated that the reason he disappeared was pressure from his parents and his school, not any gaming avocations he enjoyed. This point was lost on the media (Brownfield, 2019).

Irving Pulling's Suicide. Likewise, Irving Pulling II killed himself the day before final exams in June of 1982. Pulling took an "unusually keen interest in wars, science fiction and the popular fantasy game called 'Dungeons & Dragons'". After finding his Dungeons and Dragons paraphernalia-filled room, deputies said he left a suicide note with "unexplainable-type things" (Isikoff, 1983) inside of it. Pulling's parents even went as far as to sue the school principal, charging that he was responsible for Pulling's death by allowing *Dungeons & Dragons* to be played as an organized school activity. With both of these stories coming out within a few years of each other, and the onset of B.A.D.D. pushing their worldview into the public eye, it is no surprise that some parents have questioned the validity of this experience when raising their kids (Waldron, 2005).

The Benefits of Role Playing

However, there is another side to DnD and other roleplaying games. As Waskul (2006) writes, in his chapter The Role-Playing Game and the Game of Role-Playing,

> We all find ourselves as players located at the liminal margins between the people we believe we are and the personas we play in various situated social encounters -

> between what we believe we are and what we aspire to become - between what we believe of ourselves and what we believe others believe of us (p.36).

As players of these games, we are practicing what may happen to us in our real, very important lives, and we ascribe importance to our player characters thusly. We may not ever be in danger of being decapitated by a sword swung by a drunk, tired orc; however, plenty of the interactions and most important parts of a DnD game to players happen in everyday life. In the study done by Schrier (2017), where she asks players of the role playing game *Fable III* whether they would choose to sacrifice their friend to an evil tyrant or sacrifice other villagers (p. 843), the imperative hits much closer to home. The game then locks you into one of those two choices—a bit less realistic, but this highlights an important point to role playing games. It is important to understand what you would do in situations where there seems to be no way out. What you *believe* you would do is one thing; when you are actually asked to do it and witness the consequences, it becomes something else.

Additional Benefits

It is also important to note that the experimental players in the study—the ones who actually played the role playing game—utilized many more problem solving skills than the control players, who were only asked what they would do in an interview, with no role playing and no game available. For the skill "problem solve from another's perspective and use it to make one's decision," only three out of 10 of the control players used this skill, but in the role playing version, 15 people out of 20 used this skill to try and determine what was right or wrong (Schrier, 2017, p. 849). For the skill "consideration of long-term outcomes," those numbers were one out of 10 for the control, and seven out of 10 for the experimental (Schrier, 2017, p. 849). It is apparent that there is something about playing the game that causes those players to actually

look at their decisions rather than make them first and ask questions later. If only everybody had this ability to use in their lives at their whim.

Differences Between Study and DnD

We should remember that in this particular role playing game, all of the questions and choices measured were either binary or three-part (Schrier, 2017, p. 836). This is different from an actual tabletop role playing game because in a game of DnD or its ilk, there are no binary choices. As Waskul (2006) says about his experience playing DnD, "Infinite possibilities for imagined action intersect with finite yet indeterminate probabilities and random chance; finite guidelines are structure for infinite play" (pp. 24-25). It is entirely possible that in response to a problem set in front of a DnD player, the player will come up with a solution that the DM had not imagined; this scenario is actually far more common than its inverse, where a player solves a puzzle in the exact way the DM had imagined. This "infinite possibilities" factor is, indeed, what keeps DnD aficionados coming back to the game. The game is truly life-like, in that you can truly do anything your mind can think of (Waskul, 2006, p. 24-25).

"Life-like"ness and Issues

This life-like aspect of role playing games ties into a major problem that B.A.D.D. and others had with role playing games in general—that "players were regarded as becoming so involved in their fantasy games that their concept of self and reality began to dissolve to be replaced by the virtual fantasy world of the RPG" (Waldron, 2005, para.15). The breakdown between fantasy and reality is frightening for some to see. Nowhere is this more apparent, strangely, than an episode of the BBC crime drama *Luther.* In an episode of the drama, a Dungeons and Dragons player, portrayed by a 20-something white man, of course, rolls dice to decide how he will commit acts of terrorism against citizens of London (Cross & Miller, 2011).

