DIFFERENCES IN STUDENTS' STEM IDENTITY, GAME PLAY MOTIVATIONS, AND GAME PREFERENCES

by

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For Tor, whose unwavering support made this dissertation possible, and for Erik and Ann-Marie, whose passion for gaming and interest in STEM inspired this study.

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ABSTRACT

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The purpose of this sequential mixed methods study was to explore differences in students' STEM identities, game play motivations, and game preferences. The need to grow and support STEM education and careers in the U. S. is a widely-held concern for those in leadership, industry, and education. A purposeful sample of 167 9th grade-12th grade students from a southeastern Texas suburban school district were solicited to complete the *Gaming and STEM Survey* and participate in focus groups. Results indicated a significant difference between gender in terms of students' STEM identities, game motivations, and game preferences. In addition, results indicated a significant relationship between several game play motivations and STEM identities, as well as between several game preferences and STEM identities.

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CHAPTER I

INTRODUCTION

Education and industry continue to have gender and race/ethnicity gaps and remain a societal issue and a concern for ongoing global progress. A discussion has been taking place for decades regarding gender and race/ethnicity gaps in the areas of Science, Technology, Engineering, and Mathematics (STEM) both in academia and industry. The acronym STEM originated from the National Science Foundation (NSF) around the year 2000 to better encompass these related and interwoven fields (Dugger, 2010; Kuenzi, 2008; National Science Board ([NSB], 2012). However, beyond gender and race/ethnicity gaps, attracting and retaining highly qualified candidates is of interest to recruitment in both higher education and industry. The United States' (U.S.) ranking does not reside at the top, nor within the top 20 nations, in math and science achievement (Kuenzi, 2008; NSB, 2012; NSF, 2013). In response to these low rankings, the government initiated the America Competes Act of 2007 proposing STEM educational policies, and then more recently the NSF made a budget request to congress for STEM research (Kuenzi, 2008; NSF, 2012).

The need to grow and support STEM education and careers in the U.S. is a widely held concern in leadership, industry, and education (Donors, 2017; NSB, 2012; NSF, 2013; Tang, 2015; Vilorio, 2014; Xue & Larson, 2015). Currently, for example, leaders in technology support the Hour of Code (Donors, 2017) movement to reach over 180 countries to promote computer language coding. This is an important campaign to grow awareness, as the rate of growth in computer science degrees does not match the rate of the growing job market, an occupation where females represent less than 22.0% (Donors, 2017; NSB, 2012; NSF, 2013; Tang, 2015). Literature widely explores students' STEM identities, game play motivations, and game preferences. Research in these areas will most likely continue due to changes in schools' STEM course requirements, students' access to and participation in STEM courses, access to technology and digital games, as well as changes in digital games. However, current research examining possible relationships between students' STEM identity and gaming is scarce (Bellflower, 2012; Biles, 2012; Ching-Huei, Kuan-Chieh, & Yu-Hsuan, 2015; Fraser, Shane-Simpson, & Asbell-Clarke, 2014). The purpose of this study is to explore differences in students' STEM identities, game play motivations, and game preferences.

Research Problem

Students' equitable participation in STEM education and career opportunities remain a concern within academia and industry. When examining the number of STEM courses taken or college degrees granted, females are taking a nearly equal number of STEM courses as males, enrolling in college at a greater rate than males, and holding more undergraduate STEM degrees than males (Beyer, 2014; Halpern et al., 2007; NSB, 2012; Roeder & Gruhn, 2000; Smith, 2011; Spelke, 2005). Yet, when looking at STEM achievement from high school level courses through advanced college degrees, males still surpass females in the number of post-graduate degrees earned and exceed in areas of physical sciences such as physics, computer science, and engineering (Beyer, 2014; NSB, 2012; Roeder & Gruhn, 2000; Smith, 2011; Virtanen, Räikkönen, & Ikonen, 2015).

This gender gap is especially apparent when looking at STEM related careers and compensation (Beede et al., 2011; Diekman, Clark, Johnston, Brown, & Steinberg, 2011; Jacobs, 2005; NSB, 2012; Zarrett & Malanchuk, 2005). The gaming industry has seen the percentages of female developers more than double since 2009, according to an International Gaming Association survey revealing that females make up only 22.0% of game developers (Edwards, Weststar, Meloni, Pearce, & Legault, 2014). In addition, females are increasingly participating in game play (Agosto, 2004; Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010; Statista, 2015; Jenson & de Castell, 2010/2011; Ogletree & Drake, 2007; Shaw, 2012). Prior research examined technology use, preferences, social structures, and self-identities, for example; participants in these studies revealed differences again for males and females with respect to these constructs (Bekebrede, Warmelink, & Mayer, 2011; Bobby & Nadelson, 2010; Carr, 2005; Fraser et al., 2014; Giammarco, Schneider, Carswell, & Knipe, 2015; Jenson & de Castell, 2010/2011; Liu & Chen, 2013; Nietfeld, Shores, & Hoffmann, 2014).

Members in the academic community continue to pursue an understanding of the different factors that influence students' participation and achievement in STEM education. The problem is the need to determine new, important factors that may influence students' STEM identities and narrow the gender and race/ethnicity gap for STEM participation. Previous research investigated how adolescents' science identity and science learning have relevance to gaming (Annetta et al., 2013; Biles, 2012; Bricker & Bell, 2012; Fraser et al., 2014; Gaydos & Squire, 2012; Ke, 2008; Manusos, Busby, & Clark, 2013; Mercier, Barron, & O'Connor, 2006; Shaw, 2012; Stets & Burke, 2000). Many studies have investigated parental influences and motivation for students' selection of STEM courses or undergraduate study choices in STEM, such as years of parental education and utility-value (Choo, Sim, Liau, Gentile, & Khoo, 2015; Harackiewicz, Rozek, Hulleman, & Hyde, 2012; Kolmos, Mejlgaard, Haase, & Holgaard, 2013; Nagengast et al., 2011; Rozek, Hyde, Svoboda, Hulleman, & Harackiewicz, 2015) . Gender and race/ethnicity differences in STEM identities, game play motivations, and game preferences, as discussed in the literature review, may provide an understanding of different factors that contribute to the gaps in participation.

Significance of the Study

A more unique focus on understanding students' game play motivations, game preferences, and STEM identities may aid future educators in developing curriculum and teaching modalities that could greatly impact students' participation in STEM courses and careers. This dissertation reviews prior research for gender and race/ethnicity differences in the following three constructs: (a) STEM identities, (b) game play motivations, and (c) game preferences. Then this study moves intentionally away from gender differences and investigates students' game play motivations and game preferences, as well as how they may connect to students' STEM identities.

Research practitioners have sought and recognized some connections between STEM and gaming constructs (Biles, 2012; Bricker & Bell, 2012; Fraser et al., 2014; Gaydos & Squire, 2012; Giammarco et al., 2015; Ke, 2008). Understanding self-identity and self-concepts with respect to gender and race/ethnicity are recurring research topics (Bricker & Bell, 2012; Fraser et al., 2014). With the current gender and race/ethnicity participation gaps in STEM education and STEM careers, it behooves society to take action to make changes. The solution to such a task may be to step beyond present-day strategies and programming for closing this gap. Unfortunately, stereotypes remain in both STEM and gaming, in private institutions and the public sector alike (Bertozzi, 2012; Blickenstaff, 2005; Frevele, 201l; Vieira, 2014). Moreover, marketing efforts to attract females to participate in STEM education/careers and in gaming have historically shown to be stereotypical in nature, undermining the very intent of attracting females (Bertozzi, 2012; Blickenstaff, 2005; Frevele, 201l; Vieira, 2014).

Conceivably, understanding a possible connection between students' STEM identities and game play motivations and/or game preferences, the findings may support a case for additional research for curriculum development and instructional pedagogy, as well as perceptions for gaming use in education for learning. The literary review in Chapter II supports a fresh look and direction of the historical trend in marketing towards females for participation in STEM education/careers and gaming. This study hopes to illuminate differences in students' game play motivations and gaming preferences, and determine if either of these variables have a connection to students' STEM identities.

Research Purpose and Questions

The purpose of this study was to explore differences in students' STEM identities, game play motivations, and game preferences. This study addresses the following research questions:

1. Does gender influence STEM identity?
2. Does gender influence game play motivations?
3. Does gender influence game preferences?
4. Is there a relationship between students' game play motivations and STEM identities?
5. Is there a relationship between students' game preferences and STEM

identities?

6. How do students perceive, if at all, that their game play motivations, with respect to their game preferences, relate to their STEM identities?

Definitions of Key Terms

Game Play Motivations: defined by three main factors: achievement, social, and immersion (Yee, Ducheneaut, & Nelson, 2012).

Game Preferences: defined by the type or genre of games the participants prefer, for example: first-person-shooter (FPS), racing, puzzles, and fantasy (Fraser et al., 2014).

Gamer: Someone who plays interactive games, such as video games or tabletop games. The term also includes people who work on methods to gamify technologies relevant to game play (Tavinor, 2008).

Gamer Identity: The gamer identity as determined by types of games played, and motives for game play as developed by gaming taxonomy and theorists (Bartle, 1996, 2003, 2005; Stewart, 2011; Yee, 2003, 2006a, 2006b; Yee et al., 2012).

Gaming/Videogaming: playing digital entertainments that engage the player through game play, incorporates multiple modes of engagement for the player (Tavinor, 2008).

STEM: An acronym referring to the academic disciplines of science, technology, engineering and mathematics (NSB, 2012).

STEM Identities: defined as how a student sees themselves as a "type of person" (Carlone & Johnson, 2007; Hazari, Sonnert, Sadler, & Shanahan, 2010; Hazari, Sadler, & Sonnert, 2013).

Conclusion

Gaming is habitually viewed as a male-dominated realm, much like participation in STEM. Populations in both spheres continue to be skewed towards a greater number of males than females. Nevertheless, there is a growing trend showing more females are participating in gaming. Future research may indicate that students with greater participating in gaming have greater interest and participation in STEM education and careers. Research most likely will continue to explore gender differences for both participation in STEM and gaming. This inquiry takes a compelling look at differences among high school students. A connection between students' game play motivations, game preferences, and their STEM identity may potentially impact students' interest and participation in STEM education/careers. Research findings may encourage further studies and innovative, educational strategies for closing participation gaps in STEM education/careers. Chapter II provides backgrounds for STEM and gaming, then a review of the literature follows for STEM identities, game play motivations, and game preferences. Lastly, a summary of the literature findings and a conclusion completes the chapter.

CHAPTER II

LITERATURE REVIEW

The purpose of this study was to explore differences in students' STEM identities, game play motivations, and game preferences. Studies for participation in STEM education/careers analyzed constructs in numerous ways, scrutinizing variables with respect to population-group differences, motivations, and other influencing factors. Some factors previously considered include gender and achievement (NSB, 2012; Spelke, 2005), course or degree selection (Beede et al., 2011; Kolmos et al., 2013; Roeder & Gruhn, 2000; Smith, 2011), parental or familial contexts (Harackiewicz et al., 2012; Rinn, Miner, & Taylor, 2013; Rozek et al., 2015), science identities (and/or) peer groups (Cherney & Campbell, 2011; Robnett & Leaper, 2012; Sikora, 2014), and gender and race/ethnicities (Eccles, 2005; Jacobs, 2005; Osei-Kofi & Torres, 2015; Zarrett & Malanchuk, 2005). While studies have examined population-group differences in both STEM education/career participation and gaming independently, it has largely ignored possible relationships or connections between these two topics (Fraser et al., 2014; Giammarco et al., 2015).

STEM Background

Gender and race/ethnicity gaps continue and are illustrated throughout current literature and governmental reports, despite advances in STEM education and industry sectors. For example, males excel and progress further in academic areas of STEM and throughout STEM fields (Beede et al., 2011; Diekman et al., 2011; Landivar, 2013; NSB, 2012; Osei-Kofi & Torres, 2015; Smith, 2011). Studies of gender differences in STEM education/careers reveal that different factors contribute to numerous causes for such participation gaps. Fewer females are participating in computer science and other “hard” (Sikora, 2014, p. 403) sciences; studies attribute this to negative stereotypes towards females, females feeling isolated, and unfriendly classroom environments (Beyer, 2014; Blickenstaff, 2005; Kolmos et al., 2013; Mercier et al., 2006)

This gender and race/ethnicity gap is especially apparent when looking at advancement in STEM related careers, where males obtain higher ranked positions and receive higher wages than females (Beede et al., 2011; Diekman et al., 2011; Jacobs, 2005; NSB, 2012; Zarrett & Malanchuk, 2005). Evidence of ill-conceived marketing campaigns for STEM education targeting females has resulted in poorly received results and are surprisingly still prevalent. More females represent in academic degrees and career fields specific to areas of science considered the natural sciences (Beede et al., 2011; Landivar, 2013; NSB, 2012; Osei-Kofi & Torres, 2015; Smith, 2011).

Some would purport that these “softer” (Sikora, 2014, p. 403) science areas better serve feminine traits and meet cultural expectations and social norms, as seen through the concept of gender essentialism (Blickenstaff, 2005, Charles & Bradley, 2009; Feniger, 2011; Heyman & Giles, 2006; Sikora, 2014). Gender essentialism derives from Essentialist Theory, the belief that females and males have inherently different traits and attributes and which these characteristics classified are female or male, qualifying these traits as their separate genders (Blickenstaff, 2005, Charles & Bradley, 2009; Feniger, 2011; Heyman & Giles, 2006; Sikora, 2014). Attempting to gender-type is not exclusive to academics, but often illustrated in multiple contexts. For instance, the toy manufacturer *WILD! Science* produces science kits for females and males, seemingly a positive concept as it promotes science for both genders (Frevele, 2011; Plait, 2011). However, manufacturers label these kits designating "…'boys' science' and 'girls' science'…" (Frevele, 2011, para. 1).and package the female designated kits in pink with label descriptors such as, "…'beautiful', 'luxurious'…" (Frevele, 2011, para. 7).

Research has illuminated these unsuccessful marketing efforts, noting stereotypes (Blickenstaff, 2005; Kolmos et al., 2013). Embedded in these marketing campaigns and motivational pieces are catchy slogans; for example, "Science – it's a girl thing" (Kolmos et al., 2013; Sumner, 2015, para. 5), "Pretty Curious"(Lock & Niemtus, 2015, para. 1),. or "Yes, You Can!" (Milgram, 2011, p. 6). Yet, while these messages are intended to be positive in nature, by soliciting female participation in STEM education, they are worse than just cliché and patronizing; they misrepresent both females, STEM education, and STEM careers (Blickenstaff, 2005; Bologna, 2014; Kolmos et al., 2013; Milgram, 2011).

The Vine Public Service Announcement (PSA) campaign for recruiting females into STEM education/careers was featured on America's Next Top Super Model (Jade's Baby, 2015). Participants on the show were tasked with representing gender inequalities in STEM fields by themes, such as "…'money'… 'respect'…[and] 'power'…" (Jade's Baby, 2015, para. 18). Again, this is a public service attempting to promote STEM education/careers for females. However, this only implements a stereotypical mode, revering fashion models. Moreover, movies often miss on representing female scientist characters, portraying them as sexy, as the misunderstood scientist, as emotionally compelled rather than by pure curiosity, drive, and ability, or by their relationships with males, and usually playing secondary roles to men (Chambers, 2015). From marketing grocery items, toys, and games to STEM activities, STEM education, and STEM careers, stereotypes are thriving.

Marketing efforts to recruit women to STEM education have been ongoing over the past decade by the government and colleges. Nevertheless, they have both missed important opportunities to reach females on numerous occasions. The sexist language and images, as well as the representations of female scientists in commercials, movies, college brochures, and other media creates a wide-spread, contrived image of females (Blickenstaff, 2005; Chambers, 2015; Frevele, 2011; McCarthy, 2009; Osei-Kofi & Torres, 2015). These efforts fail to connect with potentially interested females because they highlight the unusualness of females participating in STEM majors and pursuing STEM careers, as well as further alienating females with exclusionary, false, or stereotypical representations of females studying STEM courses and holding active STEM careers. Additionally, if females enroll in a bespoken "women-friendly" (Kolmos et al., 2013, p. 342) programs, these females tend to experience a decrease in academic performance and a drop in self-efficacy over the life of their college career, do not continue their education, or obtain a higher degree (Kolmos et al., 2013; NSB, 2012). The environment and the support received is very important to female student success.

Stereotypes are not exclusive in co-educational settings alone; rather, they exist and are enforced in intra-gender circumstances, too. The research shows somewhat conflicting findings for females with respect to math and science, with some studies clearly showing positive gains in self-efficacy and achievement while others provide evidence that mixed gender groups can promote science support and interest in science careers (Cherney & Campbell, 2011; Robnett & Leaper, 2012).

In studies that looked at science subject choices and science-related career plans (Sikora, 2014) or stereotype thread (Cherney & Campbell, 2011), higher levels of confidence, as well as math and science average achievement scores were higher in single-sex schools for females than co-educational schools. In examination of friendship groups, both female science value and STEM career interest where shown to increase with a supportive STEM peer group (Robnett & Leaper, 2012). More females than males make up the majority of health-science degrees and choose health-science careers over other STEM careers. It is interesting that even in single-sex schools, studies have shown that females choose health-science careers over physical science careers (Cherney & Campbell, 2011; Sikora, 2014). Moreover, these studies reveal females perform higher on achievement tests than their co-educational counterparts in math and science respectfully, and while there were score differences for males' selection of certain science careers, the same was not true for females (Cherney & Campbell, 2011; Sikora, 2014).

Gaming Background

The gaming industry has consistently designed and marketed games seeking the male audience (Carr, 2005). Gender bias in digital games create a participation gap with potential gamers. The gaming industry has historically failed to design games and gaming consoles that target females or a wider female consumer group (Carr, 2005). An example of this is the handheld gaming device Game Boy (1989), as there was no female-labeled equivalent or Game Girl. This researcher's daughter renamed her device, calling it her Game Girl to distinguish her personal device from her brother's device, and thus identify herself as a gamer in her own right. Some studies purport that one factor for the lower percentage of female gamers is the marketing and the female character representation (Carr, 2005).

Historically, engaging in gaming accredits as a male pastime, and, again most gaming research focuses on gender differences. As some literature would have it, females avoid confrontations, competitions, and overt physical aggressiveness (Bertozzi, 2012; Carr, 2005; Gorritz & Medina, 2000; Vieira, 2014). Thus far, other bodies of research have found the converse to these descriptors, presenting cases evident of females seeking games where competition and aggressiveness are part of the game (Bertozzi, 2012; Carr, 2005; Lenhart et al., 2008; Vieira, 2014). For a time, games often had males as the main character or the hero and, consequently, had females as the victim or the antagonist (Bertozzi, 2012; Near, 2013; Song & Jung, 2015). Although the gender roles are not equally distributed across all game genres, this inequity is no longer as prevalent. The circumstance for many current games is that one may play a female or male key character (Bertozzi, 2012; Near, 2013; Song & Jung, 2015). For example, characters such as Master Chief on the Halo Reach (2010), the hero from The Elder Scrolls V*:* Skyrim (2011), character roles on Fall Out series, the main hero for Call of Duty: Black Ops III (2017), or Commander Shepard from Mass Effect (2007) allow the player to choose female or male identities for these roles.

Considering the character roles and game play types in the examples enumerated above, it is surprising that stereotypes and barriers still exist in the world of gaming. Academic literature has explored gaming within peer groups or collaborative game play, both off-line and on-line game play, but especially for online game play (Yee, 2006a, 2006b; Yee et al., 2012). Studies found peer group influence as a factor for gaming and gender (Autio, Hietanoro, & Ruismäki., 2011; Bekebrede et al., 2011; Ching-Huei et al., 2015; Khalili, Sheridan, Williams, Clark, & Stegman, 2011).

A difficulty with many studies about gaming is that often the body of research sample sizes and demographics do not reflect an equitable quantity of females. Thus, the studies' findings for females do not often reflect a wider range of females participating in the world of gaming (Lenhart et al., 2008). The existing gaming research is not exhaustive and gaming is continuously changing, thus building a case for further study.

This research aims to determine differences in students' game play motivations and gaming preferences. Moreover, it is interesting that like constructs for STEM education/careers, gaming has very parallel gender inequities; thus, it underscores the importance of additional exploration. The following literature provides an understanding of different works examining STEM identities, game play motivation, and game preferences.

STEM Identities

Due to the numerous disciplines encompassing the acronym STEM, literature examining identities are grouped below by discipline or disciplines. Several studies took a broader approach to STEM identities by investigating science identity. Science as a discipline has evolved over time and is historically defined through the cooperation of Nobel laureates, various academies, and scientific organizations as in the submission of an *amicus curiae* brief to the Supreme Court in 1986. Shermer (1991) summarized the extensive brief and subsequent court case involving science curriculum. The summary highlighted key points of the brief, "Science is devoted to formulating and testing naturalistic explanations for natural phenomena…" (Shermer, 1991, p. 529) and further explained the use of the scientific method (Edwards v. Aguillard, 1986). Thus, science as an overarching discipline embodies a wide-range of sub disciplines, and such defines STEM identities. This literature also reviews works that focused on disciplines and specific identities that fall within the context of the STEM acronym.

Carlone and Johnson (2007) developed a science identity model through ethnographic interviews of non-white college females and a review of related identity theory. These authors considered three components for science identity: (a) social performances of scientific practices, (b) competence in knowledge and understanding of science, and (c) recognition of self and by others as a science person. Self-verification (Stets and Burke, 2000), the label one uses to describe oneself (Cook, Kerr, & Moore, 2002) and viewing oneself as a "kind of person" (Gee, 2001, p. 99; 2007, p.54) supports self-identity, yet self-verification is regarded as just a component to multiple variables that comprise self-identity.

However, this variable alone, how one sees himself or herself as a type of person is a significant predictor of interest in STEM careers (Aschbacher, Li, & Tsai, 2014; Hazari et al., 2013) and one's actions (van der Weff, Steg, & Keizer, 2013). Moreover, graduation requirements and parental pressures most often drive which classes high school students choose for enrollment (Harackiewicz et al., 2012; Rozek et al., 2015). Therefore, the element of self-recognition, as in the ability to see oneself as a "type of person" (Carlone & Johnson, 2007), was the most important identity variable for this author's study, as students may express this discrete self-identity factor.

Students' science identities differ by gender and race/ethnicity. Hazari et al.'s (2013) large, national study of college students enrolled in English courses found that, overall, students reported low self-identity related to science (less than 30.0%) across disciplines. These authors compared gender within each race/ethnicity and discovered the weakest science identity was reported by Hispanic females. Rather low science identity was also reported by Fraser el al. (2014), another nationwide study, soliciting teenagers (between 14- and 19-years-old); only 38.0% (*n* = 559) reported thinking of themselves as a science person. Also, only 33.3% (*n* = 784) felt that doing science-related activities was important to their identity.

Researchers measured students' science self-perceptions on students transitioning from middle to high school. Aschbacher et al. (2014) sampled a diverse Southern California population of 8th grade students and then again when becoming 9th graders students from five different sets of middle and high schools. In addition to 10 items measuring science self-perception, supported by expectancy-value theory (Wigfield & Eccles, 2000) and focused on ability belief, expectancy and value, these authors administered the *Is Science Me?* survey. Students responded to the following four-cases: *Science is Me* (12.0%, *n* = 493), *I Value Science, but I Don't Do It Well*, *I can Do Science, but I Don't Value it*, *Science is Not Me* (57.0%, *n* = 493). Interestingly, the study found no statistical significance for gender and race/ethnicity and science self-perceptions. Small or nonsignificant differences (6.0%) were found between genders for biology and chemistry at high identification range of scale (four to six) in Hazari et al.'s (2013) study.

However, males in all race/ethnicity groups had a frequency higher than 30.0% for physics identity in Hazari et al.'s (2013) study. Responses for the physics item appeared skewed because many of the students who had not taken physics in high school chose not to respond to this item. These authors predicted that the physics identity would be much lower if all participants responded to the item. Nonetheless, on average, males in the study reported a statistically significant physics identity compared to females ($\chi 2 = 234.7$, $\rho < .001$).

Interestingly, when Potvin and Hazari (2016) controlled for college students' physics identity, gender did make a difference and was shown to be a valid predictor of physics teacher' evaluations for these students' high school science experience ($\rho < 0.5$). Gender alone did not render a significant difference in teacher evaluations. Lock, Hazari, and Potvin (2013) evaluated math and physics identity, finding males reported higher identities across all three identity components for math and physics relative to females. The importance of physics identity, in parallel to math identity, was demonstrated again by Godwin, Potvin, Hazari, and Lock (2016). The authors found physics and math identities as predictors to first semester college students choosing an engineering career. Noteworthy, the authors found students' identity, not discipline competency, served as a positive predictor for engineering choice.

Godwin et al.'s (2016) finding is consistent with Cass, Hazari, Cribbs, Sadler, and Sonnert's (2011), where students identifying as a physics person were more likely to choose an engineering career relative to those that identified as a biology or chemistry person ($\rho < 0.001$). Similar findings occurred in Hazari et al.'s (2013) study for STEM and for physics (Hazari et al., 2010) careers over biology/life science careers, the main point being that students' identity is important to educational and career choices. The two studies indicate one's identity is related to personal choices, but not necessarily limited to, career choices.

In a study conducted by Capobianco, Yu, and French (2015), findings showed gender differences in pre-adolescent students' identity. Researchers measured engineering identity for elementary students (N = 550), grades 1st through 5th. Females reported higher self-identity compared to males after participation in science learning activities.

Similar to the term science, math overarches many other disciplines and implies multiple types of mathematical concepts and skills. Math is a discipline that transcends many STEM disciplines, especially in the physical sciences (Black & Hernandez-Martinez, 2016; Eccles & Wang, 2016). Self-concept and confidence, through the lens of the expectancy-value model by Wigfield and Eccles (2010), as well as other colleagues, found that high school females had lower self-confidence levels for math and science (Eccles & Wigfield, 2002) and lower ability self-concept (Eccles & Wang, 2016) than male peers.

Congruently, concerned about gender and race/ethnicity disparities in math and science for youth, Riegle-Crumb, Moore, and Ramos-Wada (2010) examined 8th-graders' math and science self-concept across the nation. Interestingly, Black males did not report a statistically significant difference in math or science self-concept from White males. However, these authors found that White males (42.9%, $n = 2{,}742$) reported higher levels of math self-concept compared to Hispanic males (34.5%, $n = 690$, $\rho < .01$) as well as to all White (37.6%, $n = 2{,}956$, $\rho < .001$), Black (36.2%, $n = 635$, $\rho < .05$), and Hispanic (25.7%, $n = 731$, $\rho < .001$) female groups. With respect to science self-concept, White males (47.6%) reported higher levels, again, relative to Hispanic males (37.0%, $\rho < .001$)

as well as to all White (42.0%, $\rho < .001$), Black (37.4%, $\rho < .01$), and Hispanic (25.9%, $\rho < .001$) female groups.

A math identity model, tested by Cribbs, Hazari, Sonnert, and Sadler (2015), featured students' interest, competence/performance, and recognition, along with the item of seeing self as a math person. Findings showed a direct effect of recognition on math identity (self-identity) to be higher than the effect due to interest. Additionally, competence/performance had only an indirect effect on math identity (self-identity) through recognition and interest, and a higher direct effect on recognition. Lock et al. (2013) also examined three identity components for math and physics. A study on college students by Stets, Brenner, Burke, and Serpe (2017) found that external recognition was not discrepant from how students saw themselves as a science person. Moreover, students tended to rate themselves higher than how others saw them as a science person, if a discrepancy did occur. Thus, while researchers have examined identity as having multiple components or predictors, even by Stets et al. (2017), the research evidence demonstrates that "a type of person" (Carlone & Johnson, 2007) serves as a "precedent" (Cribbs et al., 2015, p. 1054) for STEM self-identity, and so utilized in this study.

Game Play Motivations

Bartle (2005) explains that the players' identity changes over time through gaming experiences and gamer development, stating, "Virtual worlds are a quest for identity. By being someone virtual, 'you find out who you are in reality'" (Bartle, 2005, p. 15). Taxonomies exist for game motivations and gamer types. Widely referenced, Bartle (1996) originally developed a two-dimensional taxonomy for four player types, organized by two axes representing the "Nature of Fun," (Bartle, 2003, para. 5). Traditionally, Bartle's Player Types model reflects four game player personalities: Killers, Achievers, Explorers, and Socializers (Bartle, 1996). Later, a three-dimensional model was developed by adding the dimension of Implicit/Explicit concept (Bartle, 2003), which grows the player type to eight types: opportunists (Implicit Achievers), planners (Explicit Achievers), scientists (Explicit Explorers), Hackers (Implicit Explorers), Networkers (Explicit Socializers), Friends (Implicit Socializers), Griefers (Implicit Killers), and Politicians (Explicit Killers) (Bartle, 2005).

Yee (2003) built a game play motivations taxonomy on the ground work of Bartle (1996), who first examined gamer types in Multi-User Dungeons (MUDs) and later based the gamer types on human personality types and the Hero's Journey (Campbell, 2008), as they relate to gaming (Bartle 1996, 2003, 2005). Ten game play components reveal three overarching components and consequent sub components: (a) Achievement, comprised of advancement, mechanics, competition; (b) Social, comprised of socializing, relationship, teamwork, and (c) Immersion; comprised of discovery, role-playing, customization, and escapism (Yee, 2003, 2006a, 2006b; Yee et al., 2012). For this study, this researcher utilizes Yee's game play taxonomy and game play motivations scale.

Game play motivations do vary across age groups. Greenberg et al.'s (2010) study found two important findings. First, competition and challenge were both sexes' main gratifications for playing videogames. Second, the greatest gender differences in mean gratification scores were arousal and social interaction. Greenberg et al. (2010) also found males had significantly higher percentages than females for all measured gratifications in the study ($p < .001$). This finding is consistent with prior work by Yee

(2006a), who upon further data analysis, found no significant gender differences; rather, his research suggests we should be looking for game play motivation differences amongst ages. Age, in Yee's (2006a) study, accounted for a significant portion of variance. More recently, in a group of 13- to17-year old youth, similarly to this study's sample age range, Yee (2015) found $r = .28$ for competition game play motivation; however, accounting for variance (r^2), age explained three times the variance observed in competition motivation relative to gender.

Dalisay, Kushin, Yamamoto, Liu, & Skalski, (2015) examined game players' activity in common citizen-type activities to explore game play motivation as a predictor of social capital, civic engagement, and political participation. Standardized regression results showed that discovery game play motivation predicted trust ($\rho < .05$) and political participation ($\rho < .01$); social game play motivation predicted neighborliness ($\rho < .01$).

In a study by Giammarco et al. (2015), findings show a relationship between game play motivations and vocational aspirations, as well as related gender differences. These authors measured a wide range of adults, from 19- to 76-years-old. Males scored higher than females in the following game play motivations: arousal ($\rho < .01$), competition ($\rho < .05$), and social interaction ($\rho < .001$). Findings show no significant difference between gender for challenge and diversion motivations. These authors also reported a link between some motivations and vocational interests, such as with social motivation and interpersonal confidence, authoritarian leadership, and consulting, each $\rho < .001$, respectively. Competitive motivation was associated with engineering, physical science, mathematics, each $\rho < .05$, respectively, as well as medical service ($\rho < .01$). This builds a case for this author's interest in seeking possible connections between game play motivations (Yee et al., 2012) and STEM identities, which of themselves, have been linked to college majors and careers choices.

Games with science features as related to respondents' Nature of Science (NOS), measured by Fraser et al. (2014), uncovered that participants enjoyed problem solving and master game traits, and liked to achieve success (74.7%, n = 1,122). Teens also reported that they liked to have the ability to choose [their] skill level (60.3%, n = 1,409). Four game preferences measured with science-related features, as related to science learning (Gee, 2007), exposed significant differences from each other except for design features of games, social aspects of games, and learning from mistakes. Fraser et al.'s (2014) study examined how games played by these youths related to their NOS through regression methods. The strongest predictor of high NOS was the enjoyment of problem solving and mastery features of games played by participants. Additionally, the following predicted respondents' science understanding: respondents' competence in games with science features, acknowledgement that games can relate to real life, and enjoyment in the social aspects (collaboration and competition) of a game.

Game Preferences

Technology and video games continue to change; therefore, it is important to generate current and medium specific data as different issues may arise. A study of 213 males and females between the ages of 10- to 15-years-old, residing in northeastern U.S., (Homer, Hayward, Frye, & Plass, 2012) reported significant gender differences, with more males preferring first-person shooter ($\rho < .001$), fighting ($\rho < .01$), sports ($\rho < .05$) and Massively Multiplayer Online Roleplaying Games (MMORG) ($\rho < .05$) games. Females, however, reported a significantly higher preference for virtual life ($\rho < .001$), puzzles ($\rho < .001$), and party games ($\rho < .001$). Findings showed significance for gender and these stereotypical game genres; however, more females played the male preferred games than the number of males reported to play female preferred games.

Different game genres or game labels in various studies reveal other gender differences. For example, Sherry, Lucas, Greenberg, and Holmstrom (2013) found females prefer simulation genre games; whereas males prefer more strategy based game genres. Over development and growth, both genders expand their preference for strategy games. Females grow their interest in strategy games at a slower rate than males; however, strategy games are females' second highest preference in 10th grade. Although males developed a high preference for strategy games in 8th grade; it is important to note that strategy genres for males were ranked near the bottom in 5th grade.

The authors determined that this shift was potentially due to the cognitive challenges of strategy games (Sherry et al., 2013). However, the authors speculated that the difference in the number of hours of game play or exposure to games may develop preferences, not age alone. A feature of strategy games is competition, a quality shown to be a desirable game style for males. Often, competition and social game play motivations are intrinsically rooted within strategy games. Additionally, Greenberg et al. (2010) found for all age groups that males preferred physical games, following closely with an imagination games preference; meanwhile, females preferred traditional games across all the age groups, with other preferences varying over the age groups. Sherry et al.'s (2013) study also found that preferences change with the developmental growth of youth.

Fraser et al.'s (2014) study examined 1502 youth ranging from 14- to 19-years-old across the nation for game preferences with respect to activities that may relate to science learning. The top games were solving puzzles and word games (52.3%), racing with obstacles and challenges (51.4%), playing or making music/dancing (48.4%), engaging in battles (47. 9%), and first-person-shooter games (45.7%). As related to game preference with a science feature, just 14.4% of respondents indicated those with scientific investigations, as well as strong correlation with activities involving science learning.

Features of participants' preferred games emerged, specifically graphics and relation to reality. Aspects of graphics favored were characters and protagonists (assuming avatars), multiple skill levels, interfaces with maps, and the ability to explore possible worlds. Traits favored in the theme of relation to reality were games that could "teach [them] to solve problems quickly and that these skills can be applied to real life," or simulated real life or real-life activities (Fraser et al., 2014, p. 526).

Fraser et al. (2014) found that some game types served as a significant predictor to participants' understanding of the NOS, including: engaging in battle, racing, building cities and environments, and solving word puzzles. Fraser et al. (2014) found that the frequency of types of specific game played, also served as a predictor to high NOS. Strikingly, youth who preferred first person shooter (FPS) games had higher NOS scores. Moreover, the most played games reported in this study were the Call of Duty (2017) (2017) series, along with The Sims series (2000), Halo (2001), Mario (2017), and the Madden (1988) game series.

However, Manero, Torrente, Freire, and Fernandez-Manjon (2016), who also studied game preferences with respect to play frequency, clustered 754 secondary school students into four groups. The authors found that casual (plays musical, social, and thinking games in moderation) and non-gamers (does not play much) clusters comprised more females, whereas well-rounded (plays all kinds of games frequently) and hard-core clusters (plays FPS and sport games frequently) comprised more males. This body of work supported this authors' interest in further examination of game preferences and STEM identity.

Summary of the Literature Findings

Identity, as a type of person, is a significant predictor of interest in STEM careers (Aschbacher et al., 2014; Hazari et al., 2013) and one's actions (van der Weff et al., 2013). Hazari et al.'s (2013) study found that students reported low self-identity related to science across the disciplines and Hispanic females reported the weakest science identity of all population groups. Fraser et al. (2014) found that youth reported low for seeing self as a science person and that doing science-related activities was relatively not important to participants' identity.

Gender differences in identity are also present in pre-adolescent students. A study conducted by Capobianco et al. (2015) found females reported higher self-identity compared to males after participation in science learning activities. Here, unlike Fraser et al.'s (2014) study, science activity did matter to science identity. Moreover, this study demonstrated that identity is not static.

Science self-perceptions were measured on students transitioning from middle to high school in Aschbacher et al.'s (2014) study, where students reported very low to

Science is Me, and over half reported *Science is Not Me*. Statistical significance was not found for gender and race/ethnicity for science self-perceptions; however, small differences were found between genders for biology and chemistry at high identification in Hazari et al.'s (2013) study. Males in all race/ethnicity groups had a frequency higher for physics identity than females in all race/ethnicity groups in Hazari et al.'s (2013) study.

Math and physics identities, also evaluated by Lock et al. (2013), showed that males reported higher identities in all three identity components for math and physics, relative to females. Physics and math identities were predictors to first semester college students choosing an engineering major (Godwin et al., 2016). Moreover, students' identity, not STEM discipline competency, was a positive predictor for engineering choice. Cass et al.'s study (2011) found students reporting a physics identity were more likely to choose an engineering career comparative to students identifying as a biology or chemistry person.

Math is a discipline that infuses many STEM disciplines, especially physical sciences (Black & Hernandez-Martinez, 2016; Eccles & Wang, 2016). Gender and race disparities exist in math and science for youth, as revealed when Riegle-Crumb et al. (2010) examined math and science self-concept across the nation. In their study, Black males did not report a difference in math or science self-concept from White males. However, White males reported higher levels of math and science self-concept compared to Hispanic males, as well as to all White, Black, and Hispanic female groups.

Math identity, studied by Cribbs et al. (2015), included students' interest, competence/performance, and recognition, along with the item of seeing self as a math person. The direct effect of recognition on math identity (self-identity) was higher than the effect due to interest. Competence/performance had only an indirect effect on math identity (self-identity) through recognition and interest, had a higher direct effect on recognition. Thus, recognition is important to sense of self. However, Stets et al. (2017) found that external recognition was not discrepant from how students saw themselves as a science person. Students rated how others saw them as a science person higher, if a discrepancy did occur.

Game play motivations do vary across age groups. Greenberg et al.'s (2010) study found competition and challenge were both genders' main gratifications for playing videogames, with the largest gender differences in mean gratification being in arousal and social interaction. In addition, the authors found that all measured gratifications in the study had significantly higher percentages for males than for females. Yee's study (2006a) found no significant gender differences and his research suggests a need for examining game play motivation differences amongst ages.

Game play motivation, examined by Dalisay et al. (2015), is shown as a predictor of social capital, civic engagement, and political participation. Results revealed that discovery game play motivation predicted trust and political participation; social game play motivation predicted neighborliness. Gender differences in game play motivations were found to relate to vocational aspirations, as seen in Giammarco et al.'s (2015) study where males scored higher than females in the following game play motivations: arousal, competition, and social interaction. Challenge and diversion motivations were not significant for gender. Competitive game play motivation was associated with engineering, physical science, mathematics, as well as medical service.

Technology and video games continue to evolve; thus, it is important to reevaluate research data. In a study by Homer et al. (2012), findings showed significant gender differences, with more males preferring first-person shooter, fighting, sports, and MMORG games. Females reported a significantly higher preference for virtual life, puzzle, and party games.

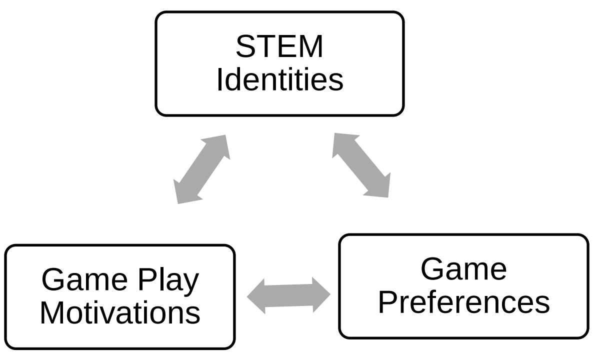
Different game genres or game labels in various studies reveal other gender differences. Greenberg et al. (2010) found males preferred physical games in all age groups, followed by imagination games; females preferred traditional games across all the age groups and compared to males, with other preferences varying over the age groups. Sherry et al. (2013) reported female preference for simulation genre games and male preference of strategy based game genres. Fraser et al.'s (2014) study examined game preferences with respect to activities that may relate to science learning. The top games were solving puzzles and word games, racing with obstacles and challenges, playing, or making music/dancing, engaging in battles, and first-person-shooter games.

Theoretical Framework

The theoretical framework for STEM identity comes from Carlone and Johnson's work (2007) on science identity. Identity, or understanding of self, forms from social experiences, and such experiences have influences on learning and behaviors. Carlone and Johnson (2007) purposed that science identity comprises of three aspects: social performance within science content and practices in front of peers, self-recognition and perception by others as a science person, and lastly, competence with science content. Well supported by Gee (2001, 2007) and utilized by Hazari et al. (2010, 2013) in science identity research is the concept of self-recognition, or "kind of person" (Gee, 2001, 2007), as an aspect of identity. A “type-of-person” (Carlone & Johnson, 2007) is the basis of this study’s identity construct. This study utilizes the identity component of seeing oneself as a type of person.

The theoretical background for game play motivations germinates from Bartle’s player types (1996, 2003, 2005), and further researched and developed by Yee and colleagues (Yee, 2006a, 2006b; Yee et al., 2012). The three main variables examined in this study are: (a) achievement, (b) social, and (c) immersion. Below, in Figure 2.1, the framework illustrates possible connections between the three constructs that this study sought to measure.

Figure 2.1. Framework for Possible Connections Between Constructs



Conclusion

The body of research for STEM and gaming variables continues to expand with new knowledge and technologies. The gender and racial/ethnicity gap for STEM and gaming participation remains a concern. Practitioners seek to find differences in student’s STEM identities, game play motivations, and game preferences. This study sought to examine student differences and find possible connections between these constructs. Similar stereotypes exist for STEM and gaming participation in the media, academics, and in the workplaces of both industries. Findings may encourage further research to innovate schemes for closing the gender gaps in both STEM and gaming participation. Chapter III addresses methodologies, research design, and procedures.

CHAPTER III

METHODOLOGY

The purpose of this study was to explore differences in students' STEM identities, game play motivations, and game preferences. This sequential mixed methods study collected quantitative data by means of a survey and qualitative data from focus groups from a purposeful sample of 9th through 12th grade students attending a suburban high school located in a large school district in southeastern Texas. This chapter delivers an overview of the research problem, operationalization constructs, research purpose and questions, research design, a description of the population and sample, instrumentation, data collection procedures, data analysis, privacy and ethical considerations, and research design limitations.

Overview of the Research Problem

The need to grow and support STEM education and careers in the U.S. is a widely-held concern for those in leadership, industry, and education (NSB, 2012; NSF, 2013; Tang, 2015). Therefore, it is urgently important that educators increase students' perceptions of STEM education as personally relevant, interesting, and inclusive-to-all. Understanding students' STEM identities, game play motivations and preferences may support development of STEM curriculum and instructional practices that include gaming with the intent to better engage and retain students' participation in STEM. Current literature reports the instructional benefits of immersive and simulated digital game play, paralleling to several learning theories (Chen, Liao, & Cheng, 2012; Shaffer, Squire, Halverson, & Gee, 2005; Yong & Shang, 2015).

Operationalization of Theoretical Constructs

This study consists of three constructs: (a) STEM identities, (b) game play motivations, and (c) game preferences. STEM identities are defined as how students see themselves as a "type of person" (Carlone & Johnson, 2007) for various disciplines. This construct is measured by the *Persistence Research in Science* (PRiSE) *Survey* (Hazari, 2010). Game play motivations are defined by three main factors: (a) achievement, (b) social, and (c) immersion. This construct is measured by the *Game Play Motivations Survey* (Yee et al., 2012). Game preferences are defined by the game activity type or genres that the participants prefer, for example: solving puzzles and word games, first-person-shooter (FPS), role-play in fantasy or role-playing environments. This construct is measured by the *National Survey of Game Users II* (Fraser et al., 2014).

Research Purpose and Questions

The purpose of this study is to explore differences in students' STEM identities, game play motivations, and game preferences. This study addressed the following research questions:

1. Does gender influence STEM identity?
2. Does gender influence game play motivations?
3. Does gender influence game preferences?
4. Is there a relationship between students' game play motivations and STEM identities?
5. Is there a relationship between students' game preferences and STEM

identities?

6. How do students perceive, if at all, that their game play motivations, with respect to their game preferences, relate to their STEM identities?

Research Design

A sequential mixed methods design was used for this study. This design had two phases: a quantitative phase followed by a qualitative phase. The advantage of a mixed methods design is that it provides a more data-rich study to make comparisons across the data and address different questions and compensate for weaknesses of either method (Driscoll, Appiah-Yeboah, Salib, & Rupert, 2007). A purposeful sample of 167 9th grade-12th grade students from a southeastern Texas suburban school district participated in this study. These students were solicited to complete the *Gaming and STEM Survey* and participate in focus groups. Quantitative data were analyzed using frequencies, percentages, means, cross tabulations, and either the Mann-Whitney U test or Chi-square ($\chi 2$) test of independence. Qualitative data were analyzed using Yin's (2006) inductive coding method.

Population and Sample

The population of this study consists of 9th through 12th grade high school students from a large suburban school district residing outside of a large metro area in southeastern Texas. The district's student enrollment for pre-K through 12th grade was over 74,000 students for the 2016-2017 school year. The average in-district home sold in 2016 was about $325,000.00, with household expenditures above the national average. Moreover, the unemployment rate was at a low 4.4% rate for 2016, compared to 5.3% across the U.S. In parallel, under half of the district's student population met the criteria for Economically Disadvantaged (37.1%), with eligibility for the free/reduced-price lunch program. Overall, 27.5% of the district's residents hold a Bachelor's degree and 14.8% have a Graduate or Professional Degree. This district serves a diverse student population, reporting 95 different spoken languages, and has 12.9% Limited English Proficient (LEP), 11.6% English as a Second Language (ESL), 4.2% Bilingual, and 7.2% Special Education. District student population groups for school year 2016-2017 were approximately: 32.8% Black, 27.2% Hispanic, 15.3% White, 0.3% American Indian, 21.6% Asian, 0.1% Pacific Islander, and 2.63% Two or More Races. The student race/ethnicities represented in this school district represent a balanced and diverse composition.

This study utilized a purposeful sample of students from this suburban high school population, spanning 9th through 12th grade. This district's 11 high schools enrolled approximately 23,000 students in the 2016-2017 school year. Represented demographics and student groups of the high schools are in Table 3.1. These campuses exhibit a wide range of each student population group. The range of students in serviced programs at these campuses are: 6.6% to 62.5% Economically Disadvantaged, 2.4% to 10.3% English Language Learners (ELLs), and 4.9% to 11.0% Special Education. The demographic range for each population group at these campuses are the following: 5.5% to 66.7% Black, 11.8% to 45.8% Hispanic, 0.5% to 34.4% White, 0.1% to 0.4% American Indian, 0.5% to 53.5% Asian, 0.0% to 0.2% Pacific Islander, and 0.8% to 3.6% Two or More Races. The most distributed student population groups reside in Campus I.

Table 3.1

District Enrollment for 2016-2017 School Year

	Campus A	Campus B	Campus C	Campus D	Campus E	Campus F	Campus G	Campus H	Campus I	Campus J	Campus K
Race/Ethnicities	%	%	%	%	%	%	%	%	%	%	%
Black	18.2	37.4	5.5	18.3	35.3	59.3	16.2	66.7	25.5	27.4	51.9
Hispanic	15.8	43.5	11.8	19.1	16.2	28.6	32.4	30.7	25.0	23.1	45.8
White	22.6	4.3	25.7	21.8	15.4	1.4	13.9	0.9	34.4	24.6	0.5
Am. Indian	0.1	0.4	0.4	0.2	0.4	0.2	0.1	0.3	0.4	0.2	0.4
Asian	40.8	12.7	53.5	38.2	29.0	9.2	35.3	0.5	11.6	21.5	0.31
Pacific Is.	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.2	0.2
Two/More	2.5	1.6	3.1	2.5	3.6	1.3	2.2	0.8	3.1	3.1	1.1
Student Group											
Eco-Disadv.	21.8	50.4	6.6	22.6	22.5	43.5	34.3	58.7	15.1	22.8	62.5
ELL	4.0	8.1	4.2	4.4	2.4	4.2	6.1	7.5	3.2	3.5	10.3

This study sampled from Campus I due to the school's relative demographic distribution and the students' access to technology and STEM learning opportunities. Students attending Campus I have the following participation in serviced programs: 15.1% Economically Disadvantaged; 3.2% English Language Learner; and 5.6% Special Education. The population groups at this campus are the following: 25.5% Black; 25.0% Hispanic; 34.4% White; 0.4% American Indian; 11.6% Asian; 0.1% Pacific Islander; and 3.1% Two or More Races. This campus has numerous student opportunities for students to enroll in STEM courses, participate in STEM clubs and competitions, and select a STEM endorsed graduating plan. Additionally, students have access to computer labs, library computers, and classrooms possessing about six computers or having a one-to-one-ratio to students. It was important to have participants that had reasonable access to both technology and STEM content, if so desired or required (for graduation). This setting supports an environment of exposure to the three constructs, helping shape students' perspectives and personal schemas. A purposeful sample of 9th grade-12th grade students from a southeastern Texas suburban school district were solicited to participate in this study.

Participant Selection

Participants for the focus groups came from Campus I. This researcher selected focus group participants based on the criteria that considered only students who participated in the survey portion of this study. Solicitation in this manner was intentional, so that focus group participants had prior exposure to the types of topics discussed in the sessions, and had familiarity with their own responses to the survey. Additionally, participant distribution across grade and course levels, as well as a balance in gender and race/ethnicity, aided in capturing a range of student perspectives. Focus group participants volunteered, and this researcher coordinated session times with the participants or classroom teachers.

Instrumentation

PRiSE Survey

The survey items for STEM identities originated from questions within the *PRiSE Survey* (Hazari et al., 2010) and utilized by Hazari et al.'s (2010, 2013) works on identity. The *PRiSE Survey* asks participants to self-identity with specific science disciplines: (a) biology, (b) chemistry, and (c) physics. However, this study also examines other disciplines for the acronym, STEM: technology, engineering, and math identities, as well as computer science. Other authors, such as Hazari et al. (2010, 2013) and Fraser et al. (2014) have also utilized the identity theory developed by Carlone and Johnson (2007). This study utilizes the phrasing *Do you see yourself as a [content] person?* as represented in the *PRiSE Project*, a large-scale study (Hazari et al., 2010, 2013) surveying college students and funded by the NSF. The study focused on identifying high school factors that influence student persistence in STEM disciplines in the transition from high school to college.

In 2007, undergraduate English composition students across the nation completed the *PRiSE Survey* by means of stratified national random sampling. Stratified sampling occurred, first by 4- and 2-year institutions, then additionally by the size of the institution: small, medium, and large. A cap of 500 students per institution kept an institution from over representing itself in the sample. Of the 160 institutions contacted, 34 submitted 6,860 student questionnaires. Large sections of the *PRiSE Survey* were previously utilized in *the Factors Influencing College Science Success Study*, with determined validity and reliability; Hazari et al. (2010) also completed independent reliability and validity analysis.

Test-retest reliability occurred by having 96 students complete the survey twice, with about two to three weeks in-between each administration. Analysis of the continuous variables, by correlation coefficient reliability, between test-retest, and the dichotomous variables, by Cohen's kappa, and with these two combined measures exhibited a high reliability of 0.7. Cronbach's alpha ($\alpha = 0.83$) tested reliability for internal consistency of the physics identity construct. Focus groups consisted of experts in science education and undergraduate students, and in addition to open-ended free response questionnaires, these provided validity to the survey items. Hazari et al. (2010) also used factor analysis to provide construct validity to the theoretical framework.

The aforementioned survey items met Hazari et al.'s (2010, 2013) needs for distinguishing between different science disciplines and was rated with a scale of 1 (*No, not at all*) to 6 (*Yes, very much*). Due to the concerns with high school students selecting from a range of unlabeled anchors, the researcher's committee chair and statistician recommended adding labels to the range. The various STEM identities are measured using a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*), as used in Fraser et al.'s (2014) study. This study only used the survey items for measuring identity as a type-of-person, for a total of seven items.

Game Play Motivations Survey

The *Game Play Motivation Survey* items were first developed and utilized by Yee (2006a, 2006b), where 30,000 Massively Multiplayer On-line Roleplay Game (MMORG) players were surveyed over a three-year period. Yee's (2006a, 2006b) purpose for the work was to empirically test Bartle's Player Types (Bartle, 1996, 2003, 2005) and to create a quantitative instrument for measuring game play motivation. Originally, the survey was 39 items. This inventory was later reduced to 12 items, a validated and reliable subset of the original 39-item survey (Yee et al., 2012). The three main components and correlating subcomponents for game play motivation are: (a) achievement ($\alpha = 0.74$) comprising advancement, mechanics, and competition; (b) social ($\alpha = 0.77$) comprising socializing, relationships, and teamwork; and (c) immersion ($\alpha = 0.75$) comprising discovery, role-play, customization, and escapism. Principal component analysis (PCA) and other oblique rotations further tested the game play components.