It soon becomes apparent that this killer has recently had a mental breakdown, and believes life is simply a game where whomever gets the most points will win in the end.

Problems with Classifying DnD as a Cult

Many attempts to research the psychological transformation of role playing gamers into Satanic cult worshippers were tried in the 1980s by B.A.D.D; however, all of these studies found that the difference was actually statistically insignificant between role playing gamers and the general population (Waldron 2005, para. 23). For instance, the levels of suicide of role playing game players was investigated in relation to national statistics on youth suicide in Canada and the United States by the American Association of Suicidology, the Centers for Disease Control and the National Safety Council, and they all found that with the estimated number of RPG gamers in the country at the time there should have been at least 1,060 gamer suicides in the same period. They only found 128, and most of those claimed suicides were actually accumulated unsourced newspaper clippings, often referring to the same incident several times over (Waldron 2005, para. 23).

In addition to this, in 1991 Abyeta and Forest tested whether role players versus non role players were more prone to any other sorts of crimes. They found 20 role players and 25 non role players, and gave all of them a personality questionnaire, which tested for extraversion, neuroticism, psychoticism, and lying; a criminality questionnaire - where each subject answered questions on whether they had done a criminal procedure, approximately how long ago it was, and how serious they thought it was; and a demographic questionnaire. The subjects then returned in three weeks for another session with the same questionnaires (Abyeta & Forest, 1991, p. 1189). See Table 1.

TABLE 1
MEANS AND STANDARD DEVIATIONS BETWEEN ROLE-PLAYERS AND NONROLE-PLAYERS FOR PREDICTOR AND DEPENDENT VARIABLES

Variable	Role-players, *n*: 20		Nonrole-players, *n*: 25	
	M	*SD*	*M*	*SD*
Psychoticism	2.55	2.13	4.16	4.06
Neuroticism	9.30	4.76	12.32	5.03
Extroversion	14.35	4.20	14.00	4.88
Lie Scale	6.40	4.28	7.16	3.48
Years Role-playing	6.85	2.30	.12	.33
Income Group	10.65	3.78	10.04	3.75
Age	21.00	2.47	19.00	2.21
Crime	3.40	2.78	3.64	3.01
Weighted-crime	20.32	23.27	24.22	24.27

The main thing the questionnaires found out about the differences between role-playing and non role playing subjects is exactly how unimportant role playing is to the level of self reported criminality is. In fact, the only *t* test that showed a significant difference in the two groups was the one run for psychoticism, and that showed role players having a lower predictor than non role players. For all of the other predictors and dependent variables, the *t* tests run to understand how the two groups differed showed no significance. All of this testing was done once socioeconomic status, personality, and age were controlled for (Abayeta & Forest, 1991, p. 1190).

Rationale

Abayeta and Forest (1991) say that the "failure to find a positive relationship between fantasy role-playing and maladaptive behavior in this study or in previous research leads one to ask why the negative view arose and continues to be expounded" (p. 1191). It continues to say that the reason this mode of thinking might have lasted so long in the Christian right is because

of the availability heuristic—or the bias that exists when probabilities are estimated based on how easily examples come to mind (Abayeta and Forest, 1991, p. 1192). This paper was written at some time in 1991, when B.A.D.D. were winding down their attacks on role playing gamers and the deaths of Egbert and Pulling were dim in the rear view mirror; however, they were still visible. In addition, it is hard to believe that very many news stories were created at any time in the 80's that showed any amount of role players helping people or being upstanding citizens, so it seems that this judgment holds. However, this was done 30 years ago. With all of the differences in realism, attention spans, and modernization of dopamine loops and the gaming mindset, it is questionable how well this method of thinking would hold up today.