Yee et al. (2012) conducted a three-phased test process to address potential weaknesses in the original survey. First exploratory factor analysis, Kaiser's Meyer-Olkin measures of sample adequacy, and Barlett's Test of Sphericity analyzed the scale. Second, gender concerns were scrutinized and Confirmatory Factor Analysis (CFA) demonstrated that the game play motivations were also valid for non-Western cultures, and thus had cross-cultural applications. Third, analysis of predictive validity in context with in-game characteristics of the World of Warcraft game were significant. However, these authors suggested further examination to produce validity with other games.

The 12 survey items use a 5-point scale ranged from 1 (*Not Important at All*) to 5 (*Extremely Important*). However, due to concerns with high school students selecting from a range of unlabeled anchors, the researcher's committee chair and statistician recommended adding labels to the range. For this study, game play motivation items were measured using a 5-point Likert scale, ranging from 1 (*Unimportant*) to 5 (*Very Important*).

National Survey of Game Users II

Survey items measuring game preferences are based on the *National Survey of Game Users II* (Fraser et al., 2014). These authors selected 15 items based on gaming research of which represent various game activities or genres, for example: solving puzzles and word games, first-person-shooter (FPS), role play in fantasy or role-playing environments. Requests were sent out across the U.S. to parents, seeking consent and confirming that 14- to18-year-old teens resided in the households. Survey information and a URL link were then sent to the teens, with1,502 teens responding to the online survey. A cap balanced the responses, with 375 participants, from each age range based on birth year.

These survey items were analyzed using descriptive statistics, finding frequency, percentage, means, and standard deviations. Included in the work was a statement that all items were analyzed for validity, predictive strength, and correlations; however, Cronbach’s alpha was not provided. These authors set up the question as a dichotomous variable, with game activity types or genres listed, and were coded 1 (item checked), or 0 (item not checked). For this study, participants indicated if they like to play the given game activity or genre by simply checking one of the corresponding boxes (*Yes*) or (*No*). Additionally, this study only used the survey items for measuring game preferences.

Data Collection Procedures

Quantitative

The researcher gained approval from the Committee for the Protection of Human Subjects (CPHS) at the University of Houston-Clear Lake (UHCL) and the Internal Review Board (IRB) of the participating school district before conducting research. Participant information was obtained from students in accordance to customary research protocol and requirements set forth by the UHCL School of Education Department. Permission was also obtained from the campus principal and classroom teachers for this researcher to speak to students about the purpose of the study, the survey, and focus groups. This researcher provided a survey cover letter and consent/assent form to students' parents to explain the purpose of the study, voluntary participation, and confidentiality. The age range for 9^{th} through 12^{th} grade students spanned from 14 years through 19 years. Although the 18- and 19-year-old students may have consented on their own, the participating school district required that this researcher inform and obtain permission from all students' parents. The survey cover letter explained the purpose of the study, voluntary participation, and assured confidentiality.

This researcher obtained parental consent and student assent to qualify students for participation. Classroom teachers monitored the survey collection process. Participants where sought from a variety of course types and levels to increase the span of participants and minimize bias that may arise from any given course type or level. The variety of classrooms increased the range of data collected in both quantitative and qualitative phases. A printed slip with the survey QR-Code (and link) provided access to the online survey utilizing SurveyMonkey. Participating students completed the survey in class, either on a classroom computer or on the students' personal digital device, such as a smart phone. The classroom teachers monitored this process and collected all used slips after students completed the survey. Each survey required approximately 10 to 15 minutes to complete.

Qualitative

Focus group interviews provided the qualitative data for this study. The focus group participants were selected from volunteers in the sample pool that had already completed the survey. Permission for participation in the focus groups was obtained on the same consent/assent form as utilized for the survey. This researcher verbally repeated that participation was strictly voluntary and that participants may choose not to share during any point in the sessions. Most focus group size ranged from three to nine members. However, two sessions had just one student each and two sessions had just two students each due to lack of other students being available. The focus groups lasted approximately 30 minutes and took place before or after school, or during a time allowed by the classroom teacher. Locations for conducting focus groups included unused classrooms, workrooms, or other appropriate spaces in the campus building. These sessions were audio recorded, transcribed by Rev.com, and reviewed by this author for accuracy.

The purpose of the focus groups was for participants to reflect and respond to questions about their game play motivations and game preferences, as well as their STEM identities, if any exist. The survey exposed students to various game play motivations and game preferences. Here, however, it is important to note that a list of Yee's (2006a, 2006b; Yee et al., 2012) game play motivations, nor Frazer et al.'s (2014) game preferences, were not provided to students participating in the focus groups. Rather, codes were based on students' expressed concepts for these two constructs.

Sometimes, students were not able to easily distinguish between the two constructs and this researcher would at times explain the two constructs, with intention, in terms and phrases that students could understand for participation. Yet, this was also done with care, so as to not lead, limit, or bias student responses. The description for game play motivations this author provided participants was "the reasons why you like to play these games or what motivates you to play these games". The description given for game preferences was "the type or genre of games that you prefer to play".

The anticipation for such data collection was for participants to make connections between their gaming practices and their personal identities. The researcher password protected and secured the data in three locations: an internal hard drive, an external hard drive, and on One Drive, a cloud storage solution from Microsoft. This researcher will keep the data and results of the study for five years before destruction.

Data Analysis

Quantitative Analysis

Data were exported from Excel into the IBM Statistical Package for the Social Sciences (SPSS) for data analysis. To answer research questions one through three, percentages and frequencies were computed to describe participants' item responses for STEM identity, game play motivations, and game preferences and a Mann-Whitney U test was conducted to determine whether there was a difference between males and females in terms of students' STEM identities, game motivations, and game preferences. To answer research question four, percentages frequencies, and cross-tabulations were computed to describe participants' item responses for game play motivation and STEM identity and a Chi-square (χ^2) test of independence was conducted to see if there were any significant relationships between game play motivations and STEM identity. To answer research question five, percentages, frequencies, and cross-tabulations were computed to describe participants' responses for game preferences and STEM identity and a Chi-square (χ^2) test of independence was conducted to see if there were any significant relationships between STEM identity and game preferences. The STEM identities, game play motivations, and game preference constructs were categorical in measurement.

Qualitative Analysis

To answer research question six, this researcher used an inductive coding process (Yin, 2016). The analysis process followed Yin's (2016) five phases: (a) compiling, (b) disassembling (coding), (c) reassembling and arranging in tables (themes), (d) interpretation, and (e) concluding. This was not a linear process, but one where this researcher moved between these phases for rechecking and accuracy of the data, and made sure that the analysis of the data was thorough and complete (Yin, 2016). Moreover, this author continuously acknowledged unwanted bias in analysis and interpretive stance of the data for fairness, value, and credibility of interpretations. Transcriptions were further examined and analyzed, coded with NVivo, and were maintained for reference during and after the data collection process. Responses were organized from codes into themes with attention on redundancy and saturation. Data were sorted by similarities, dissimilarities, non-cases, and rival explanations.

These codes were further scrutinized and sorted, linked with quotes, and organized under themes relative to game play motivations. However, it is important to note that the organization of themes is not explicitly discrete, due to multiple game play motivations articulated within a given excerpt. Overarching ideas expressed by students drove the placement of quotes under themes. Then, where appropriate, the presentation of students' quotes threaded to demonstrate multiple individuals with different STEM identities contributing to the same theme. This organization rendered a fuller picture of students' perceptions across numerous focus groups.

Qualitative Validity

Conclusions drawn from the data analysis process supported answers to the research questions. Researcher bias was minimized by asking focus group members open-ended questions and follow up questions for clarity, as well as maintaining a neutral stance and being supportive to every response from members. Triangulation was employed as a validity check (Yin, 2016). This researcher consistently safeguarded against unsupported and subjective interpretation of themes as they emerged through the analysis phase. The qualitative data were compared to the quantitative data gathered from the survey phase. The survey and focus group data helped confirm validation of the data by multiple methods: (a) by comparing results to prior literature findings, (b) by comparing amongst the identities measured, and (c) by further comparison to responses from the various student composites. Thus, triangulation for this study was achieved by having multiple participants, from multiple types and levels of courses, and through two data collection methods (Yin, 2016).

Independent reports, in the form of transcriptions from multiple sources, helped validate the collected data (Yin, 2016). Content area experts from the College of Education at UHCL peer-reviewed the findings for this study to ensure that biases were not evident with the data analysis conducted by this researcher. Additionally, this researcher held preliminary spot checks after analysis to ensure accuracy and completion of participants' responses.

For survey responses, member checking addressed the possible subjective bias, where participants may review their survey responses prior to completion and submission in Survey Monkey. After preliminary analysis of the qualitative data, spot member checking of findings occurred. This researcher consistently safeguarded against unsupported and subjective interpretation of themes as they emerged through the analysis phase.

Privacy and Ethical Considerations

This researcher gained approval from CPHS at UHCL and the IRB of the participating school district before collecting data. CPHS at UHCL granted permission to conduct research, as did the participating school district, and school principal. This researcher sent hard copies of a cover letter and the informed consent form to the participants' parents. The consent form covered both parental consent and student assent. Each cover letter to the parent outlined the guidelines of the study, including: the purpose and topics of the study, a statement that participation is voluntary, and how participants' identities, and that of campus and teachers, remain confidential.

To receive honest responses on the survey instruments, participants' identities remain confidential. Confidentiality of participants' identities and discussion in focus groups were requested, such that participants were protected, but confidentiality could not be guaranteed as participants may talk outside of the focus group. Use of names of participants, teachers, or the campus did not occur; however, this researcher used typical gender-type pseudonyms to give gender-distinction to quotes. This measure helps to alleviate any potential negative side effects by the conduction of this study on a school campus. The researcher password protected and secured the data in three locations: an internal hard drive, an external hard drive, and on One Drive, a cloud storage solution from Microsoft. This author will retain the data for five years before destruction.

Research Design Limitations

The research design has a few limitations. First, the sample size and geographical location utilized in this research may limit the results of this study. This study sampled only one campus. Generalizations from results may not be appropriate for other populations or other geographical settings. Second, limitations may arise, in part from the self-report measure of the survey, as well as participants' exposure and access to different types of gaming. The degree to which each participant responded honestly on the survey and in the focus groups thoroughly impacts outcomes in the data results. Third, the degree of participants' perceived sense of ease and trust-level amongst the peer composite comprising the focus groups may have limited participants' willingness to share in this setting and could limit the results.

Conclusion

This study explored differences in students' STEM identities, game play motivations, and game preferences. Chapter III provided information regarding the research design, procedures, and instrumentation, as well as data collection and analysis for these three constructs. The interest in analyzing these constructs is to find possible connections between the gaming constructs and STEM identities. Chapter IV reports the data analysis and study's findings.

CHAPTER IV

RESULTS

The purpose of this study was to explore differences in students' STEM identities, game play motivations, and game preferences. This chapter presents the data analysis and findings resulting from both quantitative and qualitative data. Where quantitative data analysis reflects data collected in this current study, the qualitative data analysis reflects both data collected in the pilot and this current study. Results for each of the six research questions follow, along with a concluding summary of the findings.

Participant Demographics

Survey

A purposeful sample of 175 students participated in this study; however, eight students were deleted due to either choosing to decline further participation once the survey was opened or after starting the survey. A total of 167 student survey participants' data were analyzed (see Table 4.1). Student participants represented both genders nearly equally (males, n = 80, 47.9% and females, n = 87, 52.1%). Race/ethnicity groups for survey participants were as follows: Black (n = 22, 13.2%); Hispanic (n = 19, 11.4%); White (n = 83, 49.7%); American Indian (n = 1, 0.6%); Asian (n = 25, 15.0%); Pacific Islander (n = 0, 0.0%); and Two or More Races (n = 17, 10.2%). Survey participants reported the following grade levels: Freshman (n = 49, 29.3%), Sophomore (n = 31, 18.6%), Junior (n = 15, 9.0%), and Senior (n = 72, 43.1%).

Table 4.1

Participants' Demographics (*N = 167)*

	Frequency (n)	Percentage (%)
1. Gender		
Male	80	47.9
Female	87	52.1
2. Race/Ethnicity		
Black	22	13.2
Hispanic	19	11.4
White	83	49.7
American Indian	1	0.6
Asian	25	15.0
Pacific Islander	0	0.0
Two or More Races	17	10.2
3. Grade Level		
Freshman	49	29.3
Sophomore	31	18.6
Junior	15	9.0
Senior	72	43.1

Focus Group

This chapter summary does not refer to the quantitative survey data from the pilot study; however, two sets of focus group data were examined (see Table 4.2), and serve as the qualitative data sources for this study. The first set of qualitative data were collected in the fall of the school year 2016-2017, and the second set were collected in the spring semester of the same school year for this current study. Most focus group participants were solicited from various levels of either English classrooms, Geometry classrooms, Government/Social Studies/History classrooms, and Principles of Business Marketing and Finance. Other participants were solicited from the following classrooms: Web Development, Principles of Art and Audio/Visual class, and Calculus. English, Geometry, and Government/Social Studies/History type courses are all required course work for the district's high school graduation plan.

Table 4.2

Focus Group Member Makeup for Study by Gender and Classroom Type

Focus Group Number	Classroom Type	Member Makeup	
		Males	Females
1a	Web Development	5	1
2a	Variety of Social Studies/History Classes	0	5
3a	Principles of Business Marketing and Finance	5	0
4a	Principles of Business Marketing and Finance	2	3
5a	AP Government/Variety of Social Studies/History Classes	1	4
6a	AP Government/Variety of Social Studies/History Classes	0	3
7a	Principles of Business Marketing and Finance	3	1
8a	Principles of Business Marketing and Finance	0	4
9a	Principles of Arts and Audio/Visual class	0	1
10a	Principles of Arts and Audio/Visual class	1	0
11a	Principles of Arts and Audio/Visual class	2	0
12a	AP Government	2	5
1b	AP Calculus AB	0	4
2b	AP Calculus AB	0	3
3b	AP Calculus BC	3	0
4b	English IV College Now	2	3
5b	English IV College Now	1	4
6b	English IV College Now	3	5
7b	Pre-AP Geometry/Geometry	2	6
8b	Pre-AP Geometry	1	5
9b	Pre-AP Geometry	3	2
10b	Geometry	1	2
11b	Pre-AP English I	4	4
12b	Practical Writing	2	0
13	Pre-AP English I / Pre-AP English II	0	4
14	Pre-AP English II	0	3
15	Pre-AP English I	5	4
16	Pre-AP English I / Pre-AP English II	2	4
	Total for males and females	50	80

Research Question One

Research question one, *Does gender influence STEM identity?,* was answered using frequencies, percentages, and Mann-Whitney U tests to show how participants' see themselves in terms of their STEM identities (see Tables 4.3 and 4.4). A Mann-Whitney U test was conducted to determine whether there was a difference between males and females in terms of students' STEM identities. Percentages and frequencies for males and females reporting *Agree/Strongly Agree* are shown in Table 4.5. Overall student science identity ranged from 37.1% (n = 62) to 53.3% (n = 89) for *Strongly Agree/Agree* for all STEM identities, designated by a specific STEM discipline. Technology and Math identities had the highest percentage of students selecting *Strongly Agree/Agree*. Computer Science and Chemistry had the highest percentage of students selecting *Strongly Disagree/Disagree*. Additionally, males reported a higher percentage than females for *Strongly Agree/Agree* for four of the seven disciplines than females. Females did not report any STEM identities at a significantly higher percentage than males.

The results of the Mann-Whitney U test indicate a significant difference between males and females in that males see themselves more as a physics person than do females, $z = -4.01$, $\rho < .001$. Males had an average rank of 99.2, while females had an average rank of 70.0. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males see themselves more as a technology person than do females, $z = -3.94$, $\rho < .001$. Males had an average rank of 98.3, while females had an average rank of 70.9. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males see themselves more as a computer science person than do females, $z = -3.59$, $\rho < .001$. Males had an average rank of 97.5, while females had an average rank of 71.6. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males see themselves more as an engineer person than do females, $z = -4.95$, $\rho < .001$. Males had an average rank of 102.8, while females had an average rank of 66.7.

Table 4.3

Expanded Frequencies and Percentages: How Participants See Themselves as a Type of Person-STEM Identities (N = 167)

	Strongly Disagree		Disagree		Neither Agree or Disagree		Agree		Strongly Agree	
Identity	n	%	n	%	n	%	n	%	n	%
Biology	16	9.6	41	24.6	31	18.6	53	31.7	26	15.6
Chemistry	36	21.6	34	20.4	35	21.0	47	28.1	15	9.0
Physics	20	12.0	35	21.0	50	29.9	44	26.3	18	10.8
Technology	4	2.4	22	13.2	22	13.2	82	49.1	37	22.2
Computer Sci.	14	8.4	61	36.5	34	20.4	40	24.0	18	10.8
Engineer	18	10.8	40	24.0	39	23.4	44	26.3	26	15.6
Math	28	16.8	17	10.2	33	19.8	50	29.9	39	23.4

Table 4.4

Collapsed Frequencies and Percentages: How Participants See Themselves as a Type of Person-STEM Identities

	Strongly Disagree /Disagree		Neither Agree or Disagree		Strongly Agree /Agree	
Identity	n	%	n	%	n	%
Biology	57	34.2	31	18.6	79	47.3
Chemistry	70	41.9	35	21.0	62	37.1
Physics	55	32.9	50	29.9	62	37.1
Technology	26	15.6	22	13.2	119	71.3
Computer Sci.	75	44.9	34	20.4	58	34.7
Engineer	58	34.7	39	23.4	70	41.9
Math	45	26.9	33	19.8	89	53.3

Table 4.5

Frequencies and Percentages for Gender: How Participants See Themselves as a Type of Person-STEM Identities

	Agree/Strongly Agree Male		Agree/Strongly Agree Female	
Identity	n	%	n	%
Biology	43.0	34	57.0	45
Chemistry	45.2	28	54.8	34
Physics*	62.9	39	37.1	23
Technology*	54.6	65	45.4	54
Computer Science*	63.8	37	36.2	21
Engineer*	65.7	46	34.3	24
Math	50.6	45	49.4	44

*Statistically significant ($\rho < 0.05$), males reported higher average ranks than females.

Research Question Two

Research question two, *Does gender influence game play motivations?,* was answered using frequencies, percentages, and Mann-Whitney U tests to show how participants' see themselves in terms of their game play motivations (see Tables 4.6 and 4.7). A Mann-Whitney U test was conducted to determine whether there was a difference between males and females in terms of students' game play motivation. Percentages and frequencies for males and females reporting *Important/Very Important* are shown in Table 4.8.

Overall, *Optimizing Your Character as Much as Possible*, *Competing with Other Players,* and *Keeping in Touch with Your Friends* had the highest percentage with students selecting *Important/Very Important*. Students selected *Chatting with Other Players*, *Being Part of a Guild*, and *Grouping with Other Players* at *Unimportant/Of Little Importance* with the highest percentages. Females' top four game play motivations (*Important/Very Important*) were *Learning about Stories and Lore of the World*, *Feeling Immersed in the World*, *Exploring the World Just for the Sake of Exploring It, Creating a Background Story* and *History for Your Character*. Males' top four game play motivations were *Becoming Powerful*, *Acquiring Rare Items, Chatting with Other Players*, and *Grouping with Other Players*. There was no significant difference between gender for *Being Part of a Guild, Learning about Stories and Lore of the World*, *Exploring the World Just for the Sake of Exploring It*, and *Creating a Background Story and History for Your Character*. Females did not report any game play motivations at a significantly higher percentage than males.

Eight of the 12 game play motivations were statistically significant for gender. Achievement game play motivations were more important to males than females. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males are motivated by becoming powerful more than do females, $z = -3.99$, $\rho < .001$. Males had an average rank of 99.0, while females had an average rank of 70.3. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males are motivated by competing with other players more than do females, $z = -4.24$, $\rho < .001$. Males had an average rank of 99.6, while females had an average rank of 68.9. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males are motivated by optimizing their character as much as possible more than do females, $z = -2.82$, $\rho = .005$. Males had an average rank of 94.5, while females had an average rank of 74.3.

Social game play motivations were more important for males than females. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males are motivated by chatting with other players more than do females, $z = -3.65$, $\rho < .001$. Males had an average rank of 97.9, while females had an average rank of 71.2. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males are motivated by grouping with other players more than do females, $z = -4.03$, $\rho < .001$. Males had an average rank of 99.4, while females had an average rank of 69.9. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males are motivated by keeping in touch with their friends more than females, $z = -3.06$, $\rho = .002$. Males had an average rank of 95.4, while females had an average rank of 73.5.

Immersion game play motivations were more important for males than females. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males are motivated by acquiring rare items more than do females, $z = -2.99$, $\rho = .003$. Males had an average rank of 95.4, while females had an average rank of 73.6. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males are motivated by feeling immersed in the world more than females, $z = -2.11$, $\rho = .035$. Males had an average rank of 92.0, while females had an average rank of 76.6.

Table 4.6

Expanded Frequencies and Percentages: Participants' Game Play Motivation

	Unimportant		Of Little Importance		Moderately Important		Important		Very Important	
	n	%	n	%	n	%	n	%	n	%
Becoming Powerful	17	10.2	16	9.6	49	29.3	60	35.9	25	15.0
Acquiring Rare Items	25	15.0	26	15.6	45	26.9	45	26.9	26	15.6
Optimizing Your Character as Much as Possible	19	11.4	12	7.2	29	17.4	69	41.3	38	22.8
Competing with Other Players	19	11.4	17	10.2	37	22.3	53	31.9	40	24.1
Chatting with Other Players	39	23.4	43	25.7	40	24.0	28	16.8	17	10.2
Being Part of a Guild	53	31.7	41	24.6	48	28.7	22	13.2	3	1.8
Grouping with Other Players	39	23.4	34	20.4	39	23.4	40	24.0	15	9.0
Keeping in Touch with Your Friends	17	10.2	19	11.4	32	19.2	67	40.1	32	19.2
Learning about Stories & Lore of the World	27	16.2	36	21.6	53	31.7	34	20.4	17	10.2
Feeling Immersed in the World	27	16.2	23	13.8	48	28.7	41	24.6	28	16.8
Exploring the World Just for the Sake of Exploring It	28	16.8	19	11.4	46	27.5	52	31.1	22	13.2
Creating a Background Story & History for Your Character	35	21.0	31	18.6	46	27.5	34	20.4	21	12.6

Table 4.7

Collapsed Frequencies and Percentages: Participants' Game Play Motivation

	Unimportant/ Of Little Importance		Moderately Important		Important/ Very Important	
Game Play Motivations	n	%	n	%	n	%
Becoming Powerful	33	19.8	49	29.3	85	50.9
Acquiring Rare Items	51	30.5	45	26.9	71	42.5
Optimizing Your Character as Much as Possible	31	18.6	29	17.4	107	64.1
Competing with Other Players	36	21.7	37	22.3	93	56.0
Chatting with Other Players	82	49.1	40	24.0	45	26.9
Being Part of a Guild	94	56.3	48	28.7	25	15.0
Grouping with Other Players	73	43.7	39	23.4	55	32.9
Keeping in Touch with Your Friends	36	21.6	32	19.2	99	59.3
Learning about Stories and Lore of the World	63	37.7	53	31.7	51	30.5
Feeling Immersed in the World	50	29.9	48	28.7	69	41.3
Exploring the World Just for the Sake of Exploring It	47	28.1	46	27.5	74	44.3
Creating a Background Story and History for Your Character	66	39.5	46	27.5	55	32.9

Table 4.8

Frequencies and Percentages for Gender: Participants' Game Play Motivation

Game Play Motivation	Important/Very Important Male		Important/Very Important Female	
	n	%	n	%
Becoming Powerful*	52	61.2	33	38.8
Acquiring Rare Items*	46	64.8	25	35.2
Optimizing Your Character as Much as Possible*	62	57.9	45	42.1
Competing with Other Players*	53	57.0	40	43.0
Chatting with Other Players*	31	68.9	14	31.1
Being Part of a Guild	14	56.0	11	44.0
Grouping with Other Players*	35	63.6	20	36.4
Keeping in Touch with Your Friends*	55	55.6	44	44.4
Learning about Stories and Lore of the World	23	45.1	28	54.9
Feeling Immersed in the World*	38	55.1	31	44.9
Exploring the World Just for the Sake of Exploring It	33	44.6	41	55.4
Creating a Background Story and History for Your Character	22	40.0	33	60.0

*Statistically significant ($\rho < 0.05$), males reported higher average ranks than females.

Research Question Three

Research question three, *Does gender influence game preferences?*, was answered using frequencies, percentages, and Mann-Whitney U tests to show how participants' see themselves in terms of their game preferences, by genre or activity-type (see Table 4.9). A Mann-Whitney U test was conducted to determine whether there was a difference between males and females in terms of students' game preferences (see Table 4.10). Overall, *Race with Obstacles and Challenges, Solve Puzzles or Word Challenges, Engage in Battles That Might Include Shooting or Fighting*, and *First-Person Shooter Games*

(FPS) were games that had the highest percentages for students selecting *Yes* as a game preference. There was no significant difference between gender and *Build Cities or Environments*, *Race with Obstacles and Challenges*, *Role Play in Fantasy or Role-Playing Environments*, *Conduct Scientific Investigations*, and *Learn New Facts or Information*.

Males reported three of the fifteen game preferences at a statistically higher average rank than males. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males prefer games that simulate playing sports more than do females, $z = -2.19$, $\rho = .028$. Males had an average rank of 91.3, while females had an average rank of 77.3. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males prefer games that engage in battles, that might include shooting or fighting, more than females, $z = -4.99$, $\rho < .001$. Males had an average rank of 99.2, while females had an average rank of 70.1. The results of the Mann-Whitney U test indicate a significant difference between males and females in that males prefer first person shooter (FPS) games more than females, $z = -6.82$, $\rho < .001$. Males had an average rank of 105.7, while females had an average rank of 62.9.

Females reported seven of the fifteen game preferences at a statistically higher average rank than females. Females reported a statistically significant higher preference for simulation type games than males. The results of the Mann-Whitney U test indicate a significant difference between males and females in that females prefer games that simulate taking care of animals more than do males, $z = -4.72$, $\rho < .001$. Females had an average rank of 95.6, while males had an average rank of 71.4. The results of the Mann-

Whitney U test indicate a significant difference between males and females in that females prefer games that simulate cooking more than males, $z = -6.29$, $\rho < .001$. Females had an average rank of 102.3, while males had an average rank of 63.3.

Females reported a statistically significant higher preference for games where the player could make or create something or change the appearance of something than males. The results of the Mann-Whitney U test indicate a significant difference between males and females in that females prefer games that simulate making art more than males, $z = -3.78$, $\rho < .001$. Females had an average rank of 95.6, while males had an average rank of 71.4. The results of the Mann-Whitney U test indicate a significant difference between males and females in that females prefer games that play, simulate making music, or dance more than males, $z = -3.34$, $\rho =.001$. Females had an average rank of 94.4, while males had an average rank of 72.7. The results of the Mann-Whitney U test indicate a significant difference between males and females in that females prefer games where players can change the look of something, like fashion or makeup, more than males, $z = -7.00$, $\rho < .001$. Females had an average rank of 104.9, while males had an average rank of 61.3.

Traditional type games, such as those where the player solves a puzzle or word challenges were preferred statistically more by females than males. The results of the Mann-Whitney U test indicate a significant difference between males and females in that females prefer games that solve puzzles or word challenges more than males, $z = -3.57$, $\rho < .001$. Females had an average rank of 92.9, while males had an average rank of 73.5.

Digital games that allowed the player to quiz themselves in preparation for a school or entrance exams were preferred statistically more by females than males. The results of the Mann-Whitney U test indicate a significant difference between males and females in that females prefer games that allow the player to take quizzes to help them with school or entrance exams more than males, $z = -2.75$, $\rho = .006$. Females had an average rank of 91.9, while males had an average rank of 74.3.

Table 4.9

Frequencies and Percentages: Participants' Game Preferences by Activity-Type/Genre

	Yes		No	
Activity/Genre	n	%	n	%
Build Cities or Environments	95	56.9	72	43.1
Simulate Playing Sports	96	57.5	71	42.5
Simulate Taking Care of Animals	55	32.9	112	67.1
Make Art	69	41.3	98	58.7
Change the Look of Something, Like Fashion or Makeup	60	35.9	107	64.1
Race with Obstacles and Challenges	127	76.5	39	23.5
Solve Puzzles or Word Challenges	128	77.1	38	22.9
Engage in Battles That Might Include Shooting or Fighting	120	71.9	47	28.1
First Person Shooter Games (FPS)	103	62.0	63	38.0
Play, Make Music, or Dance	81	48.5	86	51.5
Role Play in Fantasy or Role-Playing Environments	74	44.6	92	55.4
Simulate Cooking	59	35.5	107	64.5
Conduct Scientific Investigations	53	31.9	113	68.1
Learn New Facts or Information	84	50.6	82	49.4
Take Quizzes to Help Me with School or Entrance Exams	71	42.8	95	57.2

Table 4.10

Frequencies and Percentages for Gender: Participants' Game Preferences by Activity-Type/Genre

	Male (*Yes*)		Female (*Yes*)	
	n	%	n	%
1. Build Cities or Environments	49	51.6	46	48.4
2. Simulate Playing Sports[a]	53	55.2	53	44.8
3. Simulate Taking Care of Animals[a]	12	21.8	43	78.2
4. Make Art[a]	21	30.4	48	69.6
5. Change the Look of Something, Like Fashion or Makeup[a]	7	11.7	53	88.3
6. Race with Obstacles and Challenges	61	48.0	66	52.0
7. Solve Puzzles or Word Challenges[a]	52	40.6	76	59.4
8. Engage in Battles Tthat Might Include Shooting or Fighting[a]	72	60.0	48	40.0
9. First Person Shooter Games (FPS)[a]	71	68.9	32	31.1
10. Play, Make Music, or Dance[a]	28	34.6	53	65.4
11. Role Play in Fantasy or Role-Playing Environments	40	54.1	34	45.9
12. Simulate Cooking[a]	9	15.3	50	84.7
13. Conduct Scientific Investigations	24	45.3	29	54.7
14. Learn New Facts or Information	42	50.0	42	50.0
15. Take Quizzes to Help Me with School or Entrance Exams[a]	25	35.2	46	64.8

*Statistically significant ($p < 0.05$): [a]Males reported higher average ranks than females, [b]Females reported higher average ranks than males.

Research Question Four

Research question four, *Is there a relationship between students' game play motivations and STEM identities?*, was answered using a quantitative approach by calculating percentages, cross-tabulations, and Chi-square ($\chi 2$) test of independence. A Chi-square ($\chi 2$) test of independence was conducted to see if there were significant relationship between students' game play motivations and STEM identities (see Table 4.11). Percentages and frequencies are reported below within the group of participants that responded *Important/Very Important* to the game play motivation, and then also reported *Agree/Strongly Agree* to the STEM identity.

Overall, the highest number of statistically significant relationships between game play motivations and STEM identities occurred for *Technology* and *Computer Science* identities. Game play motivations *Becoming Powerful*, *Competing with Other Players*, and *Keeping in Touch with Your Friends* each had four statistically significant relationships with respect to STEM identities. Game play motivations *Being Part of a Guild* and *Creating a Background Story and History for Your Character* had no significant relationship with any of the STEM identities. No relationship was found between any of the game play motivations and *Biology* or *Math* identities. See Figure 4.1 for an overview of statistically significant connections between game play motivations and STEM identities.

Being Powerful

Approximately 41.0% (n = 35) of students reported *Becoming Powerful* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Chemistry Person*. Findings indicated a relationship existed between becoming powerful and seeing oneself as a chemistry person, $\chi2(16, N = 167) = 37.117$, $\rho = 0.002$. If becoming powerful was important to participants, so was seeing oneself as a chemistry person.

Forty percent (n = 34) of students reported *Becoming Powerful* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between becoming powerful and seeing oneself as a physics person, $\chi2(16, N = 167) = 41.293$, $\rho = 0.001$. If becoming powerful was important to participants, so was seeing oneself as a physics person.

Approximately 81.0% (n = 69) of students reported *Becoming Powerful* was *Important/Very Important* to them as well as *Agreed/Strongly* Agreed to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between becoming powerful and seeing oneself as a technology person, $\chi2(16, N = 167) = 37.785$, $\rho = 0.002$. If becoming powerful was important to participants, so was seeing oneself as a technology person.

Approximately 45.0% (n = 38) of students reported *Becoming Powerful* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between becoming powerful and seeing oneself as a computer science person, $\chi2(16, N =$

167) = 33.343, ρ = 0.007. If becoming powerful was important to participants, so was seeing oneself as a computer science person.

Approximately 54.0% (n = 46) of students reported *Becoming Powerful* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as an *Engineer Person*. Findings indicated a relationship existed between becoming powerful and seeing oneself as an engineer person, $\chi 2(16, N = 167) = 31.322$, $\rho = 0.012$. If becoming powerful was important to participants, so was seeing oneself as an engineer person.

Acquiring Rare Items

Approximately 83.0% (n = 59) of students reported *Acquiring Rare Items* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between acquiring rare items and seeing oneself as a technology person, $\chi 2(16, N = 167) = 42.334$, $\rho < 0.001$. If acquiring rare items was important to participants, so was seeing oneself as a technology person.

Approximately 49.0% (n = 35) of students reported *Acquiring Rare Items at Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between acquiring rare items and seeing oneself as a computer science person, $\chi 2(16, N = 167) = 30.183$, $\rho = 0.017$. If acquiring rare items was important to participants, so was seeing oneself as a computer science person.

Optimizing Your Character as Much as Possible

Approximately 41.0% (n = 44) of students reported *Optimizing Your Character as Much as Possible* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between optimizing your character as much as possible and seeing oneself as a physics person, $\chi 2(16, N = 167) = 27.609, \rho = 0.035$. If optimizing your character as much as possible was important to participants, so was seeing oneself as a physics person.

Approximately 82.0% (n = 88) of students reported *Optimizing Your Character as Much as Possible* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between optimizing your character as much as possible and seeing oneself as a technology person, $\chi 2(16, N = 167) = 46.493, \rho < 0.001$. If optimizing your character as much as possible was important to participants, so was seeing oneself as a technology person.

Approximately 39.0% (n = 42) of students reported *Optimizing Your Character as Much as Possible* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between optimizing your character as much as possible and seeing oneself as a computer science person, $\chi 2(16, N = 167) = 27.101, \rho = 0.040$. If optimizing your character as much as possible was important to participants, so was seeing oneself as a computer science person.

Competing with Other Players

Approximately 42.0% (n = 39) of students reported *Competing with Other Players* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Chemistry Person*. Findings indicated a relationship existed between competing with other players and seeing oneself as a chemistry person, $\chi 2(16, N = 166) = 26.362$, $\rho = 0.049$. If competing with other players was important to participants, so was seeing oneself as a chemistry person.

Approximately 50.0% (n = 46) of students reported *Competing with Other Players* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between competing with other players and seeing oneself as a physics person, $\chi 2(16, N = 166) = 27.860$, $\rho = 0.033$. If competing with other players was important to participants, so was seeing oneself as a physics person.

Approximately 81.0% (n = 75) of students reported *Competing with Other Players* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between competing with other players and seeing oneself as a technology person, $\chi 2(16, N = 166) = 31.605$, $\rho = 0.011$. If competing with other players was important to participants, so was seeing oneself as a technology person.

Approximately 48.0% (n = 45) of students reported *Competing with Other Players* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as an *Engineer Person*. Findings indicated a relationship existed between competing with other players and seeing oneself as an engineer person, $\chi 2(16, N = 166) =$

31.318, $\rho = 0.012$. If competing with other players was important to participants, so was seeing oneself as an engineer person.

Grouping with Other Players

Thirty-eight percent (n = 30) of students reported *Grouping with Other Players* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between grouping with other players and seeing oneself as a physics person, $\chi2(16, N = 167) = 33.674$, $\rho = 0.006$. If grouping with other players was important to participants, so was seeing oneself as a physics person.

Keeping in Touch with Your Friends

Approximately 33.0% (n = 33) of students reported *Keeping in Touch with Your Friends* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between keeping in touch with your friends and seeing oneself as a physics person, $\chi2(16, N = 167) = 32.486$, $\rho = 0.009$. If keeping in touch with your friends was important to participants, so was seeing oneself as a physics person.

Approximately 76.0% (n = 75) of students reported *Keeping in Touch with Your Friends* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between keeping in touch with your friends and seeing oneself as a technology person, $\chi2(16, N = 167) = 28.111$, $\rho = 0.031$. If keeping in touch with your friends was important to participants, so was seeing oneself as a technology person.

Approximately 40.0% (n = 40) of students reported *Keeping in Touch with Your Friends* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between keeping in touch with your friends and seeing oneself as a computer science person, $\chi2(16, N = 167) = 28.824$, $\rho = 0.025$. If keeping in touch with your friends was important to participants, so was seeing oneself as a computer science person.

Approximately 44.0% (n = 44) of students reported *Keeping in Touch with Your Friends* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as an *Engineering Person*. Findings indicated a relationship existed between keeping in touch with your friends and seeing oneself as an engineering person, $\chi2(16, N = 167) = 29.482$, $\rho = 0.021$. If keeping in touch with your friends was important to participants, so was seeing oneself as an engineering person.

Learning about Stories and Lore of the World

Approximately 86.0% (n = 44) of students reported *Learning about Stories and Lore of the World* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between learning about stories and lore of the world and seeing oneself as a technology person, $\chi2(16, N = 167) = 30.966$, $\rho = 0.014$. If learning about stories and lore of the world was important to participants, so was seeing oneself as a technology person.

Forty-nine percent (n = 25) of students reported *Learning about Stories and Lore of the* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Person*. Findings indicated a relationship existed between learning about stories and lore of the world and seeing oneself as a computer person, $\chi2(16, N = 167) = 26.344$, $\rho = 0.049$. If learning about stories and lore of the world was important to participants, so was seeing oneself as a computer person.

Feeling Immersed in the World

Approximately 80.0% (n = 55) of students reported *Feeling Immersed in the World* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between feeling immersed in the world and seeing oneself as a technology person, $\chi2(16, N = 167) = 33.963$, $\rho = 0.005$. If feeling immersed in the world was important to participants, so was seeing oneself as a technology person.

Approximately 46.0% (n = 32) of students reported *Feeling Immersed in the World* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between feeling immersed in the world and seeing oneself as a computer science person, $\chi2(16, N = 167) = 37.587$, $\rho = 0.002$. If feeling immersed in the world was important to participants, so was seeing oneself as a computer science person.

Exploring the World Just for the Sake of Exploring It

Seventy-three percent (n = 54) of students reported *Exploring the World Just for the Sake of Exploring It* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between exploring the world just for the sake of exploring it and seeing oneself as a technology person, $\chi2(16, N = 167) = 27.166$, $\rho = 0.040$. If exploring the world just for the sake of exploring it was important to participants, so was seeing oneself as a technology person.

Approximately 39.0% (n = 29) of students reported *Exploring the World Just for the Sake of Exploring It* was *Important/Very Important* to them as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between exploring the world just for the sake of exploring it and seeing oneself as a computer science person, $\chi 2(16, N = 167) = 41.752$, $\rho < 0.001$. If exploring the world just for the sake of exploring it was important to participants, so was seeing oneself as a computer science person.

Table 4.11

Percentages for Participants' Within Game Play Motivations Cross-tabulated with Type of Person-STEM Identities

Game Play Motivation	Biology %	Chemistry %	Physics[a] %	Technology[a] %	Computer[a] %	Engineer[a] %	Math %
Becoming Powerful[a]	51.8	41.2*	40.0*	81.2*	44.7*	54.1*	52.9
Acquiring Rare Items[a]	54.9	36.6	43.7	83.1*	49.3*	49.3	53.5
Optimizing Your Character as Much as Possible[a]	51.4	38.3	41.1*	82.2*	39.3*	47.7	57.0
Competing with Other Players[a]	50.5	41.9*	49.5*	80.6*	41.9	48.4*	55.9
Chatting with Other Players[a]	51.1	31.1	48.9	86.7	53.3	51.1	44.4
Being Part of a Guild	60.0	40.0	48.0	88.0	56.0	52.0	56.0
Grouping with Other Players	54.5	40.0	38.0*	80.0	41.8	47.3	52.7
Keeping in Touch with Your Friends	48.5	36.4	33.3*	75.8*	40.4*	44.4*	53.5
Learning about Stories & Lore of the World	56.9	35.3	39.2	86.3*	49.0*	47.1	56.9
Feeling Immersed in the World[a]	56.5	43.5	44.9	79.7*	46.4*	43.5	55.1
Exploring the World Just for the Sake of Exploring It	51.4	39.2	41.9	73.0*	39.2*	41.9	54.1
Creating a Background Story and History for Your Character	54.5	38.2	36.4	72.7	41.8	49.1	47.3

*Statistically significant ($p < 0.05$), [a]Males reported statistically higher percentages than females.

Research Question Five

Research question five, *Is there a relationship between students' game preferences and STEM identities?,* was answered using a quantitative approach by calculating percentages, cross-tabulations, and Chi-square ($\chi2$) test of independence. A Chi-square ($\chi2$) test of independence was conducted to see if there were significant relationships between students' game preference items and STEM identities (see Table 4.12). Percentages and frequencies are reported below within the group of participants that responded *Yes* to the game preference, and then also reported *Agree/Strongly Agree* to the STEM identity.

Overall, statistically significant relationships occurred between game preferences and *Biology*, *Physics*, *Technology*, *Computer Science, and Engineering* identities. Game preferences *First Person Shooter (FPS) and Conduct Scientific Investigations* respectively had four and six statistically significant relationships with STEM identities. Game preferences *Simulate Playing Sports, Race with Obstacles and Challenges,* and *Play, Make Music,* or *Dance* had no significant relationship with any of the STEM identities. Where other STEM identities had three or more statistically significant relationships with the game preferences, *Chemistry* identity had only one significant relationship with a game preference, *Take Quizzes to Help Me with School*.

Connections Between Game Preferences and STEM Identities

Build Cities or Environments

Approximately 44.0% (n = 42) of students reported *Yes* to preferring *Building Cities or Environments* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between whether on preferred to build cities or environments and seeing oneself as a computer science person, $\chi 2(4, N = 167) = 15.443$, $\rho = 0.004$. If building cities or environments was preferred by the participants, so was seeing oneself as a computer science person.

Approximately 43.0% (n = 41) of students reported *Yes* to preferring *Building Cities or Environments* as well as *Agreed/Strongly Agreed* to seeing themselves as an *Engineer Person*. Findings indicated a relationship existed between whether one preferred to build cities or environments and seeing oneself as an engineer person, $\chi 2(4, N = 167) = 14.168$, $\rho = 0.007$. If building cities or environments was preferred by the participants, so was seeing oneself as an engineer person.

Simulate Taking Care of Animals

Sixty percent (n = 33) of students reported *Yes* to preferring *Building Cities or Environments* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Biology Person*. Findings indicated a relationship existed between whether one preferred to simulate taking care of animals and seeing oneself as a biology person, $\chi 2(4, N = 167) = 11.688$, $\rho = 0.020$. If simulating taking care of animals was preferred by the participants, so was seeing oneself as a biology person.

Make Art

Fifty-eight percent (n = 40) of students reported *Yes* to preferring *Make Art* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Biology Person*. Findings indicated a relationship existed between whether one preferred to make art and seeing oneself as a biology person, $\chi 2(4, N = 167) = 10.174$, $\rho = 0.038$. If making art was preferred by the participants, so was seeing oneself as a biology person.

Change the Look of Something, Like Fashion or Makeup

Approximately 37.0% (n = 22) of students reported *Yes* to preferring *Change the Look of Something, Like Fashion or Makeup* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between whether one referred to change the look of something, like fashion or makeup, and seeing oneself as a physics person, $\chi2(4, N = 167) = 13.388$, $\rho = 0.010$. If changing the look of something, like fashion or makeup, was preferred by the participants, so was seeing oneself as a physics person.

Fifty-five percent (n = 33) of students reported *Yes* to preferring *Change the Look of Something, Like Fashion or Makeup* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Math Person*. Findings indicated a relationship existed between whether one preferred to change the look of something, like fashion or makeup, and seeing oneself as a math person, $\chi2(4, N = 167) = 11.123$, $\rho = 0.025$. If changing the look of something, like fashion or makeup, was preferred by the participants, so was seeing oneself as a math person.

Solve Puzzles or Word Challenges

Approximately 60.0% (n = 77) of students reported *Yes* to preferring *Solve Puzzles or Word Challenges* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Math Person*. Findings indicated a relationship existed between whether one preferred to solve puzzles or word challenges and seeing oneself as a math person, $\chi2(4, N = 166) = 14.927$, $\rho = 0.005$. If solving puzzles or word challenges was preferred by the participants, so was seeing oneself as a math person.

Engage in Battles That Might Include Shooting or Fighting

Approximately 41.0% (n = 49) of students reported *Yes* to preferring *Engage in Battles That Might Include Shooting or Fighting* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between whether one preferred to engage in battles that might include shooting or fighting and seeing oneself as a physics person, $\chi 2(4, N = 167) = 10.007$, $\rho = 0.040$. If engaging in battles that might include shooting or fighting was preferred by the participants, so was seeing oneself as a physics person.

Approximately 81.0% (n = 97) of students reported *Yes* to preferring *Engage in Battles That Might Include Shooting or Fighting* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between whether one preferred to engage in battles that might include shooting or fighting and seeing oneself as a technology person, $\chi 2(4, N = 167) = 26.565$, $\rho < 0.001$. If engaging in battles that might include shooting or fighting was preferred by participants, so was seeing oneself as a technology person.

Approximately 44.0% (n = 53) of students reported *Yes* to preferring *Engage in Battles That Might Include Shooting or Fighting* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between whether one preferred to engage in battles that might include shooting or fighting, and seeing oneself as a computer science person, $\chi 2(4, N = 167) = 24.765$, $\rho < 0.001$. If engaging in battles that might include shooting or fighting was preferred by participants, so was seeing oneself as a computer science person.

First Person Shooter

Approximately 41.0% (n = 42) of students reported *Yes* to preferring *First Person Shooter (FPS)* games as well as *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between whether one preferred first-person shooter games and seeing oneself as a physics person, $\chi2(4, N = 166) = 13.461$, $\rho = 0.009$. If first person shooter games were preferred by participants, so was seeing oneself as a physics person.

Approximately 85.0% (n = 87) of students reported *Yes* to preferring *First Person Shooter (FPS)*games as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between whether one preferred first-person shooter games and seeing oneself as a technology person, $\chi2(4, N = 166) = 23.617$, $\rho < 0.001$. If first person shooter games were preferred by the participants, so was seeing oneself as a technology person.

Approximately 47.0% (n = 48) of students reported *Yes* to preferring *First Person Shooter (FPS)* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between whether one preferred first-person shooter games and seeing oneself as a computer science person, $\chi2(4, N = 166) = 23.125$, $\rho < 0.001$. If first person shooter games were preferred by the participants, so was seeing oneself as a computer science person.

Approximately 51.0% (n = 52) of students reported *Yes* to preferring *First Person Shooter (FPS)* as well as *Agreed/Strongly Agreed* to seeing themselves as an *Engineer Person*. Findings indicated a relationship existed between whether one preferred first-person shooter games and seeing oneself as an engineer science person, $\chi2(4, N = 166) =$

11.856, $\rho = 0.018$. If first person shooter games were preferred by the participants, so was seeing oneself as an engineer person.

Role-Play in Fantasy or Role-Playing Environments

Approximately 86.0% (n = 63) of students reported *Yes* to preferring *Role-Play in Fantasy or Role-Playing Environments* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between whether one preferred role play in fantasy games or role-playing environments and seeing oneself as a technology person, $\chi2(4, N = 166) = 14.220$, $\rho = 0.007$. If role-play in fantasy games or role-playing environments were preferred by the participants, so was seeing oneself as a technology person.

Approximately 49.0% (n = 36) of students reported *Yes* to preferring *Role-Play in Fantasy or Role-Playing Environments* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between whether one preferred to role play in fantasy games or role-playing environments and seeing oneself as a computer science person, $\chi2(4, N = 166) = 19.711$, $\rho = 0.001$. If role-playing in fantasy games or role-playing environments were preferred by the participants, so was seeing oneself as a computer science person.

Simulate Cooking

Approximately 59.0% (n = 35) of students reported *Yes* to preferring *Simulate Cooking* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Biology Person*. Findings indicated a relationship existed between whether one preferred to simulate cooking and seeing oneself as a biology person, $\chi2(4, N = 166) = 10.012$, $\rho = 0.040$. If simulating cooking was preferred by participants, so was seeing oneself as a biology person.

Approximately 32.0% (n = 19) of students reported *Yes* to preferring *Simulate Cooking* as well as *Agreed/Strongly Agreed* to seeing themselves as a computer science person. Findings indicated a relationship existed between whether on preferred to simulate cooking and seeing oneself as a computer science person, $\chi 2(4, N = 166) = 9.662$, $\rho = 0.047$. If simulating cooking was preferred by participants, so was seeing oneself as a computer science person.

Conduct Scientific Investigations

Approximately 60.0% (n = 32) of students reported *Yes* to preferring *Conduct Scientific* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Biology Person*. Findings indicated a relationship existed between whether one preferred to conduct scientific investigations and seeing oneself as a biology person, $\chi 2(4, N = 166) = 9.806$, $\rho = 0.044$. If conducting scientific investigations was preferred by participants, so was seeing oneself as a biology person.

Approximately 51.0% (n = 27) of students reported *Yes* to preferring *Conduct Scientific Investigations* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between whether one preferred to conduct scientific investigations and seeing oneself as a physics person, $\chi 2(4, N = 166) = 12.330$, $\rho = 0.015$. If conducting scientific investigations was preferred by participants, so was seeing oneself as a physics person.

Approximately 91.0% (n = 48) of students reported *Yes* to preferring *Conduct Scientific Investigations* as well as *Agreed/Strongly Agreed* to seeing themselves as a

Technology Person. Findings indicated a relationship existed between whether one preferred to conduct scientific investigations and seeing self as a technology person, $\chi2(4, N = 166) = 23.447$, $\rho < 0.001$. If conducting scientific investigations was preferred by participants, so was seeing oneself as a technology person.

Approximately 57.0% (n = 30) of students reported *Yes* to preferring *Conduct Scientific Investigations* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between whether one preferred to conduct scientific investigations and seeing oneself as a computer science person, $\chi2(4, N = 166) = 22.201$, $\rho < 0.001$. If conducting scientific investigations was preferred by participants, so was seeing oneself as a computer science person.

Approximately 55.0% (n = 29) of students reported *Yes* to preferring *Conduct Scientific Investigations* as well as *Agreed/Strongly Agreed* to seeing themselves as an *Engineer Person*. Findings indicated a relationship existed between whether one preferred to conduct scientific investigations and seeing oneself as an engineer person, $\chi2(4, N = 166) = 12.167$, $\rho = 0.016$. If conducting scientific investigations was preferred by participants, so was seeing oneself as an engineer person.

Sixty-six percent (n = 35) of students reported *Yes* to preferring *Conduct Scientific Investigations* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Math Person* (*Agree/Strongly Agree)*. Findings indicated a relationship existed between whether one preferred to conduct scientific investigations and seeing oneself as a math person, $\chi2(4, N = 166) = 14.178$, $\rho = 0.007$. If conducting scientific investigations was preferred by participants, so was seeing oneself as a math person.

Learn New Facts or Information

Approximately 46.4% (n = 39) of students reported *Yes* to preferring *Learn New Facts or Information* and *Agreed/Strongly Agreed* to seeing themselves as a *Physics Person*. Findings indicated a relationship existed between whether one preferred to learning new facts or information and seeing oneself as a physics person, $\chi2(4, N = 166) = 10.676$, $\rho = 0.030$. If learning new facts or information was preferred by participants, so was seeing oneself as a physics person.

Approximately 85.0% (n = 71) of students reported *Yes* to preferring *Learn New Facts or Information* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Technology Person*. Findings indicated a relationship existed between whether one preferred to learning new facts or information and seeing oneself as a technology person, $\chi2(4, N = 166) = 17.517$, $\rho = 0.002$. If learning new facts or information was preferred by participants, so was seeing oneself as a technology person.

Approximately 45.0% (n = 38) of students reported *Yes* to preferring *Learn New Facts or Information* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Computer Science Person*. Findings indicated a relationship existed between whether one preferred learning new facts or information and seeing oneself as a computer science person, $\chi2(4, N = 166) = 22.528$, $\rho < 0.001$. If learning new facts or information was preferred by participants, so was seeing oneself as a computer science person.

Take Quizzes to help me with School or Entrance Exams

Approximately 59.0% (n = 42) of students reported *Yes* to preferring *Take Quizzes to help me with School or Entrance Exams* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Biology Person*. Findings indicated a relationship existed between whether one preferred taking quizzes to help one with school or entrance exams and seeing oneself as a biology person, $\chi2(4, N = 166) = 9.746$, $\rho = 0.045$. If taking quizzes to help students with school or entrance exams was preferred participants, so was seeing oneself as a biology person.