Crime and Role Playing

Ferguson (2013) has written a fantastic book talking about crime and the media, and in it he has an entire chapter about violent video games (pp. 105-126). Video games are not exactly the same as role playing games are—as evidenced by the differences mainly between binary choices and "life-like" decision trees—but they are still role playing in that you are imagined to be the character on the screen (ZackScottGames, 2017) Many video games use silent protagonists to stretch this illusion farther; in the Legend of Zelda series, the player plays as the character "Link", who traditionally stays completely silent in conversations. The name "Link" is canonically used because he is literally the link between the player and the game, and the developers chose to keep him silent over the 30 years of increased voice acting and full motion video in video games: "We wanted the players [both] to be able to relate to Link and to play as themselves" (ZackScottGames, 2017, 2:22).

Problems with Crime Studies

In Ferguson's chapter (2013), he takes apart several studies that seem to look into the correlation between playing violent video games and being violent. In many of these violent video game studies third variables, such as family violence, genetics, peer influence, and identification with aggressive role models are not accounted for (pp. 112 - 115). Once these variables are accounted for, however, it was found that all of these research studies were inconclusive in drawing the link between violent aggression and aggressive video games. He notes that many reviews have concluded "that violent video game playing is not predictive of extreme violence particularly school shooting incidents with which they are commonly linked in the media" (Ferguson, 2013, p. 115).

Conclusion

In this chapter, we have looked at the Satanism scare and whether the beliefs that role playing and gaming is indeed dangerous to youths is a justified belief. This researcher believes that the data does not bear that out—that, indeed, as Ferguson says,

> Indeed, looking at the data on youth violence and video games sales data for the years 1996–2009, the only years that both sets of data are available, we find that the relationship between youth violence and video game sales is $r = -0.95$, almost perfect, but in the wrong direction (Fig. 7.1).

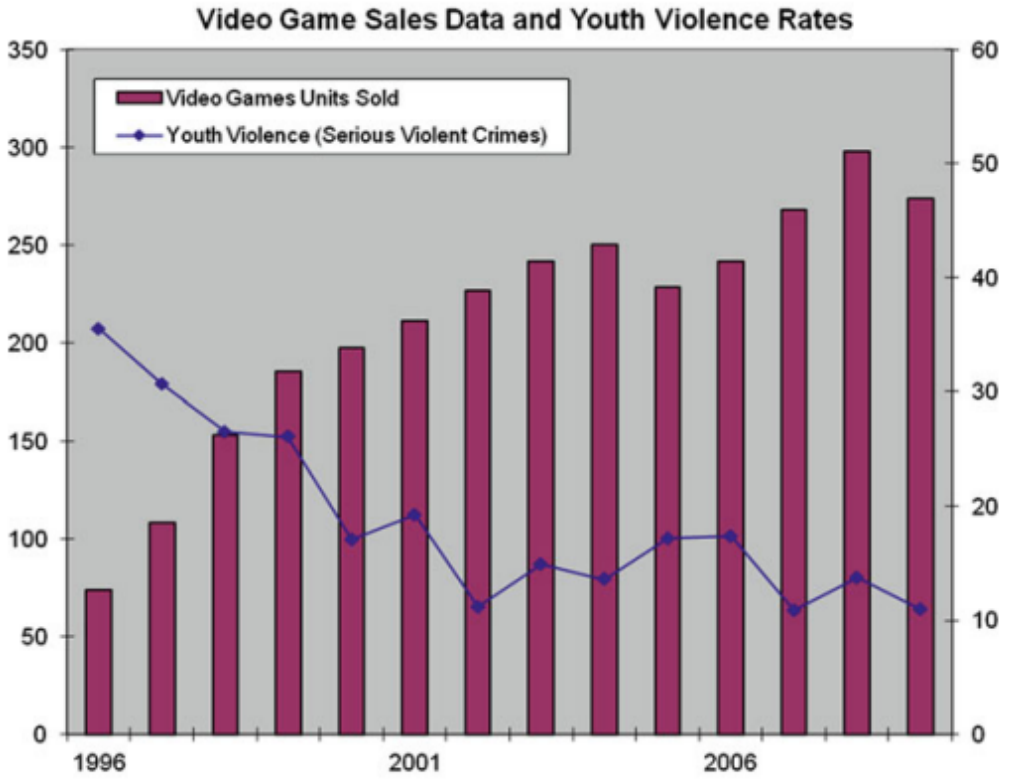

Fig. 7.1 Youth violence and video game sales data

These assumptions and beliefs have walled off a major vein of interest and engagement in students. As high school students come of age, they realize that their lives are not as perfect as they had always believed, and this can come with a feeling of powerlessness against the world and the status quo. This feeling should be used against the actual specters of ignorance and stupidity to make our next generation better than this one.

Next Steps

I have shown several things in this chapter that I find incredibly important to using gamification in schools. As teachers, we need to be vigilant that all of our students are gaining as much as they can from our classes, and gamification is one of the ways that I can be sure

students are positively engaged in learning and understanding. The major way I do this is through the act of *role playing without roles,* where students are role playing as themselves. This removes the fear of not having knowledge, as well as the problems that have happened in the past due to parents not understanding their children's hobbies. This entire process happens daily in my classes, and it enables me to further move my students' usable scientific knowledge higher and higher. As well, taking part in activities in my classes have shown that my students' social emotional learning has gone up as well. In the next chapter, I will lay out exactly what I have done with my students in order to create this atmosphere of learning.

CHAPTER THREE

Overview

In this chapter of my capstone, I will explain how I answered the question, *How can science teachers use game design elements of role playing games to motivate high school students towards higher level engagement?* I will talk about the curriculum development I have done over the last two years in this way, and as well, interesting ways to change my work for younger or older students as needed. I will additionally go into my current class size and school type, as well as the importance of the constructivist paradigm in teaching my particular class of students. My class will mostly be centered on 9th grade physical science and computer science class, but there is no reason that one could not easily change the specific events for students who are younger or older than this. The most important thing is that we are always trying to virtualize the idea that the scientists who came up with these ideas are exactly like our students in their level of knowledge before they made their discoveries with respect to their area of study.

Role Playing Without Roles

In Chapter Two, I talked about the idea of *role playing without roles*. Many of the thought processes students need to use in science mirror the game playing tropes we see in Dungeons and Dragons. In Chapter Three, I also want to solidify this idea and explain how my curriculum development grows this plan in students as well. I will, as well, explain the timeline of my class, and I will talk about when and how I plan on placing these role playing activities into the class.

Objective

It is apparent that many students, especially low-income, minority, and female students, need assistance with their interest in pursuing STEM (science, technology, engineering, and math) careers or attaining STEM degrees. Eisenhart (2022) states that while young, interest in

STEM subjects and work is high, but it remains true that there is an abnormally low number of these groups who eventually get STEM degrees. My objective is to infuse interest in these subjects that I teach by creating interesting events and activities that speak to what many high school students like to do with their time—that is, play games. It is my hope that my class will be more memorable and the lessons that students take from it will be more helpful because of this.

Importance of Scientific Knowledge

The lack of scientific knowledge in society at large is at an all-time low. This dearth of logical thinking and planning is of utmost importance precisely at this point in time, with problems like climate change and the need for vaccinations, among others. It is my belief that this next generation of students will be the ones who will solve the majority of these problems, and it is our job as teachers to help them learn what they need to do so that they can reach these heights. It was this realization that caused me to begin teaching about fallacies and biases in my upper level science classes; as expressed in Chapter Two, even some scientists fall into traps like confirmation bias and availability bias. I wanted to fix thi as much as I could, and my fallacy curriculum is consistently the most talkative and interactive part of my classes.

Curriculum Development

For this project, I have developed two separate activities to run in two of my science classes. One of them is a *discrepant event* activity to run for one day a week in my ninth grade physical science class. The other activity is a development of an invention or app to be used in an engineering or computer science class, that will take at least a week to complete. Both of these activities use role playing to increase interest and develop good ideas. This role playing is done through the environment that the students are thrown into, rather than the students themselves adopting other roles themselves.