Approximately 48.0% (n = 34) of students reported *Yes* to preferring *Take Quizzes to help me with School or Entrance Exams* as well as *Agreed/Strongly Agreed* to seeing themselves as a *Chemistry Person*. Findings indicated a relationship existed between whether one preferred taking quizzes to help one with school or entrance exams and seeing oneself as a chemistry person, $\chi2(4, N = 166) = 11.418$, $\rho = 0.022$. If taking quizzes to help participants with school or entrance exams was preferred by participants, so was seeing oneself as a chemistry person.

Table 4.12

Percentages for Participants' Within Game Preferences Cross-tabulated with Type of Person-STEM Identities

Game Preferences	Bio %	Chem[c] %	Pys[c] %	Tech[c] %	C S[c] %	Eng[c] %	Math %
1. Build Cities or Environments	48.4	35.8	42.1	78.9	44.2*	43.2*	58.9
2. Simulate Playing Sports[a]	42.7	38.5	37.5	74.0	31.3	42.7	59.4
3. Simulate Taking Care of Animals[b]	60.0*	36.4	34.5	70.9	40.0	36.4	52.7
4. Make Art[b]	58.0*	39.1	36.2	75.4	39.1	44.9	55.1
5. Change the Look of Something …[b]	56.7	35.0	36.7*	73.3	33.3	33.3	55.0*
6. Race with Obstacles and Challenges	49.6	35.4	39.4	75.6	36.2	44.9	57.5
7. Solve Puzzles or Word Challenges[b]	50.0	39.8	36.7	71.9	34.4	43.8	60.2*
8. Engage in Battles…[a]	50.0	35.0	40.8*	80.8*	44.2*	48.3	55.8
9. First Person Shooter Games (FPS)[a]	49.5	35.0	40.8*	84.5*	46.6*	50.5*	54.4
10. Play, Make Music, or Dance[b]	58.0	38.3	34.6	79.0	34.6	42.0	48.1
11. Role Play in Fantasy or Role-Playing Environ.	55.4	31.1	43.2	85.1*	48.6*	45.9	58.1
12. Simulate Cooking[b]	59.3*	33.9	30.5	64.4	32.2*	30.5	49.2
13. Conduct Scientific Investigations	60.4*	45.3	50.9*	90.6*	56.6*	54.7*	66.0*
14. Learn New Facts or Information	53.6	41.7	46.4*	84.5*	45.2*	45.2	57.1
15. Take Quizzes to Help Me with School…[b]	59.2*	47.9*	36.6	76.1	42.3	40.8	60.6

*Statistically significant ($p < 0.05$), [a]Males reported higher average ranks than females. [b]Females reported higher average ranks than males. [c]Males reported higher percentage than females.

Research Question Six

Research question six, *How do students perceive, if at all, that their game play motivations, with respect to their game preferences, relate to their STEM identities?*, was answered using a qualitative inductive coding process for a better understanding of how students' perceived that their gaming motivations, with respect to their game preferences, related to the STEM disciplines. Twenty-eight focus group sessions were recorded, transcribed through Rev.com, reviewed and compared to notes scripted during sessions. Transcriptions were coded in NVivo for participants' perceptions of: (a) STEM and other identities, (b) game play motivations, (c) game preferences, and (d) relationships between (a) and (b), and (a) and (c). Other concepts or connections generated by students were also coded.

Focus group participants reported a range of responses regarding their STEM identities, game play motivations, and game preferences. Some students could perceive a direct relationship between their gaming and STEM identities and others could articulate a less overt relationship. Other students could not observe any relationship between their game play motivations (or game preferences) and how they saw themselves as a type of person.

Nevertheless, others found connections between their game play motivations (or game preferences) and other, non-STEM based identities or to interests in non-STEM disciplines, such as fine arts, business, law, or stock market trading. Moreover, students often identified with more than one STEM identity. Students' reflections on their game play motivations and game preferences were most often not discrete from each other. Attempting to separate the two would cause loss of meaning in students' perceptions.

The interconnectivity of game play motivations and game preferences was evident in students' excerpts. Even how such constructs influenced students' perceived self-concept or self-identity and vice-versa were debated and varied within focus groups.

Identity Formation

Students shared multiple perspectives on how their identities, game play motivations, and game preferences related with one another. In some cases, students felt that there was little relationship between these constructs. Others, however, felt that some connection between identity and gaming existed, but driven by identity, rather than by games. Still, other students thought that the games that they played did influence their identities.

Students' STEM identities were coded in NVivo by specific STEM discipline or alternately coded when no STEM identity existed. All students could readily state their perceived identity or identities and often included additional descriptors, whether related to a STEM identity or something different such as, "I'm into agriculture," "I'm a sports person," or "I'm an outdoors type person." Sometimes students would link these descriptors to additional information, such as, "I'm in Future Farmers of America (FFA)," "I play soccer," or "I hunt and fish." Whether students perceived that their gaming was related to their identity, STEM identity or otherwise, was discussed in focus groups and produced a variety of student perceptions. The following examples summarize similar assertions put forth by students participating in focus groups.

Identity perceptions. Bree identified as a science and technology person and thought that game preferences and game play motivations are not developed through digital game play itself. Rather, she stated that one's game preferences and game play motivations are pre-determined and grounded within the individual. Her statement contrasts with others who spoke of games influencing their sense of self:

> I've heard some people say that when they play games that kind of makes them who they are, a little bit by developing character and stuff. But, I think that we choose the kind of games that we want based off of who we are in the first place. So, it's not like it's changing us. It's, like, based on us.

Her quote offers evidence of her belief that people choose games based on their personalities. Somewhat aligning with Bree's views, Teagan, who expressed that she had science and biology identities, purported individuals' perception of identity may be either "set" or ambiguous. If considered "set," the individuals' said fixed "characteristics" would predetermine games preferred. However, she alleged that games could influence individuals who are uncertain "in who they are" and would be shaped in their response or interaction to games played:

> I think they influence each other. It's just based on if you already set yourself as somebody with these characteristics. Those games you pick is from who you are, but if you still don't know who you are, you would find games that attract you and kind of like inspire [you] in a way.

Teagan sees that multiple factors influence the types of games chosen, related to the strength of an individual's identities; if a person has relatively static identities, their choice of games may not influence their identity. However, she feels that individuals with more fluid identities may be more influenced by the games they play; their game choice may contribute to their identity formation.

Proposing a different viewpoint, James, who identified as both a science and math type person, stepped forward. He suggested that gaming, at least at times, may have nothing to do with one's identity. James viewed gaming as allowing him to "be someone else." Not pre-planned or thought to be in his "personality" to sit for hours pursuing objects, within the game, although he felt compelled to do so anyway and found it "fun." He described:

> I'm leaning on the other perspective. Like, I don't like ... I always want to do something different and I always want to be something [different]. But, I don't want to sit down for a four-hour game just for an Easter egg, but I do that. So, like sometimes personality, sometimes, isn't really influence [influencing] your game type, but I guess it kind of does. But, sometimes some people play games that don't really follow their personalities, but they play [them] anyways because it's fun.

These reflections emphasize the elusive quality of identity, especially in the formative years of teenagers and young adults. The survey, however, did not capture all variations of perceived identities. Several students felt that the seven STEM identities listed in the survey were not specific enough to represent their perceived STEM identities. Additionally, students frequently utilized the generic "science person" in stating their STEM identity, rather than automatically naming a specific STEM discipline. For example, although Sophia stated she chose 'science person' on the survey, she viewed herself as a "medical type person" and expressed that not having 'medical person' on the survey felt "awkward" and "Then you're looking at the science portion. You're just like, 'okay.'" Other students stated STEM related identities, such as agriculture, veterinarian, and forensics. These statements further support the generic and overarching use of the acronym STEM and the term science itself as a discipline or identity.

Other perceived identities. Students without STEM identities also saw connections between game play motivations, with respect to game preferences and identity. For example, Daniel, who had a history and government identity, was in the same focus group as Bree, Teagan, and Sam. Although, he did not have a STEM identity, he added his own perspective to the interwoven qualities of identity. He contended that digital game play and self-identity were "inter-related." Where Teagan thought games could potentially influence one's identity, Daniel asserts further that one's identity is flexible and may change over time. Moreover, he thought identity, like one's interests, may not only develop through gaming, but also contract and narrow:

> I would say that they [one's gaming and identity] are inter-related because, like, I guess before you play video games, you are attracted to, like, what genre is related to what you're already interested in. Like, if you watch a lot ... Or, if you played with Legos as a kid, you might be interested in Minecraft (2011), per se. Or, FPS [games] if you liked Army [things] and stuff like that. And later, as you play these games, you might develop a, um, acute interest in other games. And so, you develop [your identity]. So, I guess before you had like this broad area of interest, and now it's more of acute. And so, I guess the game [play] has developed, um, what you're interested in [over time].

Peter had earlier stated, "I like to play sports games like 2K[17] (2016), 'cause like, I like to build a team, and like you know, try and get my team to be better…so, like in ultimate team or whatever." A student with a business identity, David, stated the relationship he perceived between his preferred games and his future career interest, saying, "You know like puzzle games, like, I want to be a business man. So, like putting a whole group of stuff together, like overall outcome[s], doing something better, and like finishing [a task] is like that for me is business." David then added, "Yeah, like also like Peter said, like when you make a team, or something, you have to kind of problem solve a lot. So, it's like, it kind of helps with your real-life problem-solving skills." David further added to Peter's explanation of team management and business. He said, "…Some sports games, like 2K[17] (2016), you can be a business owner or something and you gotta like manage your business, make sure you're not too much in debt and stuff, and you can get…trading and getting people free agents."

David, like Peter, did not have a strongly perceived STEM identity. Peter saw himself as a math and history person; both played sports. However, David's excerpt demonstrates that even students with other perceived identities could make a connection between their game play motivations, with respect to game preferences, and identities. These statements also illustrate that students also related gaming to their future aspirations.

Identities and Career Aspirations

Several connections between students' identities and career aspirations were evident throughout the data. Some students saw alignment between their identities and their future careers, while others saw little to no relationship. For example, Sarah, who expressed a math identity, stated that she "loved" math and aspired to be an engineer.

When asked if her love of math drove her to seeing herself as a future engineer, her answer was surprising. She stated:

> No. I like physics and I think that drove me to do [engineering], I didn't even want to do anything with science before I took physics. I like physics a lot and a lot of physics, a lot of the problems [in physics] is like algebraic problems where you have to find this because of all of this (motions with hands to describe types of problems).

Brandon discussed how he was learning to code and how that learning, as well as his gaming, inspired him to want to pursue a job in computer science:

> Well, it's like, [I'm] learning how much simpler it [coding] is than I thought. Like, when I imagined binary, I imagined, like, thousands of digits of zeros and ones, but it's just eight, and it's just numbers, so ... well, it's neat to kinda figure things out, for me. So, like, seeing, again, how those things [coding] work and, um, what I could do with that [in the future]. That's [figuring out how things work is] interesting too. Some games, um, inspire you to do things, um, create ... That's why some games, like Mario (2017), they, it inspired, um, other game designers to try to build something for it, try to at least get something out of it. As more games come, they uh, they inspire more people. As games develop, we find out more things, better things which causes more people to [be] inspired. Of course, as I said, that I want to be a character designer, the people that design characters. Or, if that may not be a good job for me, I may do something in the art or in computer science.

Similarly, Luke also stated how games generate ideas for career options. He said:

> It does to me [relate to career aspirations], kind of. Because, um, like, the games, they ... like, the games are exciting, and I want, like, an exciting career at the same time. So, it, like helps give me ideas."

Aaron stated his interest in architectural games and a future in the field:

> For me personally, I, um, I enjoy architectural games more than I know I should. So, that's, like, uh, I kind of like to, I'd like to explore that career area possibly more because of that [enjoyment form such games].

Students found many connections between their game play motivations, with respect to game preferences, and their future career aspirations. Games provided a vignette into future possibilities and opened their schema of potential job options just a bit broader than before. Moreover, many students like Aaron saw games served as perhaps a type of apprenticeship and indication of possible future aspirations. Aaron, "playing" architecture-type games, fueled his career interests. Later, the data shows many connections that students made in reference to career aspirations and even perceived preparation for careers, in terms of personal skills and knowledge.

Game Play Motivations with Respect to Game Preferences

Students' perceived game play motivations did not always seem to coordinate precisely with Yee's (2006, 2006b, Yee et al., 2012) main game play motivation types: Achievement (advancement, mechanics, competition), Social (socializing, relationship, teamwork), and Immersion (discovery, role-playing, customization, escapism). For example, many students discussed learning from different types of games, players they competed with or teamed with during gaming. Others discussed acquiring different types of thinking and approaches to problem solving, and/or how games shaped their attitudes toward STEM disciplines, and to other people in general. Comparing characteristics in digital games to STEM disciplines and future aspirations was also very common in students' statements across the focus groups.

However, Yee's (2006a, 2006b, Yee et al., 2012) game play motivations did emerge from students' perceptions, even though students did not necessarily play MMORGs as in Yee's works. Though messiness of multiple STEM identities and interlacing of multiple game play motivations, with respect to numerous game preferences, made grouping students' reflections challenging; however, some overarching themes did arise through the data analysis. Excerpts in the following sections represent many students across the 28 focus groups and attempt to capture similarities, differences, or variations in students' perceptions.

The next sections review overarching themes that saturated across the focus groups (see Table 4.13). The main themes are: achievement, social, immersion, learning, and inspiration. Due to multiple, as well as supporting, game play motivations within student excerpts, additional themes emerged woven in as subthemes, including: accumulation and management of resources; competition; progress and leveling up; school competitiveness and class rank; playing with others and stereotypes; shame and/or embarrassment; focus and/or escapism; story line; academic learning; game skills; thinking and mental challenges; problem solving; and real-life application to future aspirations.

Table 4.13

Themes and Subthemes

Themes	Subthemes
Achievement	Accumulation and management of resources Competition Progress and leveling up School competitiveness and class rank
Social	Playing with others and gender stereotypes Shame and/or embarrassment
Immersion	Focus and/or escapism Story line
Learning	Academic learning Game skills Thinking and mental challenges Problem solving Real-life application to future aspirations
Inspiration	N/A

Achievement. A sense of achievement in task completion was a common game play motivation discussed in focus groups. Nathan explained how these types of games provide a sense of achievement through creative options for the player, such as developing one's game character. This quote is a typical example of how multiple game play motivations are layered within most excerpts. He said:

> For like the main thing I get out of strategy games is mostly, uh, like completing objectives. So, I'm big on like, getting all the achievements and like just getting as much done as I can in a game in the least amount of time. Um, and then RPGs,

> I mainly like to, uh, like, just build like a fully-immersed character, like make back stories, like make it my own story. Stuff like that.

As this quote demonstrates, completing game objectives, such as completing missions, finding Easter eggs or foraging to collect materials that can be used to build or create something else were a common source of achievement for students.

Developing and enhancing one's game character were important motivators, as Nathan explained. Other creative options such as building structures, customizing objects such as weapons or armor, or even designing whole worlds and civilizations were also strong motivators. Games such as The Elder Scrolls V: Skyrim (2011), Minecraft (2011), and the Civilization series (1991) were frequently mentioned with these perceived game play motivations. For instance, Corey, who also had a science identity and what he called "a little bit of engineering," enjoyed RPGs as well as finding and creating things, such as "developing my own character." He hesitated at first, but then became excited as he described:

> Kind of like having the thrill of creating something, that you can call yours, and just, like, trying to get all of the difficult stuff to find inside the game. That's really cool, and…Yeah. Yeah, yeah, yeah, yeah, yeah. You feel accomplished once you get those things…Yeah. Then for me, the types of RPGs I like to play are more medieval based. I'm really into blacksmithing and like forging and all of that stuff.

Even though his thoughts were somewhat scattered as he spoke, Corey shared enthusiastically, possibly demonstrating his excitement about creating his own character and the items for which he forages. In his perceived connection to STEM, he said, "So, I feel like that, like, I guess, um, [gaming] helps me like science more, because of the chemistry and the, of all the physics that goes into building weapons and the such."

Here, Corey does not expound upon why his digital game play "helps" him "like" science more. However, utilizing real-world technical skills, such as mining, foraging, blacksmithing, or launching an arrow from a bow, even with the enhancements of embedded "game magic," are meaningful to students in making connections to STEM disciplines or to their STEM identities. Digital game play allows students a variety of virtual, immersive, "hands-on" experiences that are both valued and motivating.

***Accumulation and management of resources*.** Several students discussed a sense of achievement that came with accumulation and management of resources in various digital games. Students also discussed the relevance of such games to future goals. Based on their comments, interests, like self-identity, seem to not develop in a vacuum. Students expressed multiple interests and identities while discussing their perceived relation to gaming. Simulations through gaming provided students with perceived worthwhile experiences. For example, Eileen, stating a science identity, spoke about the sense of accomplishment she felt in managing a virtual zoo, and the relevance she perceived to her future goals. Eileen stated her interest in animals and aspiration to work in veterinary medicine. She also stated her desire to one day open a zoo:

> [I have virtual zoo,] with like, thousands of animals, 'cause I love animals. And, there's a lot of games that I play that deal with animals, and it helps me know, like, okay, well in the future, if I own this animal or this animal, I need to have like this much money or this much money. So, it's also like a money thing too. Like, it helps me know like how much I'm gonna need. Like, for example, if I

> wanted to own a zoo, I have to have 1.3 million [dollars] for an elephant exhibit, kind of thing. 'Cause that's how much you paid in the game…and I like, I like games like that 'cause, one, it has the animals, and two, it helps me like, know, like okay, like eventually, if I wanna go this route, this, I'm gonna have to be like, I have to have a lot of money.

Eileen's excerpt illustrated how students perceived value from gaming and in gaining knowledge relevant to real-life. Understanding financial and resource management through game play, was also characteristic for several other games discussed by students, such as Madden (1988) and Minecraft (2011).

Tyler perceived social recognition and a sense of achievement linked to accumulating and managing resources in Minecraft (2011). He enjoyed building and creating things within the game, but also coding. Tyler was bolder in describing his preference for playing Minecraft (2011), relative to others and later discussed. Tyler explained how his gaming related to his science identity:

> Well, so the main game that I play is Minecraft (2011), and a good reason I like that is because it, uh, you can make like contraptions, and more specifically you can add like actual commands to it that, like, it's just like actual coding.

Stephanie, who identified as science type person, also saw her virtual zoo as important to her goals. She was interested in poultry science, aspiring to becoming a veterinarian, again, similar to Eileen. At first, Stephanie was very enthusiastic about sharing the games she played, stating she liked games "geared toward girls" on the Girls Go Games (2004) site. She further explained what made the games girly: "Like, when you open the screen it's, like, pink. Everything's pink! And, all the games are like, make up, and I don't know. It's all these like, girl ... It's super girly…It's fun. I ... Oh my gosh!" Stephanie explained a game she enjoyed playing on her phone, saying, "I play like, Tap Zoo (2011) on my phone, where you like, build a zoo, or like, an amusement park." Stephanie grew a bit embarrassed, then she explained:

> I like to, like, play like, I don't know, whenever you like, have goals. Like, it gives you a goal, and you have to, like, get two giraffes in your zoo, or whatever. And like, just building your zoo and the ... I don't know. It seems dumb, but it's... oh, it's like a ... No, you build it. You literally have to build a zoo…It's something weird. But yeah, it's like, you, um, like, earn money from like, collecting from your animals, and …So, ... my zoo.

Here, Stephanie made another connection to achievement as a game play motivation, through goals, or objectives, set forth in games. Stephanie made a connection between her gaming and future aspiration:

> Um, when it comes to like, I guess, for like, building the zoo, you have to like, manage your money, and like, your stars, or whatever. And, that's kinda like in real life, like, we're all, we're all having to ... Especially being seniors in high school, we're about to go pay for college and stuff. We're gonna have to be able to learn how to manage our money, and like, how to know what are actual expenses that we need to pay for, and things that we don't really need. And then, on top of that, for me, I'm a like, animal lover. So, it doesn't seem weird that my games have to do with animals, and like, that's the field I want to go into one day, and stuff like that.

Stephanie's comments expressed a desire to learn about something she hopes to actualize in the future. Her comments also conveyed a concern for the realities of being a senior in high school, becoming a young adult and dealing with the financial responsibilities and tasks of college, living independent from parents. She also made an interwoven connection between managing money in her virtual zoo to real-life.

Aiden identified as a math type person and related his preference for playing building, first-person shooter, and racing games. These games require players to accumulate and manage resources; Aiden stated he liked the game mechanics and optimizing things in the game. He shared:

> Um, I said I was a math person and I'm more of like a geometry [person]. So, like building games, like Minecraft (2011), I like because there's a lot of mathematical aspects to it. Like, say you're building your house, and then if you get all the measurements wrong ... Like, say you put more blocks on this side than that side (motioned with hands), then your house is lopsided or, like, just like the food aspect, too. Like eating [in a game] and how much each piece of food gives you, like, in [terms of] hunger. And, I also like racing games because of science and how like speed, acceleration, and mass [of the car] takes into how fast you're going…Like, when I'm buying new cars (in a racing game), if the acceleration's slow, but the speed is fast, I don't like buying that car.

Aiden stated that he would take specific car attributes into consideration in making decisions in racing games. His connection between Minecraft (2011) and math may be somewhat unclear; however, this may be where he thought geometry was important.

Aiden was another student that did not mind talking about Minecraft (2011) and seemed to enjoy playing it, especially building things.

Here, racing cars was not just simply racing, but something that required the player to consider various upgrades, as well as know when and how to use them. Minecraft (2011) requires the player to accumulate resources through mining, gathering, or through trading and bargaining with others. The achievement is in successfully acquiring such resources and then executing the use or application of said materials, tools, or upgrades.

Competition. "Competition," "beating," "winning," "being better than everyone else" and similar responses were very typical across the focus groups as a game play motivation. However, for many, it was not competition, in itself, as a game play motivation, but regularly coupled with other factors that provided a sense of accomplishment. For example, students regarded the processes involved for competing as just as important, such as: persisting through a game objective, learning from defeat or failure, and being able to adapt to different types of players in which they competed with and/or whom they grouped up with or join with in a team.

Feeling successful through competing in digital games and to "finally beat[ing], like everybody," Eileen stated that the time invested in gaming was worth it because "it's gratifying that your work paid off." This statement also spoke to the appreciation in one's own perseverance that participants felt by sticking with a game until reaching a certain level and accomplishing a task, such as finishing a campaign or a mission. When asked about any relationship between her game play motivation and identity, Eileen connected her competitive drive to her identity in science and her future aspirations. She stated:

> Very [much there is a relationship], like, I, I like, well not only competitive games but also strategy like games. And, I feel like when you're in the science or medical [field] or whatever field you're in, you have to know like, strategy-wise. So, you're always trying to solve it, a problem. So, it's like when you're playing a game, you're trying to solve the game and their problem. So, it's like, you can relate to like, your motivation is like, "Okay, I want to get this done." So, whenever you go to the s-, like to the actual world, like, it's like motivation, like, "Okay, yeah, I need to get this done." And then, it [gaming and identity, with respect to real-life] kind of just goes together.

Eileen's excerpt demonstrates that just like other game play motivations and STEM identities, digital games are often multifaceted. A game with strategy can also have competition, or role-play, or options for solo or group play, for instance.

Seeing himself as an engineer type person, Luke related his interest in STEM to his preference in playing the leading role in a game, and was motivated by earning the most points and winning. Luke explained the layers of considerations he must navigate during game play and related these to math calculations:

> Most definitely, [connection between gaming and STEM identity] and …Like, to compare the two, I mean, you have to use the same type of, the same type of ways or the same type of, um, it's, it's basically the same information with the math and the technology because the same thing is developed in the game. Like, sometimes you have to do some calculations on the game like for Call of Duty (2017), you

> have to calculate your range and you have to make sure that everything is precise and you're not missing targets. At the same time, you have things like, um, you do have math, comes into, because some games like GTA (1997), you have missions and you have the amount of money you get, the amount of points you got from it.

Duplicating other responses, Luke reiterated the real-life bridge between gaming and technology and math disciplines. Implicitly, he spoke about needing to understand characteristics of different resources in games to complete an objective or compete against other players, such as weapons, money, and cars, as well as how to then properly utilize these resources. Moreover, Luke makes a subtle, tangential point about "shoot 'em up" games, such as Call of Duty (2017), GTA (1997), and others. Using such resources requires multiple considerations, problem solving, and "precision," rather than an assumption of a series of simple, erratic, or thoughtless acts.

Jeannette also stated she was a competitive person, saying, "It's like fun to, um, beat someone, like, through the game. But, then, also because some of the games, you need to problem solve to like beat them." She further explained with a slight laugh and bit of embarrassment: "So, it kind of shows that, I don't know, I guess you're thinking better than them, I guess." Jeannette identified as a science and math person, preferring word games, puzzles, and Suduko, and playing when there was "nothing to do." While she saw a relation to Suduko and math, she explained that "other than that, all the other games were just problem solving like they [gesturing to other focus group members] said." Jeannette implicitly exposes the seeming superiority one may feel in successful competition and winning.

Max saw himself as a technology and science type person. He acknowledged a preference in playing games that offered competition and provided recognition to his gaming skills, tying his game play motivation to game type preferences. Max mainly preferred first-person shooters and sports games:

> I pref-, I play any type of games. I do prefer mostly games that are just competitive, because you have an opportunity to prove, uh, [to show] why you're better than somebody… the reason I like them so much is just because uh, you know, you can beat somebody at something, and it's just at the competitive edge.

Max first stated that he played "any type of game," but was shy and hesitated in his response. Acknowledgment from peers, as in Max's reflection, or a private awareness of one's own success, similarly to Jeannette, was typically important to students who count competition as a game play motivation.

Game progress and leveling up. Many students stated that making progress through the game or "leveling up" was one of their main game play motivations. Rachel, for example, was an avid game player, playing numerous game genres, and considered herself a technology type person. She described the wide range of games that she prefers to play, such as:

> …free roam games, shooting games, but not first-person shooters, like, like, third person, cause I'm able to see the character and I know when to dodge and stuff cause usually...Call of Duty (2017) [series]…Overwatch (2016), it's first person, but I- yeah, it's first person, but I like the game overall because of the characters and the diversity and let's see ... Sims[series] (2000). I love Sims (2000), … I like Wii (2006) games, like Super Smash Bros (1999)…because it's generic. Let's see,

> what else…uh, I forgot! Mortal Kombat (1992)! Yes! Mortal Kombat (1992)! Yeah, it may be brutal, but I like brutal games.