Discrepant Event and PEOEs

This activity was taken and adopted from Sarah Hick at Hamline University. The idea is to introduce a strange thing that happens in science, and try to work out the reasoning behind it. We do this through a quadrant called a PEOE (predict, explain, observe, and explain), and talking with our classmates and the teacher. This activity is designed for my ninth grade physical science class, with ~20 students in it.

Process. We begin by explaining the event that is to be predicted by the students. For this example, I will use the "helium balloon in the car" event that I came up with in Hick's class. For this discrepant event, I would begin by asking the students, "What happens to you in a car when it starts, stops, or turns?" After a short discussion, I would then have my students make a PEOE quadrant and fill out the first two sections, predicting what they think will happen with a helium balloon in a car, and explaining why they think that. They are encouraged to talk to each other through this process and take answers from each other, depending on who at the table has the best answer in their minds. Next, I go through the experiment, in person if possible. For this example, it's very hard to fit 20 ninth grade students in a car to show this event, so I use a YouTube video (SmarterEveryDay, 2014) to show them the interaction. I then have the students fill out the last two sections of the PEOE quadrant, observing what happened to the balloon, and explaining why it happened. Again, they can talk to their classmates and talk with me walking around the room to answer the question of how to explain what happened as best they can. The students can then turn in the PEOE for points. This entire process, if well metered, will take about 45 minutes, which is a class period at my school.

Relationship to Role Playing. This activity is like role playing in that the students are asked to take on the role of somebody who does not know what is going to happen to the balloon, which, usually, is themselves. If a student does say that they know what is going to happen to the balloon, then I ask them to think back to a time before they learned this fact, so they do not lose out on the growing process. I grade these PEOE sheets on completion, and I tell the students this, so that they do not fear being wrong in the classroom. The students are allowed, even encouraged, to be wrong, so that they can see the thought processes of people they will meet every day. In this way, the entire class grows, when the students talk about why they predicted incorrectly, with my help to teach them the correct way.

Timeline. This activity is not an every day activity. Eventually, the students would become tired of being incorrect, and some upper level students will begin to game the system, guessing the correct answer without understanding the reason behind it. This is when the classroom has been saturated with discrepancy, and it is not a fun place for anyone to be in. In order for true learning to happen, there has to be a surprise, or a realization that something went wrong with their expectations. This leads to a need to know why they were incorrect. This is a valid path for learning, and one that I use to great benefit during my classes. Therefore, we will be employing this activity at a maximum interval of once every week, with some breaks in between some weeks. We will begin with physics demonstrations, like the helium balloon demonstration to show the value of inertia.

Balloon in Jar. Another good discrepant event is the idea that pressure affects the ability to blow up a balloon in a jar. We can run the entire experiment with a balloon in the jar with a hole in the bottom, and then ask the students what they think will happen when the jar is whole.

This will lead them to understand that pressure is a force, and can cause discrepancy in expectations.

Invention/App Development

My other activity is a minimum of a week long, and can be used in either an engineering class or a computer science class. The students were expected to find a need for a new invention or app, and spent time drafting and editing it based on others' opinions of the end product. This activity/unit is written for older students than the discrepant event work—somewhere around juniors or seniors in high school. We will actually be doing the work of the engineering cycle (University of Colorado Boulder, 2018) in this application, and it is entirely possible that the students could make their inventions on their own time, and maybe even sell them.

Process. The students began by selecting an area in which they see a problem that is fixable. Perhaps a student's coat hangers keep breaking, or the tie from their bread bag keeps getting lost. Once the student had a good problem, they then researched to figure out answers to how someone else solved the problem. In this way, the students were role playing being actual engineers—real engineers thieve each other's work all of the time! Granted, during this process, I had a day with my students where I explained intellectual property and when my students can/can't sell something outside of school. The students, once they have exhausted their research, then imagined new solutions, planned by selecting one of these new solutions, and created a prototype. I did not actually ask my students to create prototypes here; however, we have a 3D printing application (AutoDesk 2023) where the students can make anything they want to, and I told them I expected to see an annotated image of the prototype that my student has come up with.