Rachel also described her game play motivations, mostly leveling up, multiple objectives, and playing with and competing with others. She said:

> Um ... [I like] finishing the objective, cause when you finish the objective you realize, "Oh my gosh! I have reached another level and I can explore more into it." That's what I like, um, objective based games cause it's like, oh, you need to do this while doing this. I like double objective games. It's like you need to do this while doing this. Like, say if I'm playing GTA (1997); it's like, "You need to drive this car all the way to, um, the garage shop while protecting the person in the car, without damaging the car, without the person getting shot." I like those types of objectives because it makes me focus, and like I remember playing, um, Mortal Kombat (1992), like two days, no, yeah, two weeks ago with, against this, um, guy, he was really experienced in Mortal Kombat (1992) and when I realized how newbish I was to the game, because it was my first time playing it myself, he kept defeating me constantly and then that point when you get tired of being beaten. So, it's like, I was completely in the zone and when I beat him, he was like, "How'd you do that?" I was like "I don't know!" (laughs).

The various levels provided Rachel access to new resources to tackle the challenges presented in the next level. Moreover, she describes perceived knowledge that she gains with each level and from other players, which she believes leads to her own unique approach, as she explained:

> And other ... And leveling up is also a thing because you have more variety to, uh, such weapons and other characteristics of the game you never really got to get to. So, it's like, um, let's see ... Yeah, in GTA (1997), another example. If you play online, you have like, only like, what, a gun and a knife at level 1. So, I, you start off with a knife and a gun, but recently, I'm up to like, level 100, so I have reached up to, like, a machine gun and all the other weapons that you would think. They aren't legal around the world, but I have them now cause … the fact of missions you receive and the experience you get from accomplishing those missions, you learn so much from other people and you like, take all their knowledge together and form your own to have your own mindset in the game. So, it's like okay, I see what this person is doing. I'm gonna do it myself, except I'm gonna do it my own way. When you do it your own way you realize, if I keep doing it my way, I'll um, reach to certain heights [that] I've never reached before. So, that's why [I like to play]. Yeah.

Rachel’s discussion evolved around several game preferences and game play motivations. Perhaps this was due to the number of games she wanted to cover and her excitement to disclose her gaming practices, or possibly because she was interviewed alone, due to a lack of available participants for that session; thus, allowing her to speak openly without interruption. She could express her game play motivations for completing the game objectives and leveling up, as well as a sense of achievement she feels completing tasks successfully or “beating” someone she is competing against.

Rachel embedded numerous game play motivations throughout her statement. She discussed the challenge of multitasking in games and having to focus or “be in the zone," similar to what other students shared regarding focus. Rachel also made a connection between being defeated and the motivation to recover, then compete and overcome one's opponent. Assessing other players and learning from engagement with such players was important and viewed as a means to build one's own repertoire of gaming skills. In addition, Rachel embeds leveling up in competition. She explained the benefits that come at each level, rewarding the player with new weapons, tools, or other advantages which are to be managed and utilized. New game levels also provide a player a renewed sense of engagement with new objectives and challenges along the way, throughout the game.

Another competitive perspective, shared by Zach, focused on two very different game preference genres: FPSs and puzzle games. He also struggled to choose just one identity, stating he was a chemistry, science, and medical type person. Zach stated that he liked "to win" and he enjoyed playing with people that he did not know online. With battle games, he said, "I like the fun of competing against other players and you know, just coming out on top. Puzzle games, I like just to solve puzzles. Puzzles are interesting." He explained:

> I like puzzles and I like the shooting games 'cause, it's not really, it is the competition, but I like the struggle. With rankings, you find it harder to compete and I like when it's a little bit harder. So, I like solving the puzzles and everything in a quicker time than everyone else. I like showing off.

Here, Zack is tying the process of struggling to the increased challenge with each game level. He also shared the value he perceives from peer recognition and a sense of being at the top rank in a game. Beating the clock or a timed-type of game was a mutual game play motivation for students who played Sudoku, AA (2013), or other word and puzzle games. Although Zach identified as a chemistry, science, and medical type person, he was not certain if his gaming "melded with real life." However, he later stated a connection he perceived with chemistry:

> I don't really treat games as in like a personality outlet, but more like a, like a stimulus thing, like solving things quicker and faster. That's why I like chemistry a lot. I love solving those problems and chemistry is what makes up everything. So, I do like it.

When asked if his gaming related to a thinking process for problem solving, he said, "No. Puzzles are more like shapes. Abstract, finding where things go. Chemistry's all algebra. It's all numbers." Here, Zach offered an example of the interconnectedness between STEM disciplines and skills required for tasks and thinking within the discipline, as well as to game play motivations, which in this case competition and ranking over peers.

Ryan wanted to study kinesiology and identified as a biology and physics type person. Ryan's game play motivations were leveling up, goal attainment, and strategy. He shared:

> For me, I guess when it came to like, first person shooters, or um, like, Diablo (2017), it was all about leveling up. So, uh, leveling up is always fun. It's kinda, like you reach your goal. But, when it comes to like, phone games, I guess it's just, like ... cause it's a little harder to win, um, but it's more strategy to it I guess, which is fun too.

Like Zach, Ryan was motivated by the increased challenge with each level. Obtaining a goal or completing a game objective was satisfying to them.

The excerpts for competition demonstrate the interconnectedness of multiple game play motivations. Students attribute such game play motivations as supporting skills and building strengths which are seen as applicable to real-life scenarios, or to a STEM discipline or future aspiration. Just as in the variety of game preferences which feature competitive options, so too was the variety of students' reasoning and their linking to other game play motivations.

***School competitiveness and class rank*.** Students often related their competitiveness to other aspects in their lives, such as with sports or class rank in school. While Sophia stated she liked "all games" and was a science person, she also explained that she preferred to play solo because, unlike Eileen's earlier excerpt, Sophia stated, "competitiveness is not really my strong suit." This demonstrates that playing solo is not just a non- or anti-social characteristic, but can be associated with other game play preferences or a player's reasoning. Sophia further explained the negative feelings she had with competition; she stated, "'Cause like, if I do get competitive, I'll get really competitive, and then and personally, it just makes me feel worse about, about, like (laugh) my surroundings." Several other students, in addition to Eileen and Sophia, indirectly or directly spoke about competitiveness in high school or regarding students' class rank.

In contrast to Sophia, Paul stated he was also competitive in school and "I like having better grades than people sometimes. But, I don't ... (laughs) I just, I just like being at say, like the top of my class. That's a, a good feeling to have sometimes."

Competitive success was a common game play motivation and often tied to a personal sense of competitiveness, whether through school, sports, or how the student approached or saw real-life tasks.

Jeannette described her perceived connections between how she sees herself and competition game play motivation:

> I think, I'm just a very naturally competitive person, so if there's, I'm very goal-oriented, as well. So, if there's a goal at the end of the tunnel, like whether it is to come out with an A in calculus or to finish this game and be on top ... then, that gives me some motivation to complete the task that I need to do.

Jeannette explained her perceived connection between gaming and class rank. She then made interesting, yet somewhat conflicting, statements about those students with high class ranks and gaming abilities when asked if she thought or knew if these students she described were indeed gamers: “No. I think, I think most of them, they don't have time to game. But, like I'm sure if th-…” Here, Jeannette hesitated and had to stop and think, realizing the incongruencies with her earlier statement about high achievers frequently playing games, then said:

> I'm sure if they did, they'd be pretty good at some of the games. So, they-… they're, they're like individually, like self-driven ... people. And, a lot of the people that I see gaming, either they're really good at gaming and at school, or they're just good at gaming and they have no time for school, so they just don't do as well in school.

Jeannette illuminates another perception of people who play digital games: whether or not they are successful students. It is interesting that as a young adult who admitted gaming herself, she too wonders on the likelihood of if gaming and success in school can coexist. Finding balance between school and other activities was a typical topic in focus groups, especially finding time to game.

Feeling her identity as a math person was related to her competitive approach in gaming, Sarah discussed linear problem solving, playing solo games, and school competition:

> I think I'm more of a math person, just ‘cause I like solving for one, right, like I like solving for X and like having to work towards something…one thing. I think [it] is that I'm more into games where it's just me playing by myself and so it forces me to be competitive more with myself, not with people around me in the game cause it's just myself. So, I think that kind of affects how I see myself ‘cause I like to think I'm a person who competes with myself more than trying to compete with other people. Because with school, you know, we're always in competition for class rank and stuff, but I have to realize I can't control the person right below me in class, where like [who] makes a B or makes an A and passes me up. All I can do is worry about myself, so I can see where that has a connection with the type of gaming, kind of.

Here, Sarah seemed to be concerned with her class rank, but conceded that it is better to not worry about others' relative to her own class rank. This sentiment was somewhat similar to Sophia, who earlier shared that she felt stressed by class ranks, or to Paul, who earlier seemed to feel good about knowing his class rank relative to others. These statements illustrate that achievement as a game play variable is very diverse. Students' perceptions also demonstrate that competition is not simply about winning, but layered with complex attributes.

Social. Social game play motivation, through grouping or teaming up with other players was important to several students. Multiplayer games were well-liked and played by students across all focus groups. However, students also enjoyed keeping in touch with friends through gaming apps on their phones, such as playing word games and texting. Other students stated that they enjoyed socializing through sharing their creations or something they built with friends or even virtual worlds that they maintain, for example: Minecraft (2011), Tap Zoo (2011), or other environments such as in Club Penguin (2005).

Playing with others and supporting players was enjoyed by Katie, who played multiplayer games. In contrast from earlier, where James liked playing with others for both competition and to learn from them to improve their skills. However, playing in competitive type games often involve group or team play, and may be viewed as social in itself. Katie states her social game motivation for playing with others and supporting other players in the game:

> I like playing like, League [of Legends] (2009), just on the computer, because it's like, multiplayer, and I like playing with other people. I think it's fun, and I also like, just like, supporting each other on there. That's my favorite thing to do

Many other students stated they liked playing online with others, especially males. However, few elaborated on why they favored doing so, in contrast to how Katie shared her preferences. Many times, males would claim a more competitive game play motivation for reasoning why they enjoyed playing with others; these included holding a "higher rank" among peers or "beating others," and "being the best," a more difficult task to accomplish if playing just solo.

Several females enjoyed the same games as Katie, games which many thought were more typical "boys' games," but fewer females began sharing within their focus groups with such open statements, with respect to such games. Social interaction and group cooperation, as Katie mentioned, were recurrent game play motivations. However, more males expressed social interactions through active game play and online gaming in multiplayer options than females. Although, the majority of these males did not elaborate beyond this mode of play being "fun" or "meeting people." Katie liked the multiplayer options and further discussed the variety of games she enjoys:

> I like computer games a lot. Like, I play, like League of ... Oh, I play League of Legends (2009), and just like, MOBAs [multiplayer online battle arena], and just different, like Diablo (2017). Like, I'd rather play like, console games but on the computer, because I'm by the computer. Usually, if I'm on console, it'd be like those horror games…Yes. I love Bioshock (2007) so much. And then Fear (2005), and just all the ones like that.

Self-identifying as a technology and science person, Katie stated that she wanted to do something in the medical and technology fields. She played numerous games, especially RPGs and volunteered the game titles readily, uncharacteristically from most female participants. Katie, like Rachel, played many types of games and when asked whether her gaming related to identity, technology and science, Katie said:

> To me, I think it's because it makes me more creative, and it makes me more driven to become successful, using different strategies. And also, as you said,

> like, leveling up. That's a big deal in my life, so I ... A lot of games, I reference in my own life, because I use that to help me grow as a person.

How gaming shaped an individual has been previously illustrated through numerous students. Katie went on to explain how her gaming was related to her identity, seeing games as "helping her" and "related" to her in the sense of making "different discoveries" in science, similarly to discovery in games. Katie makes a strong assertion about how games have shaped her as a person; statements like this were not uncommon in the data. This excerpt, while brief, presents a case for viewing games as more than mere time-wasters, but potentially having a large impact in the way students see themselves and attitudes toward disciplines, or even real-life issues. Moreover, students discussed the desirability of being able to have peer-to-peer interaction, such as sharing one's creations.

Mia, for example, preferred to play "against people," particularly on Game Pigeon (2016), "where you like connect to people by [game] types. I like that." Mia's game play motivations were competition and social, as she explained the social aspect:

> 'Cause, you can play with people, like, you're not really friends with. And it kinda like ... not only brings you closer, but makes you more comfortable with them, I guess. And just kinda, like, starts up a conversation, I guess.

Mia was not the only participant to discuss communication and relationships with friends and people who they did not consider to be friends at school or in the community. Moreover, only a few students spoke about being "anti-social" in "real-life" but being freer and more comfortable to open up socially to online players. Andrew, for example, stated he was a science and biology type person and discussed his perception of being anti-social in real life:

> Well since I play like online with other people, it kind of made me like anti-social in my real life. So, I just feel like that I play a lot of games because like it helped build who I am.

When asked to explain, he said, “I don't know, I just. I am just not social, so I guess that has to do with me gaming so much.” It was not uncommon that some students did not feel connected to school peers or felt introverted; thus, naming this behavior as anti-social. Andrew felt he could be social with online gaming peers and that this interaction supported his sense of self. Andrew said he would not change who he was “for the [those on the] internet,” though he did recognize that some people do have different online personas.

Emma concurred with Andrew’s perception of being able to be social online. Emma stated she was a physics type person and reflected upon the importance of online communication and supporting those who do not feel courageous enough to speak openly in front of peers. She said:

> I think to be honest, it, it can be [a] help [to] people, to be honest. Like, for me, I am sort of a quiet person in school and life but online it's whenever we get to competitions and stuff, I get real active. So, I think it can help people out. So, if there's like a quiet kid who is like afraid to talk, if you get him an online game where he is talking to people, trying to communicate with them, I think you can really help him break out of his shell.

Tyler, having a science identity, also viewed the online social aspect as an important factor, stating, “I mostly like being able to, like, talk to people and be, like, ‘Hey, I made a thing and here's this stuff that I've gotten from it,’ and just like, ‘Hey, I've done cool stuff'." Students reported a range of perceptions in terms of the social aspect of gaming, and more males than female students reported comfort in playing with people around the globe and with strangers. Females' perspectives seemed to attach more fear to playing with online strangers, even that it was "scary" and expressed a sort of awkwardness in playing with someone that they barely knew, such as a school acquaintance versus a closer friend; seeing them in the hallway at school may create uneasiness. For example, Vanessa explained this social discomfort:

> But, we're playing with them as if, you know, we're friends. Like, I don't really like…playing like that. Yeah, I had that instant one time, because I was playing with this person through social, and then when I met that person, I went, yeah, he's a friend of mine, (laughs) but yeah, it was just awkward.

This may parallel with the discomfort people may feel in encountering a Snapchat or other social media connection in real-life, where there is not existing necessarily a true friendship. Perhaps, the awkwardness occurred due to seeing these gaming associates out of context, in the real-world, rather than simply in game play.

Aaron, in contrast, stated he wanted to be flexible and did not want to do one thing, and felt working with others while gaming is desirable; he said, "I think honestly, it's more fun to collaborate with other people, but I do better when I'm alone. You know what I mean?" Interestingly, Aaron said that he currently liked playing games alone, but this was not always the case; previously, he would play with friends or people online. Aaron identified as a computer science type person and his statement about socializing on and offline speaks to the varied and dynamic needs of the game user. How strongly defined one's social groups are, both on and offline, along with other game play motivations, such as online competition, serve to shape how students perceive their social connections and preferences to play alone or with others.

Playing with others and gender stereotypes. Some interesting data arose regarding playing with others, especially family members, and gender stereotypes. Several females like Jeannette and Sarah admitted to playing first person shooters and other battle type games with family members, especially brothers. If not currently playing with brothers, they would state doing so in the past, such as with Corrin who stated, "with my brother, [a] couple years ago," when asked if she played games such as Halo (2001) or [Call of Duty:] Black Ops (2017). Other females shared that they played with their father, brother, and even cousins, such as Oliva who stated:

> I grew up watching him [brother] play, and then I started to play it. And it was really cool, 'cause it's…you create your own story. Like, the storyline is there, but, your actions have, you know, effects and such which is really cool.

Playing with ones' brothers, fathers, or other family member seemed very common, especially for females. Meanwhile for females, this seemed to be, at times, a safe or an acceptable way to discuss non-traditional games in front of peers, or a perhaps simply a common way for females to engage in multiplayer games, rather than online with strangers.

Males claimed to play more with "random" people and "new" people online and "connecting" with and "meeting" people "around the world" than females. Some males discussed being part of a guild, or a group of players that they could have "a fun time" with. Others felt they could be open with people online. For example, Joe shared how such people were supportive, saying:

> Uh yeah. It help[s], like talking online to people is sometimes a lot easier for me because stuff that happens in my real life, it kind of gets hard to I should talk to my parents about it. So, sometimes I just take that to online and I talk it out with my friends online and it's a lot easier for me, personally because I mean, they won't, they may judge you, but like you, sometimes you know them a little bit more better than your actual real life so it's like, okay yeah, I get you, I get you. But, yeah.

Males and females about equally stated that they played with friends; however, they did not state which gender. Very few males compared to numerous females, claimed to play with a brother. Moreover, males did not share that they played any stereotypical “female games,” except for very few males stating they played dance games, such as Just Dance (2009), and typically only after a female would talk about it.

Shame and/or embarrassment. This researcher often observed that students most frequently made statements at the start of focus groups that were tentative, and accompanied with exhibitions of awkwardness and hesitation to share their gaming habits in front of peers. Such statements seemed to prove as an initial shield from reactions by others in the group. For some, this initial distancing of oneself from gaming, almost a disclaimer statement, allowed students a safe way to share their gaming habits and discuss their gaming. Of course, students may also have been nervous or perhaps felt exposed participating in their first focus group.

Ryan stated that he had played a wide variety of games on multiple devices, such as 2048 (2014), Diablo (2017), StarCraft (1998), Sims [series] (2000), [Call of Duty:] Modern Warfare (2007), Halo (2001), Baseball BIGS, The Show (2007). Although

Ryan's first statement was mumbled, as he looked down, he stated, "For me, I don't play games as often as I used to." Comments regarding a drop with respect to gaming frequency were typical for students, especially for those students with after school jobs, clubs, or sports. The demands of high school, extracurricular, and other responsibilities are certainly legitimate reasons to have less time to game; however, students' mannerisms, such as looking down, mumbling, or looking around the room at peers as one spoke, conveyed a sense of testing the room and distancing oneself from current gaming habits.

Stephanie, for example, became quiet while discussing her virtual zoo and her excerpt in a previous section reiterates feelings of embarrassment or shame in one's gaming, as she became aware of the laughter and looks from peers in the focus group. Later, Stephanie explained she only played when bored and only after checking social media. Boredom was very frequently the excuse or reason put forth by students for gaming and Stephanie's example demonstrates her attempt at recovering from risking being vulnerable in front of her peers. However, others in the group took turns sharing and Stephanie persisted in talking about her virtual zoo, explaining that she shared her zoo with friends and enjoyed the social aspect of sharing. She then seemed to become self-aware and embarrassed, stating, "Oh my God! This is so weird!" This offers further evidence of her discomfort with discussing the games she plays.

First maintaining that she played just word, puzzle and math games, Jeannette later revealed that she also played Call of Duty (2017) with her brothers, at first and with some hesitation, and just when they were in town. However, later she shared she had, in fact, played Call of Duty (2017) with friends the day prior. Jeannette did not divulge this game genre at the start of the focus group and this behavior was typical, especially for females. She only shared this type of gaming after another female stated that she preferred Call of Duty (2017). Parallel to Ryan, these excerpts demonstrate that teens and young adults may feel shame or embarrassment from peers regarding gaming and are fearful, or at least reserved, in exposing themselves to others in this way.

Jeannette, whose comments regarding competition were shared earlier, also made an assertion regarding students who solo or social play. She implicitly exposed her thoughts on students who play solo, and distinguished herself as one who played for social reasons, and "with friends." She stated:

> Um. I would have to say that like a good translation of this [between gaming and identity] like with kids and games, some, some people that are, like, really good at like gaming and stuff like that. You could see them high up in our class [rank], and that's also because they like compete like by themselves like individually most of the time, some of the games they play [by themselves]. Whereas, like me, I like to play like with my friends and stuff like that. But, like in our class ranks and stuff you can kind of see also like c- competition and stuff. And you can see who like wants it more, you know.

This sentiment reiterates potential shame or embarrassment from gaming in general or the stigma of solo play and other gamer stereotypes. Jeannette's demeanor through this excerpt was analytic, of herself and peers; as a senior, and with class rank. However, her tone and facial expressions also conveyed judgment of others, with respect to how one games, like herself with friends or solo.

Minecraft (2011) was a game that students frequently laughed about, discredited, or showed embarrassment toward. Often, students would state things like “I used to play” (typically in middle school) or “my brother plays it.” However, Tyler and Luke, whose excerpts were shared earlier, were rather open and seemed confident in what they shared. Tyler seemed proud of coding and his creations; perhaps he felt modifying a game or coding within a game elevated the game or justified him playing the game. Alternatively, maybe these two students simply were not concerned with what others thought, or felt comfortable sharing with the particular members in the focus group.

At times, students did not seem to feel comfortable sharing their gaming habits, or seemed reserved in sharing different game preferences. Game play motivations were easier for many to describe as they did not require a game title or genre type. However, the degree to which students admitted to gaming or the level of description provided varied considerably with each focus group.

Sometimes, at the end of focus group sessions, this researcher would ask students if they considered themselves a “gamer.” Most often, the answer would be “no.” Students would most often describe being a gamer as a “male” characteristic. Bethany, however, suggested that her gaming was influenced by having a brother. She said:

> …like people in general think it's just guys, when it could be girls, like, I grew up with a brother. So, I had a lot more masculine things in my life. So, I like more masculine kind[s] of like games, like the fighting games and stuff like that.”

It was striking to find few students in the data that self-identified as a gamer and that the stereotype of such a label was – still - attributed to males. These findings may parallel to the lack of social acceptance of one's gaming habits, as well as students' hesitation to self-identify as a gamer in front of their peers.

Immersion. Immersion was another game play motivation that many students discussed. Exploration, discovery, and a sense of belonging to and contributing to a game were important to focus group members. Story line and character development were considered valued attributes to a game. Moreover, students enjoyed being able to have choice and a sense of control over one's participation within a game.

These many factors can contribute to students' sense of feeling immersed in a game and influence their motivations to play games. Some students discussed how their virtual worlds were better than real life, stating they enjoyed having money in the game and creating homes or living vicariously through a game character, such as a soccer star. Potentially, some youth may feel that in real-life, they do not have the same power or ability to drive life-choices and find satisfaction in determining outcomes throughout the games they play. For example, Kimberly stated:

> I personally prefer role playing games, because it's like you get to create a whole different identity outside of yourself, and you get to control all of their actions. So, it's almost like giving yourself like control that you might not actually have? And, so I, I personally prefer those kinds of games.

Money, possessions such as fancy cars or homes, and freedom in the sense of control were discussed by some students. For example, Karen, who enjoyed fashion or changing the look of characters, stated:

> Um I like the Sims (2000) because you like build your own rules however you want it, like unlimited money. So, it's like better than actual life. You just build

your own life and stuff. And, I like League of Legends (2009) because I play online with my friends and even though I suck at it, it's fun to play with them. Yeah. Because in real life you don't actually have money like to build stuff like that. It's just like better, I guess and you can like make your own people and make them how you want them to look.

Nathan related the exploration and discovery in RPGs to his science identity and to science as a discipline. He stated:

> Um, well, in like a, in the genre RPGs, like the main thing I like to do is, like, explore. And so, whenever you're exploring it's kind of like science based because you're trying to, like, make new discoveries, but in a, in a RPG you're just trying to, like, find something new, and so there's always something new to find, or like new things to discover. Stuff like that.

Liam enjoyed FPS and platformer-type games, and depicted how these games "really helps you get immersed into the world that you are playing…It just helps you like escape, be in like a different type of world, usually a fantasy or a different type of, uh, world like that." He stated he enjoyed "seek[ing] out different areas of the [virtual] world, [to] see if I can collect, like new things and, you know, um."

Katie also liked playing fantasy games, and when asked about what types of fantasy games, she said, "Yes. A lot of them [fantasy games]. I like playing [The Elder Scrolls V:] Skyrim (2011) as well." She shared that she also enjoyed the story lines in games:

> I like playing like, League [of Legends] (2009), just on the computer…and also, I love the progression of the different stories, and the different routes you can, um,

> take. And I think they're all kind of literary, and you can take them, like, to a, um, a different level of meaning, so I like that.

Katie’s enjoyment of story line and exploring different routes are parts of immersion game play motivation. The games Katie plays affords her the opportunities to explore and make discoveries and have choices in pathways within the story line.

Focus and/or escapism. Several students spoke about “focus” and each, somewhat similarly, described what that meant to them. Luke saw himself as an engineer and was interested in pursuing a graduate degree because his mother “said it would be important [to his future].” Expressing his thoughts about focus and gaming, Luke spoke about gaming helping with focus and paying attention to help with one’s understanding of content. He thought gaming in the classroom would “help you be able to pay attention more.” Luke also thought one gained experience and awareness through gaming, such as when playing Call of Duty: Modern Warfare (2007).

Many students, like Eileen, discussed the mental challenge that motivated them in game play. She identified as a science person and said she enjoyed playing puzzle and RPG games because, “I think that they're really stimulating, but role play games can be fun too.” Later, she stated she liked playing with other people, as well as strangers, for example when playing Clash of the Clans (2012). She further explained her game play motivations:

> I just like to play anything that keeps my mind, you know controlled, because I can get off topic and go anywhere else with that. So, it kinda just helps me stay there in one spot for about five minutes.

Eileen spoke about gaming as if the act were almost soothing, being able to have "control" and "stay in one spot." The self-evaluation of her mind getting "off topic and go[ing] anywhere" reflects that she feels playing games helps her focus. However, she may also feel that gaming helps her relax and get her mind off her many real-life problems.

Paul also spoke about escaping school through gaming. He identified as a biology and sports person, and played Call of Duty (2017) and Rocket League (2015). Here, Paul discusses how games can provide stress relief, an escape from the pressures of school:

> I like the competitive aspect, like, none of the games I play, I mean like all of the games I play are like really competitive. They're, there's a multi-player and rankings and stuff, so that's why I like to play…Honestly, games and school and kind of like po-, like polar opposites. I play games to not think about school sometimes (laughs). It's kind of just a way to just, not think about anything and just focus on one thing for a period of time.

Paul, like Brady, used the word "focus" as a means of escape or distraction from everyday realities. Brady identified as an engineering person and also thought puzzles helped with boredom by providing a challenge, as well as supporting focus, stating, "Like when, if I'm playing, like a, like a puzzle game or something, like, that it just like gets my mind off of everything and just focus on that and it can be a cool time." Brady's example demonstrates that being able to focus on a game can sometimes be for escaping other realities and for relaxation. Rather than seeing focus simply for academics, as Luke explained, Brady's viewpoint of focus was more for escapism. Similarly, Tim stated:

> Kind of the same thing [as] Max[‘s game preferences] . I love Call of Duty (2017) and Grand Theft Auto Five (2013). I just like the idea of being able to blow off steam after a long day at school. 'Cause like, literally going to class and not doing anything for about eight hours is a bit draining. So, I like, like he said, first-person shooters 'cause, they're kinda like immerses you in your own little world. And, it kinda just defla-, deflates um, the day.

Immersion has multiple attributes which were important game play motivations for students. A sense of control, as well as escapism, were common game play motivations. For example, while some students enjoyed the different options within a game, or free roaming, others enjoyed the ability to get away from perceived stresses or realities of their everyday living. These two game play motivations may seem mutually exclusive; however, students perceived a sense of relief and recovery from everyday stressors, such as school or lack of real-life control.

Story line. Story line in a game was important to many students. Students described enjoying the ability to take different routes and have choices in their digital game play. Others stated that they liked having a sense of control of the story line or the ability to make other game choices or determine game outcomes, such as with the Sims series (2000). Katie spoke of the story and literary aspects of RPGs and open world games. Games which students regarded as “story-based” or having a “story line” such as Assassin’s Creed (2007) and The Evil Within (2014), were an important game play motivation for some students. Immersion in a story setting allowed students to discover and explore, interact with players, or have various choices, even in dialog, as mentioned earlier.

Ethan was interested in technology and computer science. He agreed that story line was very important to his game preferences. Ethan shared he was leaning towards a future in game or character design:

> I do like more- I usually play story-driven games and sometimes architectural, 'cause I believe that, in a story-driven game, you feel like that, uh, you're basically into it. You're, like, as the main character, or as the one that you're playing, you're basically in it, you feel like if you don't like the real world and you feel that it takes you away for a bit. So, it feels like you're in the story.

Besides Katie and Ethan, story and lore were important to several others as well. For example, Marybeth, who identified as a science type person, shared, "I just like games that have, like, a lot of dependency on, like, the story line, typically." She also shared how she liked to "choose the story" or direction of the story, such as with games in the Assassin's Creed (2007) series and The Evil Within (2014).

Steven identified as a math and history type person and concurred with Marybeth, stating, "…like to know the background story to the games I'm playing…, [and] learning...just the world around you, like, getting everyone's story and knowing what they've been doing this whole time. It's pretty interesting." Steven explains that he prefers games that have story progression and well-developed characters.

Several students who identified as a history type of person were very interested in the story line of games. For example, Olivia, with a history identity, echoed Steven's sentiment regarding story with respect to the Dragon Age (2009) series:

> Um, well, I mean, it's one of the first games that like I ever saw like ... me and my brother and my dad are big gaming people. So, that's what I like grew up

> watching him play, and then I started to play it. And it was really cool, ‘cause it's ... you create your own story. Like, the storyline is there, but your actions have, you know, effects and such which is really cool…So, like, being able to choose, ‘cause some games you can't choose how you respond to things...I always liked stories and history as like a giant story of everything, pretty much.

Students who stated a story line game play motivation expressed a preference for a more complexly developed game, ones where they immersed themselves and that they attached to discovery or a sense of meaning or belonging. Several students found either historical or literary context in these types of games.

Learning. Students throughout the focus groups discussed learning from digital games. The perceived learning varied and demonstrated the range of connections students asserted. Some viewed learning from games as helpful to improving their success in future gaming. Many students considered learning from games as correlated, even applicable, to real-life. A few students made comparisons to traditional classroom learning or perceptions regarding gaming and learning in school. Relevance between learning and STEM identity or future aspirations were also supported in students' statements.

***Academic learning*.** At the end of a few focus groups, students asked questions about this research. Stephanie, who identified as a science person and provided some lengthy statements about her virtual zoo, was one of these students. She made an interesting observation about gaming and education, relative to this study:

> I found the study to be pretty cool, because most of, like, growing up, we were always told, like, video games are bad for you. Like, “don't play video games!”

> “They're gonna ...” I remember, even like on TAKS test (previous Texas state assessment), we had excerpts about why we shouldn't play video games and stuff, like trying to get kids not to play video games. And so, I think it's kinda cool that you're taking the opposite approach and like, trying to incorporate it into our education. Because, quite frankly, I believe that the education system is flawed, in the fact that they're trying to...they're still using the paper to book method. I think we're way passed that. So, I think it's kinda cool that you're reaching out, and trying to do something about it. Thank you.

Stephanie’s comment about the assessment passage, as well as the messages she heard growing up, are indicative of what students contend as the common adult perception of digital games; namely, that engagement in gaming was not valued or beneficial, nor found worthy of one’s use of time, and certainly not educational. Perhaps, it was even perceived as detrimental to youths’ development. Rachel, for example, discussed how her younger brother would want to “play” Think Through Math (2005):

> He goes on it all the time. He's like, "Oh Rachel, Rachel, let me on the computer, let me on the computer." I'm like, "Why?" He's like, "I want to play Think Through Math (2005)." I'm like, "It's not really, uh [game]..." I'm like, "But shouldn't you be like reading or something?" He's like, "No, no, no. I want to play. I want to play. He goes on it all the time. So, I'm like, "Okay, before Mommy gets on me." I let him on the computer. He's like there the whole day.

Here, Rachel seems to be questioning the value of her brother’s learning on the program, asserting his time would be better spent reading or doing something else, perhaps something more ‘academic’. She further struggles to acknowledge that her brother learns from the program, in spite of his own testimony. She said:

> He learns from it because, usually, sometimes, my mom will be like, "What is he really learning from that?" So, I would, like, give him a worksheet and then he would finish it, surprisingly. I was like, "Oh, how'd you do all that?" He's like, "Oh, I just went on Think Through Math (2005)." I was like, "Okay." But, I'm not sure if he's actually learning or just playing the games, like just plays and stuff. I don't really get into that.

Rachel’s stance on her brother’s learning was surprising, given her perceptions of her own learning and applications from her avid gaming habits; all the more so, given that her brother was playing a digital program designed for individualized mathematical instruction and learning.

Rachel did think it would be useful to have children “beta test” games and for “them to see what children think” and whether they “enjoy it, for like learning.” She also thought games could be motivational to children’s learning and next levels in achievement; she stated, “So, it motivates them. If I, I guess start learning this, so, I can actually move to the next level, or else I'm gonna stay at level one, like a baby, and go on and to more heights.” Given her views on gaming, it is interesting that Rachel missed the fact that her brother was indeed motivated and did move up levels, math skill levels, in learning through “playing” his math program.

In the discussion about learning and classroom digital game play, Elizabeth, who stated she was a science person, shared that she enjoyed an interactive response application called Kahoot! (2013). Competition and the immediate feedback of knowing if one was correct in response to questions was perceived as “actual learning.” She purported that this method of learning was parallel to students’ everyday lives, or “normal life.” She said:

> We also have Kahoot! (2013). I like that one because it's like a competition and everybody is in the classroom trying to get the right answer and I feel like that's it's more like, you know, you tally up the scores and everybody that put their answers in and it'll show you, you know, this many people got this wrong or whatever and you know, it's like a competition, and then you have first place, second place, third place. And, I just like that because it's like interactive with the kids and we are not sitting there bored reading a book like we are actually on our phones, which we are on our phones all the time so it's like normal life. I like it.

Elizabeth spoke here to the reality of technology in our everyday lives and its typicality. She illuminated the present-day mainstream use of phones and other digital devices. Elizabeth asserted that digital learning is preferred by today’s students over the perceived pedantic and outdated mode of paper, book, and pencil.

When Maddison reflected on the study, she began to speak about gaming and learning as she discussed a game that she played in her English class:

> I don't know if you have ever heard about this, but it's called InQuisitive and it came with our textbook last year in a class I took and U.S. History. And, basically, it's like an online interface and it asks you questions about the chapters and you kind of just play different games. So, you go through different levels and stuff and I know that helped me a lot in that class for sure. Um, the games like, obviously it was very educational, but it still made it interesting and it was really

interactive, and I know that is something that, like, I definitely used as a study tool to help me in that class. So, I know that, that helped a lot, and I have only seen it for those specific college textbooks. Oh, we also have it in English [class]. We have done it in -Yeah. But, those definitely help and if they could develop something like that for STEM, I know that it would probably help a lot of kids because it's just, it's more interactive and fun.

Sometimes, at the end of focus group discussions, this researcher would ask students if they thought that their parents or teachers would think gaming in the classroom was a good idea or allowable. The response to this question was always answered with loud laughter, replies of "No way!" and similar sentiments. This perception demonstrates strong adult attitudes and negative viewpoints of gaming, especially for potential educational value. Students' excerpts provided a strong contrast in perceptions and attitude toward the value of gaming.

Simulated learning and real-life connections. Students discussed how they enjoyed blacksmithing, constructing, or practicing sport maneuvers in games. Interestingly, while Paul spoke about the separation between his gaming and school, he did find a similarity between his enjoyment for biology and gaming:

> I like biology because, um, I like to memorize the stuff. There's a lot of memorizing in that, when it comes to using more equations and stuff. And, I like memorizing all of the, all of the things we learn in biology and stuff. The different things. And, then that correlates with kind of the games I play. Like, sports and stuff. So, I can know the plays and memorize them and know which play would be the best for the situation I'm in.

Paul shared that he would memorize different plays to help him advance over peers. Similar to other males, this is an example of utilizing memorization and strategies in sport games for real-life situations. Soccer, football, and basketball were the most frequently mentioned sports that students referenced for gaining strategies and memorization of specific moves or plays for real-life application and practicing on the field. However, a few students also mentioned perceived learning from a game of pool, played on phones, and then using this knowledge in real pool games with friends. Here, games serve as a model and simulation for students to learn from and then turn around and duplicate in real-life.

Max was a shy student and seemed concerned about his future career options in technology. He saw himself as a technology and science person, but wanted to keep his options open for careers. Max discussed his game play motivations and perceived learning through gaming:

> In terms of motivation, um, it's just nice to just learn while you're playing. Uh, some of the different mechanics that these game developers implement, uh, you can take some of those and use them in everyday life, or sometimes jobs. Uh, sometimes, some of them are a little far-fetched, but sometimes they come back and help you…later on.

Max has difficulty articulating his perceptions here, and failed to explain what the "different mechanics" implemented by game developers were; specifically, how they might be utilized in everyday life or for jobs. However, he perceived learning from games and found gaming as a worthwhile endeavor. Earlier, others spoke about real-life applicable skills from gaming, whether for a specific discipline or career aspiration, or for “everyday” skills such as social interaction and problem solving. When asked how he thought the games exactly helped him, Max replied:

> Uh, well it depends which games you play. Like, you could play some, uh, some games that just introduce basic concepts of you know, physics and whatnot, and those kinds of things you'll use later on. And, depending on what field you go in. And, uh, I mean there's some games that slowly teach you. There's some games that revolve around history, or you learn a new story, or something. So, it's the same way you'd watch movies or [a] documentary. It just involves you, and so ...

On a different slant, a few girls stated that they enjoyed being an assistant in the Kim Kardashian (2014) game. They maintained that this game taught them about scheduling, setting up connections, and meeting important deadlines, such as figuring out how to get the character to her performances and shows. For example, Elizabeth also stated she liked “more girly” games such as fashion and cooking:

> My game that I like, um, is more like celebrity games, like I said Fashion Port (2016). So, like we have to, like, go through a maze to get through…go on a private jet, you have to figure out how you are going to get to the next show. Like, I like stuff like that, planning and just -It was a Kim Kardashian (2014) game and, and, they had a That's So Raven (2004) game. I don't know if you've seen That's So Raven [show] (2003) back in the day. But, it had a game and I [played] that game on the DS (2004)…It's more like you are like her personal assistant. I feel important.

Other female participants enjoyed cooking and baking games, such as [Papa’s] Cupcakeria (2013), and as Camden stated, she liked pleasing the customers, saying, “Like, you gotta hurry and get the food to the customers before they get mad.” Girls Go Games (2004) was popular among female focus group members.

Elizabeth also made a connection between learning from her dental and medical related games. She discussed learning terminology and tools of the profession, gaining familiarity that created a sense of preparedness. She stated:

> Yes, I do [think it is a valid form of learning], because [when playing dental and medical related games] I was learning what the tools are [for the related career field]. Like, I know with a lot of the tools in the workplace is when I was a little girl, so now it's just like, oh, I know what that is, okay. But, I don't really know the names of it, I just know what it is, you know? I am going to learn.

Prior excerpts from students who liked Sims (2000) often liked simulating real-life, pretending to be someone else or managing others and creating the world in which their characters lived. While Sims (2000) served as a vehicle for immersion and escapism, it also -provided a means for students to simulate real-life. Similar to Max, other students found the historical backstories of games, architecture, or structures of governments within games as a means of gaining new knowledge that was relevant to learning in school, especially with, but not limited to social studies and history type courses. The excerpts demonstrated the various ways that students perceive learning through gaming.

Gaming skills. Many students enjoyed learning from others that they played with or competed against. Liam also sought out gaming peers from whom he could learn, saying, “When you're online and you're trying to find someone who, like, matches your skill level or is better than you. So, you can learn from them or have a fun game. Make it challenging." This was comparable to other members within this focus group, such as Daniel, who said, "It [playing online] adds new challenges, because you don't know how good people are from around the world." Megan added, "It [playing with others around the globe] adds a new perspective as well, 'cause the way someone in Rome plays may be different from what others may think." James also found value in learning from others through gaming:

> Kind of like what he said about different aspects [of gaming]. Everybody plays, everybody has their own style of playing. So, maybe experiencing everybody across the world, you gain more knowledge and more strategy on how to take them, take your opponent down.

Luke, who identified as an engineer type person, also believed that one could learn through gaming. When asked what he meant about learning through his gaming, he discussed experience and awareness, stating:

> Experience, um ... Really, with games like [Call of Duty:] Modern Warfare (2007) and Call of Duty (2017), it teaches you, like, awareness. You can learn how to be more aware of your surroundings. Like, your eyesight, different visuals that you see. And, like, it really helps you to become smarter because you can see someone maybe sneaking on you or trying to plant something right by you, you know what I'm saying? So, it's just ... So, it brings out the, um, it brings out more awareness out of you.

Rachel also spoke about learning within the game, but also from interactions from other players, learning different playing styles of teammates and competitors. She explained that one can learn each other's playing abilities, observe patterns in game play, and learn how that could be utilized as a strategy or how they can lead to outcomes during playing. Additionally, she discussed the trust and teamwork that can be accomplished when playing with people who are close, such as her family members:

> But, since we like already have, uh, we already know every-, we know each other's like, status. We already know each other, what our weaknesses and our strengths are. That's how we are able to accomplish things much faster when we're playing a multiplayer, uh, shooting game. What was it? It was [Call of Duty:] Battlefield 4 (2017). We were playing, um, together, multiplayer, and then we were on teams. I was with my little brother, sadly. So, when th-, my older sisters, uh, they were playing together, but I managed to get my brother into the game and realize, hey, you gotta do this, finish this so we can get them off. So, eventually it ended in a tie. But, what happened was um, our ... my sister's weakness is, uh, she would always do, like spam the same moves, and so when you real-, when you get into that rhythm, you realize the pattern and you like cut that pattern off and you would eventually win.

Students perceived learning through games beyond those designed with an academic focus. The apparent importance of learning from peers and from playing with peers, even if just for improving one's game skills, came through in focus group discussions.

Thinking and/or mental challenge. "Thinking" and/or "mental challenge" as a theme evolved from students' own words and perceptions. Across the focus groups, students would discuss how games "made" them "think" or "challenged" them or somehow put a demand on the "brain." George, for example, was excited to share how he perceived his gaming and learning. He was interested in games that had multiple choices and endings. George related this game attribute to the research in science. He had future career aspirations to work in medical science. He stated:

> When it comes to what I love, I'm very passionate about playing video games and science, technology, engineering, and mathematics. But, I do like playing open world games a lot like Fallout (1997) or Grand Theft Auto ([GTA], 1997) or Mafia (2002) because I also, [pause]... The reason I like Fallout (1997) is because it's not like a linear game. It's not like it's going to end the same way no matter what you decide to do. Either you have a choice on whether you want to live or die. That's another thing. And I want to be a, I want to be a research scientist as well and I want to be a medical scientist when I grow up. In science, science can take a lot of different turns. It's not going to be, at the end of the day, it's not going to end in, it might not end in the same place as where you anticipated to end. So, that's why I like games where basically you can't really expect how it's [or] what's going to happen to you.

George was able to explain his gaming preferences and motivation for exploring the unknown in both science and his game play motivation with respect to “non-linear” thinking and open world design. With respect to biology and chemistry, George elaborated:

> When I play video games I like open world games because I don't like having a routine in general. And, I feel like in games like Fallout (1997) where you have the freedom to decide the um, path of the game rather than it always ending or doing or happening in a certain way. Because in reality science is not going to

> happen in a linear way like you predict it. Most of the time it will take turns in places like for example, you're trying to devise a cure for, I don't know, Alzheimer's. But, then you find like another factor that prevents your theoretical cure. Then you have to take a different approach. Video games in general they like make me think about problems from a different aspect. So, that I really actually enjoy that. And like my passions are for like biology and chemistry. In a nutshell, I do like playing open world games or games that don't end lineally.

George was one of many students that spoke about the type of thinking involved in a digital game. The type of thinking within a game was something that was enjoyed by many students as a game play motivation and often was related to a specific STEM discipline or identity. Ava's preference for such games contrasts with George's and aligned with what he called 'linear' games. She stated:

> I think, for me it does [have a connection], like, also the games that I do is, like, strategy, so, like, there's always a solution to it. Like, you either win or you don't win. Or, like, you always get the answer, you passed the level. So, like, one of the classes that I took, like, calculus and, like, physics, there's always, like, that one answer to that problem. So, it's not going to be, like, open-ended. So, that's why I took those classes.

Ava participated in a large focus group and stated she identified as a math person. She was shy, albeit engaged, in a group of students who often spoke over each other. This make-up and behavior of the group made it more difficult for each student to fully elaborate on their game play motivations and preferences. Ava, mirroring others in this group, preferred Mario Cart [series] (2017), racing games, completing the "world tours," and dance games, such as Just Dance (2009) or Dance Central (2010). For Ava, playing games provided a stress relief and she sought out games with opportunity to level up. Her preference for games that were designed with advancing levels where she can work her way through game levels was similar to her interest in math and physics.

Finding "linear" solutions, the one answer, the one path, was common for students who liked racing games or traditional type games. These games are not considered as complex as others by some students, and typically have similarly, repetitive tasks, such as games that students described were located on Game Pigeon (2016). Nonetheless, a sense of accomplishment in "beating a level" was typical. Moreover, Ava intrinsically references the parallel of her linear game preference to the algorithms and formulas utilized in calculus and physics.

Tyler stated he enjoyed RPG games and was also a science person. His motivation for playing these games was for the cognitive engagement. He said, "Uh, me, I like strategy and RPG type games, um, mainly because those are challenging, and they require a lot of brain power." Tyler did not elaborate much on "brain power;" however, here he also mentions challenge as a game play motivation. Using one's brain and the mental challenge a game affords the player were common perceptions, and such are related to required thinking to play and succeed at a digital game.

Liam though that both first-person shooter games and math have many similarities. He discussed "the use of critical thinking" perceived in both math, his identity, and first-person shooter games. He stated that for both, he had to think about the varied approaches he could take to accomplish his goals. Liam discussed how his FPS preference related to his math identity:

> So, I don't know if this technically counts, but seeing as how math, you know, you involve a lot of numbers and, like, critical thinking and stuff like that. I think that's sort of translates to how I prefer things like first-person shooters because it makes me think, not necessarily the same way, but sort of in a way in where how I would solve a math problem by looking at different, um, ways to solve, uh, a question. I would look at different ways on how I could, like, you know, get a head shot or something in like a first-person shooter. And it's more, um, it's a parallel in how I think. And I think in that sort of same way but different, um, uh, sort of thinking the same way, but at the same time a different way because of the two different, like, things. One being math and the other being a game.

Liam also stated he saw escapism as a game play motivation. The required type of thinking was illustrated to bridge the parallels between gaming to one’s identity, through math as a discipline.

Identifying as a science person and “a little of math,” Kent stated he enjoyed biology and was interested in forensics. Kent played several games, such as Stop (2016), “it's like a really good thinking game,” as well as 2K17 (2016), Madden (1988), Injustice (2013), Call of Duty (2017), and Just Dance (2009), or games “that make me think more.” He did not elaborate on the type of thinking, possibly due to his outward shyness. Kent later explained that he becomes “bored at home;” however, he also preferred playing solo to “concentrate better.” Here, Kent conceives that his gaming not only requires him to think, but helps him think and focus, similar to others above. Later, when discussing connections between gaming and identity, Kent explained how “messing up” on a small part can cause a mess up on the whole part:

> I'm more towards like, forensics. I want to go into the science field and do, ah, be a forensic scientist and I feel like the games that I play that connects to it because I like to be with myself and like since the games make me think. I feel like you know, forensics can be used for anything like finding murderers and stuff. So, you have to really think about it and like, forensics like involves a lot of chemistry. So, you, it's, chemistry is kind of like math a little bit because if [you] messed up then you just, you just mess up the whole thing.

This excerpt is an example that demonstrates how the concepts of game play motivation and preferences are interwoven for many of the students, and often muddled with multiple STEM disciplines and STEM identities. The students' statements illustrate that they perceive in game learning and mental challenges. The examples and variations of learning perceived are noteworthy and counter perceived adult misconceptions.

Problem solving. Problem solving as a game play motivation came up repeatedly through the focus group sessions. Several students brought up the connections between problem solving and the element of the unknown or multiple possibilities, such as George described prior. For example, Lauren also liked puzzle games for the challenge and "being able to solve stuff." She identified as a science person and felt this preference and game play motivation connected to math and science and "that you solve stuff in real-world applications." Lauren felt the games grew her patience, she explained:

> Well I like actual video games as well as like apps that are like puzzle games. So, I think like for me that helps with like more patience when you're approaching a problem and like being able to um, solve it. Even if you can't solve it like immediately, you're like willing to stick with it more.

Here, she also spoke to the perseverance needed to solve a problem. Lauren added, "…especially like physics and astronomy. So, um it's like a big puzzle. It's like there's always something else to find. There's always something else to discover or figure out, so that's kind of why I like it." She also stated she wanted to be an engineer, but was unsure of "what kind." Lauren explained an interest in engineering and stated, "Like physics is my favorite science, so like physics and math's coupled together as like something."

Appreciating that in math "there is just one right answer," Sarah played games that helped her in math class, such as Brain Builder Trig (2013), as well as crossword puzzles and Sudoku. She perceived a "correlation with my interest in math and science, just finding a puzzle and solving it, and working through it, challenging myself." Here, Sarah makes a connection between the games she plays and enjoying math, as well as the satisfaction she gains through challenges she encounters in the games she plays.

Amanda was interested in physics and an avid player of games such as Resident Evil (2017), Call of Duty (2017), Army of Two (2008), Assassin's Creed (2007). She identified as a technology type person and described the games she played as well as her game play motivations, stating:

> I play a lot of video games. I play, I've played basically all games. I just like playing games. I guess it's just, um the solving and like understanding how to like um, do it the right way to get the um answer.

Although Amanda felt math was her favorite subject; she thought she was a technology person, and similar to Rachel, fixed technology at home. She further explained how game play helped her with problem solving in physics or chemistry:

> I like, like what they [other focus group participants] were saying basically. Like if I'm able to, like, solve like all these difficult puzzles and like games or like go through all these different adventures. It gives me more motivation and patience to be able to go through like a really hard um, physics or whatever kind of problem, chemistry problem. That you might at first looked at it and been like oh my gosh I can't do this, but you're like because you play the games and because you do other things you're like okay, maybe I can get through this because I've gone through other things as well.

Amanda's reflection to patience parallels Lauren's earlier statements regarding problem solving and speaks to acquisition of grit and fortitude to address future situations. However, her perspective also illustrates that many students find value in their gaming habits and can validate their habits with respect to real-life, practical applications.

Amanda found connections between game play, patience through problem solving, and physics. She also stated she wanted to be a doctor, although she could not see a connection to this desire of "what I want to be" and to her game preferences because "I don't play like surgeon type games." Similarly, Mia identified as a math person; however, she had an interesting take - or disconnect - on her future and use of math. She said, "But probably in the future I probably won't use math. I'll probably go into, like, business or something." This perception, or misperception, is in congruence with Amanda's with respect to her view of problem solving and traits of a surgeon. In addition, this was interestingly different than most of the students who did see connections to their STEM identities or to disciplines, and also saw connections to their career aspirations. Moreover, it underscores how some students can see a vivid connection between skills such as problem solving and their identity or future self, where others seem almost blind to them, perhaps not explicit enough to how they see such concepts.

Mia also related the concept of thinking ahead in problem solving and trials, first to pool, then with respect to FPS games she played, and finally to STEM disciplines:

> I, I don't know. I guess, like, with [digital] pool and stuff, like, I guess you can kinda connect that with, like, physics and, like, business kinda thing ‘cause, like, in business you always gotta, like, think, like, ahead. So, like, whenever you're playing pool, you're like, "Oh, if I play this ball, then, like, I need to be, like, next to something where I can play, like, again. Like, you don't wanna get yourself, like, in a hole. And, like, also, like, the angles and stuff. You can also, like, associate that with, like, physics and everything…Or maybe, like, trial and error or something like that, like, in science. Like, you do trials and stuff. It's like if you, like, miss, like, them shooting or whatever, you're like, "Oh, I need to, like, move up, like, a little bit to, like, get them and stuff.”

When asked about her identity, Cameron said “I’d say probably a math person. Math's definitely has always been my favorite subject and I love the aspect of like being able to solve different problems in like a multitude of different ways.” This statement echoed those of George, Lauren, Amanda, and others discussed in terms of problem solving approaches. Cameron also found a connection between gaming and STEM:

> Um, I think that there's a correlation to what kind of games I like and then um, my passion for STEM because I like playing games where I'm solving puzzles. So, with STEM, a lot of times in science and math you're solving different um, real-

world problems. So, um, and especially in math it involves a lot of solving, so I think there's a correlation between the two for me.

Cameron also explained how playing games with puzzles related to how she approached problem solving and increased her confidence:

> So, like I said before, I like playing games where I'm solving puzzles. Mostly, like apps on my phone. Um, I don't really play any video games. But, um, I guess in a way it could increase um, your confidence when approaching certain problems if you know that you're a good problem solver and that you can solve different puzzles. Um, it also kind of like works your brain out. Well, it's kind of like a brain exercise, so it's like teaching you to like look at things in a new perspective. Maybe, some way you didn't look at it before. So, I guess that's kind of like why I like the games that I play.