Next, I asked my students to *use* their prototype. If my students actually had a working prototype, they would try it out, but if they only had a picture of the prototype, they would ask someone else who had the same problem as them what they thought of their invention. This is role playing in the sense that my students were actually looking for helpful answers to their questions that we developed in class, but not all of the feedback was beneficial in that way. My students then improved their product in at least one beneficial way based on the feedback that they received from their users.

Relationship to Computer Science. I wrote this in engineering mode, but I have done this equally well with my computer science students, and instead of creating inventions, we created apps. Everything else was identical—my students developed needs for an app that they were interested in, they coded and programmed prototype apps, and then gained feedback from their users that helped them to improve their apps. I saw many similarities between this activity (which took us quite a bit longer than one week, more like a month) and the activity I described above.

Assessment

At the end of every quarter, I always run a Google Form designed specifically for my students to assess my class and teachings. In these examples, one in ninth grade and the other for tenth-twelfth graders, I made sure to add specific questions asking what they thought of the discrepant events, or what they thought of the invention development activity. In both cases, I received good feedback from students on how to improve the activities, and I also heard from students saying that was their favorite activity in science they have ever done. For the discrepant event activity specifically, I also asked whether their minds had been changed by the activity. For the events that had the most incorrect answers BEFORE the event happened, I got about 60-70%

yes, my mind was changed after they understood why the event happened. This was for the harder discrepant events, like the helium balloon in the car, as well as the planet falling speeds and the balloon on the nails.

Conclusion

Here I have talked about my best methods to engage high school students in my classes using this new gamified theory of learning. I described two separate ways that I regularly utilize a form of role playing to engage students in learning what I believe is the most important part of science class—the ability to think for yourself and use critical thinking to form opinions of phenomena happening around you.

Final Chapter

In the final chapter of this thesis, I will speak about what I have learned through this process, the benefits of gamifying more of my students' assignments and activities, and how this has helped both their understanding of the science material I am presenting as well as the social emotional learning goals I have for my students. The school I teach at, Cyber Village Academy, is a small charter school in Minneapolis, and we have become somewhat of a sanctuary for students who have greater needs than others. I will, as well, talk about what this means for this project.

Chapter Four

Chapter Overview

This chapter will cover what I have learned as a result of centering games as a viable learning strategy, specifically role playing games. It will focus on how I answered the question, *"how can science teachers use the game design elements of role playing games to motivate high school students towards higher level engagement?"* In the last chapter, I laid out a formalization of the kinds of methods I use to teach my students about science and technology in the classroom, and this chapter will be about how this process has changed me as well. Beginning by talking about how my work has focused on gamification and the ways in which my discussions and assignments in class have resulted in true learning in my students, I will talk about my literature review and the ways in which learning about games from academic sources has enfolded my beliefs and views into others' and caused me to change my procedures in some cases. Finally, I will discuss my prediction that gamification will rapidly grow in popularity in all places, and I will talk about how I changed some of the things I was planning on doing this year and how well that has been progressing. Gamification has always been extremely important to me when talking about learning because of the fact that I have been blessed with a group of friends who I have loved to tell stories utilizing Dungeons and Dragons (D&D) for many years.

Centering Gamification and Major Learnings

Some wonderful learning has happened in my classrooms since I began to use role playing as a major learning pathway. There have been some "aha moments" as well as some trepidation from students asking "Is this really schoolwork?" However, I feel it has been a positive journey for all involved.

Benefits of App Development

My app development project is where I have seen the most change in engagement in schools. One student, who spent the entire early part of the semester not completing any assignments, worked very hard on his app, in which he described the mechanics of fighting games, specifically the game *Guilty Gear Strive.* This app was polished and easy to use, and had so much pertinent information inside of it. During the app showcase at the end of the semester, this student was glowing as he showed all of his classmates and myself the best ways to use each of the attacks of his favorite character.

Throughout this unit, many of my students were understanding the problems that came with truly being able to do anything they could dream up on code.org's app development site, which is the medium I use for this class. One student created a "fireperson game" which was simply an app where you controlled a person with a net, catching people falling out of a burning building. This student made this app for their uncle, who was a Minneapolis fireman. Another student, who took almost as long as he possibly could to choose his topic, made a wonderful app cookbook, which laid out chosen recipes step by step and gave the user exactly what they needed to finish the step they were on. Many of these projects caused these students to work far past when class ended, and I choose to believe it is because they cared about what they were working on.

Benefits of PEOEs and Discrepant Events

The process of showing students a discrepant event and asking them to fill out a Predict, Explain, Observe, Explain chart is not quite as obviously beneficial. This roleplaying act brings the student out of their comfort zones through asking them about common phenomena they might see in their lives, while still letting the student know that their intuition may be incorrect.

This produces a lot of conversation and speaking out about what students have observed, and how their observations in life are similar or different than what they are shown in the lab. I have been doing this consistently (maybe once every two or three weeks) for my physical science students, and I will place them variously within other classes as they become important talking points -- for instance, I ran the helium balloon in a car event for my physics class, and I will run the volume inspection for my chemistry class once we reach the solutions part of the course. These discrepant events cause much unrest in the classroom, most likely because it can be very hard to let go of your original explanation when you find out that you are mistaken. My advice is to take it slowly, and to give ownership to the students as much as possible. This allows them to discover their errors naturally. This will cause authentic learning to happen in your classroom, that your students will not easily forget.

Benefits of Other Gamification

Several other methods of roleplaying have surfaced in the last year in several of my classes, and those have had positive effects on my students as well. Code.org's "The Internet" unit in their Computer Science Principles class has students using an "Internet Simulator" that morphs throughout the course, starting as a text messenger, and then changing to need IP addresses and packet information as students learn about these points in the course. It is quite well done and it fulfills my own needs for exploration in an otherwise computer-based course.

I have been doing my best to create as many exploration-based labs for my students in all of my classes, since labs are a primary way to show how to play the role of a scientist looking for answers. In my electrical engineering class, we created inductors via nails, wire, and 9 volt batteries, and then we tested to see how many paper clips each of our inductors could pick up with its magnetic field. I gave my students free reign to create their own inductors, and some of

them didn't work out! So the students chalked that up to learning and understanding, and tried again.

Literature Review

My literature review was wholly responsible for helping me to understand my place in this intermix of academics and teachers all looking for more engagement. When I created my idea for a topic, my first faculty advisor helped me to choose specifically role-playing games as a type of game to focus on, mainly because it hadn't been discussed as much as general gamification had in the educational space. This opened up my eyes to all of the things I do as a teacher in my classrooms and how the most efficient acts I take are the acts that allow the students to act like themselves — the acts that allow them to be themselves in my space.

Help from "What Gamification Does"

Dichev and Dicheva (2019) definitely had a positive effect on my understanding of gamification and how it plays into educational tasks. Their division of the different concepts inside of games caused me to examine some of the more boring things I do in my classes, and change them to become more game-like. For instance, since I began this study, I have been in discussions with a programming associate of mine to work on a simple program that will add some game elements to specifically note-taking. I hope to use the general gamification skills I have learned to make these tasks more engaging for my students.

Gamification and SEL

Thuneberg et. al. (2022) and their transversal competences was integral to my understanding of the types of knowledge I ideally would like to give to the students who pass through my classroom. Thinking and learning how to learn is one of the skills I feel is most important to learn in science, as science rebounds upon itself; the more people who understand

how science works and the bases of the technology we use every day, the more accelerated our society will become. Unfortunately, this goal has been short-circuited by easy-to-copy AI answers and the internet in general allowing students to stop needing to think.

In general, these transversal competences have been good things to keep in my head when I am planning out assignments and activities to do in the classroom. Always making sure that my students are discovering and exploring and not just feeding my students important formulas and testing them on those formulas has developed me as a teacher.

Help from Satanic Panic

This section of my literature review was the part I wrote first, and it holds quite a bit of personal value to me—I have always been driven to understand why some humans see simple things like games as evil. The brain is so quick to turn people who enjoy unconventional pastimes as *other*, and our need as humans to be in a group makes it very easy to accept and persecute those who we see as different from us. My favorite part of this chapter, and the part which I will be using most often in my discussions about game playing being dangerous, is the proof section. Waldron (2005) and Abyeta and Forest (1991) did a wonderful job of showing that the numbers do not line up with what the major RPG detractors were saying, and they did so very efficiently.

In addition, Ferguson (2013) brought up a very salient point; the presence of confounding variables within the discussion of whether video game players are more violent than people who do not play video games. His point that family violence, genetics, and peer influence were not looked at in the studies is a point often lost on those who I personally argue with about the use of video games, and once again I plan on using this with any parents who have problems with the way I teach.

The Future of Gamification and Role-Playing

There is very little question that gamification is the way of the future. According to Alam et. al. (2023), there has been a large growth in gamification research recently. Anecdotally, I see the changes in students every day. The youngest of us know changing technology innately—my three year old daughter can use a tablet very easily and my four year old cousins regularly use their parents' iPhones to access the web and play games themselves. With all of this changing technology, it is time to change the way we teach and hold students accountable for learning. My school presently uses online programs like Alyx, i-Ready, and Edmentum for online learning, but the majority of those are not gamified well. My formalization here of what I do in my classes hopefully shows a different way to gamify education without necessarily using scoring, badges, and leaderboards. If we can get kids to explore, to question, to discover, we are indeed using gamification to bolster their learning and engage them. By asking our kids important questions and by actually listening to them when they choose to share things with us, we ourselves are role playing as our students' caretakers, and for many of them that is the most important thing.

Changes in the Past Year

I have in some cases chosen to, and in some cases been forced to, change up several things for my specific, highly unconventional school. We are a hybrid school, with three days teaching in person, and two days online. In addition to this, we have a number of students with IEPs and 504's. I developed all of my teaching styles for this school, so whomever is reading and planning on using these ideas for your classes can adapt as they choose to as well.

PEOE Changes

When the idea for doing PEOEs were introduced to me, we were told to allow any type of submission for the predict and observe portions of the sheet—writing, pictures, sound files, or

even slideshows. After doing this for my physical science class over the year of 2021-2022, I found that I got many indecipherable pictures from students that I had to make an addendum -- if you choose to draw a picture for your predict or observe, it must be an annotated drawing, with important details pointed out with words. This has increased my understanding of all of my students' submissions and has in some cases caused me to change the way I am teaching because I now understand that a group of students have an important misconception about major points of my class. In addition, my students learn what an annotated picture is, and that transfers very seamlessly into another large point of all of my science classes; models are always flawed in some way.

Changes in App/Invention Development

The main change in app or invention development is the number of students to a group. Both of these activities are so deep that I don't want my students to waste any time choosing what they would like to do. For the inevitable group of students who have no idea what they would like to make an app about, I began to utilize the portion of the lesson in code.org where students are asked to brainstorm topics which they feel they know more about than other people, or topics which they enjoy talking about. If the group of students continue to hem and haw about what to choose, I will use their lesson results to place them with somebody whose chosen topic aligns closer with theirs. This, in addition, allows for both students to have somebody to bounce ideas off of and also allows for pair programming as well. Pair programming is where two sets of eyes are watching the programming of app items, which can help immensely for brand new programmers.

Conclusion

I have learned here about specifically what gamification is and isn't and how it can and can't affect students' engagement levels. My question was "*how can science teachers use the game design elements of role playing games to motivate high school students towards higher level engagement?"* In the past I had always wondered exactly what it was that I was learning from role playing games. Now I am positive that role playing games teach higher level thinking skills—evaluation, comprehension, and problem solving to those who are willing to listen. It will be imperative in our students' lives to use these skills to achieve what they want to, and I am proud to be one of the people who is teaching exactly that.

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