Earlier, others spoke about persevering and patience through problem solving, Cameron speaks about how it provides new insight and sense of opportunity. This comment by Cameron reflects the value of being flexible when approaching problem solving. Take Gwen, who liked Mario Kart (2017) and related it to the adventure of physics, her stated identity, and what she perceives as the unknown with physics and problem solving:

> Um, I guess mine kind of applies. I like, like Mario (2017) and stuff like that so like adventure games where I get to like experience living in different worlds I guess. So, I guess you could say it applies. Like, in the sense that it's an adventure, um I like physics a lot. So, you don't really know what you're getting yourself into with every problem I guess you could say. But, yeah.

When asked how playing Mario (2017) was like physics and problem solving, Gwen further explained:

> Um, well with physics if you look at a problem um, like with my teacher he'll give us like problems that look really hard all the time where it's like, oh my gosh. But, then after you actually do it, it could just be really easy but just take a long time. Or in another sense it could just be really easy and you just have to do one thing. Where you don't have to do what you originally thought and things like that.

Gwen spoke to understanding herself as a problem solver, as well as persistence through a difficult challenge. This echoed Zach, who enjoyed what he called "the struggle" and others who found the challenges presented in gaming desirable.

With somewhat contrasting thoughts regarding problem solving, Max, who stated he had a physics identity, related his gaming to problem solving as quickly adapting in competitive situations and swiftly making decisions. However, Max's statements are parallel to Luke who spoke about "awareness" and Aiden who discussed swift adjustments in "decision making", and Megan who spoke about "think[ing] on one's feet." Max said:

> I'm actually not going anywhere into the STEM field, I'm going in business. So, with that, um, view again, you have to make sometimes decisions quickly and without hesitating, whether you're thinking about it or not, you know, is one one thing, but ... So, I do think that it'll help me, help me out in the business field, um, making decisions and not hesitating about them.

Maddison stated that physics, her said identity, was her favorite subject in school and that she was “more into STEM.” She liked puzzle games, problem solving, and played games such as solitaire. Her motivation for gaming was having an objective or goal, she explained:

> Uh, I like problem solving so I definitely make sure that that's one of the main components of the game for me to be interested. It's like if the game doesn't really have like a, a point or overall objective I am not going to play it. If it's just like, to me if it's just like shooting something I am not really interested. I would rather like map something out. There is a game called Uncharted (2015) on PS4 [PlayStation 4] (2013) which my sister is actually playing it and I, I usually don't play on any video game consoles or anything like that, but she was playing it and it's actually really interesting to me because it's kind of like an adventurous game and you have to, like you have clues and stuff you have to figure out a bunch of stuff in order to make the overall goal. I thought that was really interesting.

When asked about if she saw any connections between her game play motivations and her identity, Maddison mentioned puzzles and solving problems again:

> Absolutely [there’s a connection]. I mean, I think that I have always loved puzzles as a kid and just because I am always like working towards an answer and trying to solve something, it's probably one of the main reasons that I am interested in STEM and pursuing a career in like engineering. Um so I feel like that has a lot to do with it for sure.

Similarly, Gwen asserted that her game play motivation for leveling up and problem solving connecting to her physics identity:

> I guess with Mario (2017) now that I'm like thinking about it, it gives me... because I pass all levels, and stuff, I just go back and play the old ones. So, I know what's going to happen all the time. Like, he was saying, you don't really know what's going to happen all the time when you're dealing with science. Because I want to be a physicist. So, I guess in some things you can, but you're always going to approach different problems that you don't know the end results.

When she was asked what, it was that she wanted to major in or what she wished her career to be in, she responded, readily, “Astrophysics!”

The students in this section spoke rather openly and assuredly about their gaming and perceived connections between their gaming and STEM identities. They most frequently discussed problem solving and how it related to their identities, enjoyment of a STEM discipline and future aspirations. Problem solving was a reoccurring game play motivation across focus groups. Students saw themselves as a person that liked problem solving to get to the correct answer and problem solve in real life. Additionally, students saw approaches to problem solving and important traits of problem solving, such as persevering or learning multiple ways to solve something, very valuable.

***Real-life application to future aspirations*.** Students perceived real-life applications from their gaming with respect to situational awareness, understanding different player-types, and skill sets. Students found worthwhile experiences and perceived preparation for their future aspirations through their gaming, such as: being able to communicate with various types of people, understanding different skill sets, and knowing how to collaborate or react to these people. Others viewed their gaming as offering a type of virtual apprenticeship to future aspirations.

Sophia, who selected science identity to capture her medical type of person, agreed with Eileen's stance on how game play can help one prepare for the future. She discussed the importance of strategy and stated:

> So, I'm going to go off of Eileen's point, with strategy. Because, strategy will al- almost always help you. In the long run, in life. 'Cause you need to know when to plan things, you need to know how your li- ... How you want your life to turn out, so that you can have something to look forward to. And I think that strategy games help you do that, because you know how, what you need to do, and how to plan something. So, that you can keep going. And that's kind of like, the big picture.

Sophia also liked medical-type simulation games and after patiently waiting to speak she added to the discussion about learning and gaming related to identity, as well as future aspirations and sense of preparedness. Sophia stated:

> I think a lot of games are educational. You just don't know it. So, like, I was playing a role-play game last night, where, called Ed-Heads (2003), where you pretend to do surgeries. And It's just fun, 'cause you learn how to do certain things. Like, you learn how to replace a hip, you learn how to change a ... You know how to change a knee. And, it's all kind of, medical things that you would know if you need to go into the medical field.

Megan identified as a science and biology type person and liked puzzle and medical-based games for the challenge, and as she stated, "[to] distract my mind when I…escapism, and for knowledge." Megan elaborated on her gaming as it relates to her future self as a surgeon:

> Um, I want to be a surgeon when I grow up, and surgeons have to think really quick on their feet. And, I think that playing, like, word puzzle and games that have like limited time for you to answer them, helps my knowledge and helps me think faster. And as well as, um ... It helps me have, like, a wide span of knowledge over everything, whether it can be important or not.

Here, Megan states that her gaming helps her be "quick on [her] feet" and cognitively responsive to various situations and thus, realistically helpful to her future aspirations in medicine.

Elizabeth's sense of accomplishment through gaming was evident. Elizabeth identified as a science type person and in response to any perceived connections between her gaming and identity, she made connections to her future goals:

> It's funny like we are talking about games um that connects with us because when I was a little girl I used to play like these dentist games and I was like on Nickelodeon (2017) at night or whatever. And, like, you like drill the person's teeth and take them out and I always just been like interested in like the nasty side of medicine and like just drilling and surgeries and all that stuff. And now, I'm going into my nursing degree. So, it's just like a connection is there. It's fun for me.

Elizabeth then discussed another medical related game related to how she sees herself in the nursing field:

> Yes, I feel like just um, even the little, I don't know if you played that game where you just um take out the ... operation. You take out the organs like that was the

best thing for me. That was so fun for me because I was like wow, I can really do this in real life take out people's organs.

Similar to Elizabeth, Tom spoke about the relationship between his gaming and future aspirations. Shy and soft-spoken at first, Tom also was uncertain if there was any relationship between gaming and his computer science identity, but he did see one with his future self, stating, “Um, I don't think for my identity really, but like for future careers, yeah because, uh, I want to be a computer scientist.” Yet, he then stated he identified as a computer science type person and said, “Yeah. Yeah, like I probably would have never been on a computer if I didn't have games on it (laughs). I never would have been inter- [interested in it], never would have started it.” Here, Tom is stating that gaming built an interest in computer science as a discipline. It is another example where gaming can have an influence on one’s interests and inspire future decisions. Tom was one of several students that saw their present identity related to their future self or future identity. Even when asked in the current tense, students would at times make the jump to how they perceived themselves in the future, as in future aspirations.

Aaron identified as a computer science person, but was uncertain of what career to pursue; however, he did think it would be computer related. He stated he did not want to make up his mind before he had to “because things change.” But he explained his thoughts, stating:

> Of course, as I said that I want to be a character designer, the people that design characters. Or if that may not be a good job for me, I may do something in the art or in computer science.

Similarly, Rachel did relate her gaming to her identity and future ambitions in technology and possibly in game design. She was influenced by the possible learning from gaming and sought further learning in game design and the technology behind the games she played. She said:

> Because from playing a game that involves like, constructing stuff, like go up to this point and find this and bring it back and you have to construct. It makes me think, oh, I can do that in real life if I sit down in a chair and have this item I want to construct. I would have to go out and search for all these pieces in order for the product to be complete. So, I would think about that sometimes, like, hmm. I can construct my own ideas. I can construct this certain object to help people in the future, like constructing my own computer, constructing my own, let's see, tablet, constructing my own like phone like Apple, 'cause phones and stuff like that, it's technology I want to make myself one day.

Ryan further related his perceived identities to his game play motivations. Ryan discussed strategy and the process of planning in a game with his future career aspirations in kinesiology:

> I'd say, uh, the strategy in the games relates well to, I guess, what I would be going into, kinesiology, because whenever you're trying to bring someone back from an injury, you have to, injury, you have to have a strategy, a plan, for bringing them back to 100% again. So, I mean, you lose life in a game, you'll go down to like, 20%. You gotta have a strategy to get back, so I guess that kinda correlates.

Here, Ryan explained similarities he perceives between his gaming and a future career. He conveyed the understanding and strategy necessary to recover from a loss in a game to a real-life scenario, such as an injury. In being able to recuperate one's power, armor, weaponry, or other traits for a game character, Ryan claimed this skill is similar to what he will need to be successful as a kinesiologist.

Students' perceptions regarding thinking required in gaming and the mental challenges present in one's gaming resonated across the focus groups. Additionally, problem solving and aspects of what problem solving is afforded students a sense of perseverance, patience, and flexible thinking. The data demonstrates that students assert that their gaming has value and positively impacts their sense of skills.

Moreover, future aspirations, as in how students see their future selves, were frequently discussed in relation to gaming. How students saw themselves today was commonly associated with how they saw or aspired to see their future selves and future career aspirations. Moreover, students made many connections between game play motivations, game preferences, and their STEM identity as linked to future aspirations.

Inspiration. Many students were inspired by technologies that were presented in games, either for personal pursuits, such as assuming the role of the family technician, or fixing other things around their family home. Students were inspired by the fictional technology that they hoped would become a reality in the future, even hoping to participate in its creation. Moreover, students found inspiration through gaming for future aspirations. For example, Manuel identified as an engineering and chemistry type person and preferred the Halo (2001) and [Call of Duty:] Black Ops (2017) series because he “like[s] to explore space and be a part of it,” and stated that games inspire him:

> …make me think, like, one day maybe we'll get to that, get to that technology…to aspire for greater things ... because when you see stuff that, it looks like impossible, you really think about it, it won't be impossible.

While Manuel did not always express his thoughts with clarity, perhaps due to his shyness or some struggles with language, he was clear that gaming inspired him and motivated him to seek engineering as a future career. He has a desire to contribute to future technologies.

When Lauren discussed other games that she liked, she explained how she thinks about the science and technology behind the game, much like Rachel:

> Uh well for me, um the games I play there's a lot of action and like adventure and running. So, for me, I take that and like I always like wonder how they do that. Like how the people like um, get it on screen and make it so you know, real. So, I guess that's just the science behind the game. So, I'm very like um, keen to science and technology.

Identifying as a biology person, Rose enjoyed FPS and sports games and was motivated by leveling up. She shared that for her, there was a connection to the future as well:

> Maybe, like, for technology, you see the, like, games and the future. It's kinda like you can take those ideas and make it a reality with all that…Or like, like, because when you see, like, there's things in games that look really futuristic and you can use technology to make them real.

In Rachel's case, she was also inspired by the technology that was in games and in the creation of games, like Rose. However, while in game play she explained that she does not think about the technology:

> When I see ... When I'm playing a gun based game I won't have any other uh, let's see ... I won't have any other mindset to like technology. I'm like, oh, okay, here's a gun. I'm going to focus more on the weapon rather then what was used to create it.

However, after playing different games, Rachel would research the technology that went into making the game and into different technologies. For example, Rachel explained how she taught herself about a game design called Unity (2005) due to her interest in Sims (2000). She watched videos and practiced the tutorials. The games she played inspired her to seek out and learn about game design and explore coding.

Inspiration was important to include as a theme because it counters some of the negative perceptions and misconceptions expressed in the data regarded the value of gaming. Moreover, students' perceived inspiration through gaming is relevant to how they may feel toward technology, future career aspirations, and role-playing experiences. This data illustrates that gaming may not only be inspirational but influential to how students may aspire to future careers or their attitudes toward different topics.

Summary of the Findings

Research Question One

Males reported a statistically significant higher percentage for *Physics*, *Technology*, *Computer Science*, and *Engineer Person* compared to females. Females did not report a significantly higher percentage for any of the STEM identities. *Biology*, *Chemistry,* and *Math* identities did not show a significant difference between males and females.

Research Question Two

Males reported a statistically significant higher percentage for *Becoming Powerful, Acquiring Rare Items, Felling Immersed in the World*, *Optimizing Your Character as Much as Possible*, *Competing with Other Players*, *Chatting with Other Players, Grouping with Other Players,* and *Keeping in Touch with Your Friends* compared to females. Females did not report a significantly higher percentage for any of the game play motivations. Game play motivations that did not have a statistically significant relationship with any STEM identities were *Being Part of a Guild, Creating a Background Story* and *History for Your Character*, *Learning about Stories and Lore of the World,* and *Exploring the World Just for the Sake of Exploring It*.

Research Question Three

In summary, males reported a significantly higher percentage for *Simulate playing Sports*, *Engage in Battles*, and *First Person Shooter games* compared to females. Females reported a significantly higher percentage for *Simulate Taking Care of Animals*, *Make Art*, *Change the Look of Something*, *Solve Puzzles or Word Challenges, Play, Make Music, or Dance, Simulate Cooking*, and *Take Quizzes to Help Me with School* compared to males. There was no significant difference between gender and *Build Cities or Environments, Race with Obstacles and Challenges*, *Role Play in Fantasy or Role-Playing Environments, Conduct Scientific Investigations, and Learn New Facts or Information*.

Research Question Four

Several game play motivations were found to have a statistically significant relationship to STEM identities. *Becoming Powerful* had a relationship to *Chemistry, Physics*, *Technology*, *Computer Science*, and *Engineer Person.* *Acquiring Rare Items* had a relationship to *Technology* and *Computer Science Person.* *Optimizing Your character as Much as Possible* had a relationship to *Physics*, *Technology*, and *Computer Science Person.* *Competing with Other Players* had a relationship to *Chemistry*, *Physics*, *Technology*, and *Engineer Person.* *Grouping with Other Players* had a relationship to *Physics Person*. *Keeping in Touch with Your Friends* had a relationship to *Physics*, *Technology*, *Computer Science*, and *Engineer Person.*

Learning about Stories and Lore of the World had a relationship to *Technology* and *Computer Science Person.* *Feeling Immersed in the World* had a relationship to *Technology* and *Computer Science Person.* *Exploring the World Just for the Sake of Exploring It* had a relationship to *Technology* and *Computer Science Person.* Game play motivations that did not have a statistically significant relationship with gender were *Being Part of a Guild*, *Learning about Stories and Lore of the World*, *Feeling Immersed in the World*, *Exploring the World Just for the Sake of Exploring It*, and *Creating a Background Story and History for Your Character*.

Research Question Five

Several game preferences or genres had a statistically significant relationship to STEM identities. Building *Cities or Environments* had a relationship to *Computer Science* and *Engineer Person.* *Simulate Taking Care of animals and Make Art* had relationships to *Biology Person.* *Change the Look of Something* had a relationship to

Physics and *Math Person.* *Solve Puzzles or Word Challenges* had a relationship to *Math Person.* *Engage in Battles* had a relationship to *Physics*, *Technology*, and *Computer Science Person.* *First Person Shooter* had a relationship to *Physics*, *Technology*, *Computer Science,* and *Engineer Person.*

Role-play in Fantasy or Environments had a relationship to *Technology* and *Computer Science Person.* *Simulate Cooking* had a relationship to *Biology* and *Computer Science Person.* *Conduct Scientific Investigations* had a relationship to *Biology*, *Physics*, *Technology*, *Computer Science*, *Engineer,* and *Math Person.* *Learn New Facts or Information* had a relationship to *Physics*, *Technology*, and *Computer Science Person.* *Take Quizzes to Help Me with School* had a relationship to *Biology* and *Chemistry Person.* Game preferences that did not have a statistically significant relationship with gender were *Build Cities or Environments*, *Race with Obstacles and Challenges*, *Role Play in Fantasy or Role-Playing Environments, Conduct Scientific Investigations*, and *Learn New Facts or Information*

Research Question Six

Some students were able to perceive a direct relationship between their gaming and STEM identities, more could articulate more direct and less indirect relationships, while others could not observe any relationship. Still, others found connections between their gaming and other identities, discipline areas, future career interests, or how they saw their future selves. Several participants, across the focus groups, perceived either explicit or implicit relationships between their game play motivations and game preferences as linked to their STEM identities. Future career aspirations, college major, and discipline interests were also linked to participants' gaming.

Types of thinking, focus, or mental challenge were related to participants' game choices and often connected to science preferred or self-identified by some participants. Linear and non-linear thinking and games were discussed, as well as how choices or storyline were related to the entire game or system. Problem solving was frequently discussed and related to personal goals, beating the game, or beating others by being faster or using a better strategy. However, participants also spoke about gaining patience, learning perseverance, and having tenacity to learn and stick with a game to reap the benefits, whether just finishing the objective, learning how to achieve a goal in multiple ways, or winning points and getting to the next level.

Finding objects, Easter eggs, or completing tasks or an objective was important to several participants and often seen as a benefit to leveling up or a sense of achievement. Management of resources collected was seen as an important skill, not just within the game, but for practice or future use and knowledge. Participants found value, real-life parallels to practical skills utilized in games such as: management of and improving a team, communication with other players, trading stocks, decisions to purchase something or utilize a resource based on statistics or a strategy, having a counter argument to one's opponent, negotiating trade or issues in virtual worlds, and performing duties of one's role, such as a personal assistant. The virtual experience of building and creating things, from weapons, to structures, or even entire civilizations was appealing to many participants. Often, these tasks required accumulation of materials and skills, as well as decision making on how to best use these to the participants' advantage.

Several students claimed they felt accomplished when successfully moving through the levels and attaining a rank. Some felt personal satisfaction with this feat, where others enjoyed the peer recognition. Digital games provided participants virtual realities to escape in or to explore and create in. Participants' games offered inspiration to possible selves, future aspirations, and future technical realities. Many participants felt that there was learning, of some kind, in the games that they played. Additionally, gaming was seen as a social outlet for those who preferred communicating with online peers, as an escape from the pressures of life, the high school environment, or even class rank. Most liked competition with others or with themselves and the game. Several students articulated that gaming could support STEM content or real-life problem solving, resource management, and decision making. Lastly, the technology found in gaming was inspirational and motivational for students' engagement in gaming and in STEM disciplines.

Conclusion

This chapter presented the results of the quantitative and qualitative data analysis of this study. In the next chapter, Chapter V, a comparison takes place between this study's findings and prior studies recognized in the research literature as presented in Chapter II. The discussion intends to illustrate any comparisons and make contrasting points between findings. Additionally, the implications of this study's results are proposed with attention toward closing gender gaps in STEM areas and gaming in an educational setting. Recommendations for future research are provided.

CHAPTER V

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to explore differences in students' STEM identities, game play motivations, and game preferences. Results indicated a significant relationship between gender and several game play motivations, as well as between gender and game preferences. In addition, results indicated a significant relationship between several game play motivations and STEM identities, as well as between several game preferences and STEM identities. This chapter will compare similarities and differences between the findings and existing literature by question and make attempts to cluster discussion around each STEM identity, game play motivation, or game preference.

Research Question One

In this study, overall student science identity was higher than anticipated, with approximately one third to over one half of students selecting *Strongly Agree/Agree* for all STEM identities by STEM discipline. This finding was in contrast to Hazari et al.'s (2013) study, which found less than a third of the participating students reported self-identity related to science across the disciplines and Hispanic females reported the weakest science identity of all population groups. Fraser et al. (2014) also found that youth reported a low percentage for seeing self as a science person, as did Aschbacher et al's (2014) study where over half of student participants reported Science is Not Me.

The higher percentage of STEM identity found in this study may be due to the STEM type courses required by the sampled high school. Greater exposure to STEM courses may increase one's sense of self with respect to STEM identities. Moreover, this study's sample was of high school students rather than college students as in Hazari et al.'s (2013) study or eight- and ninth-grade students as in Aschbacher et al.'s (2014) study. Fraser et al.'s (2014) study had a larger sample size of students from across the U. S., where this study sampled from one school district in one region of the U. S. The findings of this study for identity are important, as they further stress the existing gender gap in STEM. As long as these gaps continue, educators, the government, and industry must challenge society to make changes in attitude, access, and pay for females' participation in STEM.

Males in this study reported a higher percentage than females for Strongly Agree/Agree for four of the seven disciplines. Also, males reported a higher percentage compared to females for *Physics*, *Technology*, *Computer Science*, and *Engineer Person*. Females did not report any STEM identities at a significantly higher percentage than males. In this study, *Biology*, *Chemistry*, and *Math* identities did not show a significant difference between males and females. However, it is important to note that students from the sampled high school are required to take a minimum amount of science and math courses, where lack of gender differences across these three identities may have occurred due to a commonality in exposure to basic or requisite courses. These findings only slightly contrasted to the small differences found between genders for biology and chemistry self-identity in Hazari et al.'s (2013) study although, statistical significance was not found for gender and race/ethnicity for overall science self-perceptions. The findings of this study further parallel prior findings for STEM type identities; however, they also indicate little impact has been gained on the current gender gap for STEM participation as one's STEM identity is connected to participation in STEM disciplines.

Overall though, this study's findings for STEM identity and gender paralleled all other findings in the literature. For example, with the exception of Black males, Riegle-Crumb et al.'s (2010) study found significant gender and race disparities for science and math self-concept for youth, where White males reported higher levels of math and science self-concept compared to Hispanic males, as well as to all White, Black, and Hispanic female groups. Riegle-Crumb et al.'s (2010) differed not only in the sample of 8^{th}-graders, but also examined gender disparities further within race/ethnicities.

For some students in this study, doing well on problem solving and puzzles or playing *Sudoku* was perceived as related to one's success in math. Additionally, the ability to level up, one's rank relative to others, or getting a higher grade in a math course relative to one's peers was seen as important to some students. In parallel to this study, Cribbs et al. (2015) found the direct effect of recognition on math identity (self-identity) was found to be higher than the effect due to interest. However, this study's findings also contrasted with Cribbs et al.'s (2015) study where several students' reflections stated that "the struggle," "the challenge," or discovering "different ways to get to the answer" through problem solving was reward and self-recognition in itself. This is an important finding because "interest" in a STEM disciplines may not be as important as one's perceived satisfaction in the various problem-solving processes within the STEM discipline, as conveyed in the many focus group statements.

Likewise, Stets et al. (2017) found that external recognition was not discrepant from how students saw themselves as a science person. In fact, students rated themselves higher than how they believed others saw them as a science person, if a discrepancy did occur. This is important to the validity of students' responses in this study's survey identity questions as well as perceptions provided about STEM identities and perceived relationships to STEM disciplines within focus groups.

Several students in this study stated that experiences in math or physics class led to interest in engineering or even astrophysics. Similarly, Capobianco et al. (2015) found females reported higher self-identity compared to males after participation in science learning activities. Here, too, unlike Fraser et al.'s (2014) study, science activity did matter to science identity. Moreover, Capobianco et al.'s (2015) study demonstrated that identity is not static. Congruently, some students in this study reflected upon perceived learning from science-type digital games as cultivating an interest in several science disciplines, especially those students that identified for biology or interested interest in the medical field. This is an important finding because if students are exposed to various discipline-specific experiences through digital emersion, they may develop a greater interest in that discipline. Move over, such apprentice-type experiences through digital play may even shape how students see themselves as a type of person, ultimately impacting one's identities, as identity is flexible and may change.

Even the immersive experience of a technically advanced virtual world and engagement with technically advanced tools or weapons inspired students to pursue course work in computer science and/or develop an interest in technology-based careers. These students who shared a relationship between their digital experience and identity or career aspirations mainly identified as either a technology, engineering, or computer science type person. This is an important finding because students were able to transfer value perceived from skills obtained through immersive game play and make connections to real-life interests and career aspirations.

Like this author's study, males had a frequency higher for *Physics* identity than females in Hazari et al.'s (2013) study. Lock et al. (2013) too, evaluated math and physics identities, where males reported higher math and physics identities (in all three studied identity components) relative to females. In contrast, however, this study did not find a statistically significant difference between males and females for *Math* identity. This may be due to the math requirements of the sampled high school or the difference between high school participants in this study versus the college students sampled in Hazari et al. (2013) and Lock et al. (2013). College students, even freshman college students, may have more freedom and variety in course selections and graduation requirements differ from high school students. This survey question would need to be duplicated with a larger sample, spanning the U. S., to determine if youths' math identity has truly shifted away from a male majority and distributed more equitably among females.

Physics and math identity were found to be predictors to first semester college students choosing an engineering major (Godwin et al., 2016). Moreover, these authors found students' identity, not a STEM discipline competency, was a positive predictor for engineering choice. This is an important finding (2016) because like this study, students may have identified with a particular STEM identity, yet their ability within the STEM discipline or their career aspiration may not have necessarily aligned.

Moreover, while Harackiewicz, et al. (2012) and Rozek, et al. (2015) were mentioned in the literature review for parental utility and student achievement, this study's findings, as well as Godwin et al.'s (2016), demonstrate that parents as a factor in youths' participation and retention in STEM disciplines, or even one's achievement within a STEM discipline, may not be as important as self-identity. Additionally, parent's opinions or guidance regarding STEM, desires for their students to enroll in STEM courses, college major, or career aspiration, were never coded within focus groups. Achievement in a STEM discipline was rarely discussed within focus groups and typically with respect to competition and/or class rank, yet not necessarily, connected to one's perceived STEM identity.

In this study, students often shared that their interest in math or physics courses related to the problem solving they perceived as required for these disciplines, and/or how they saw themselves as a type of person led them to be interested in the engineering discipline as well as aspire to a career in engineering. Cass et al.'s (2011) study also found students reporting a physics identity were more likely to choose an engineering career compared to students identifying as a biology or chemistry person. Again, in parallel, more students in this study's focus groups that identified as a physics type person were interested in engineering careers compared to those students that identified as a biology or chemistry person.

Math is a discipline that infuses many STEM disciplines, especially physical sciences (Black & Hernandez-Martinez, 2016; Eccles & Wang, 2016). In parallel, students who identified as a math type person often shared that "the fun" or "challenge" of solving problems in math was the motivator for one's interest in math and other disciplines such as engineering. Mental flexibility, timing, and solving problems in multiple ways were key factors discussed in focus groups with respect to math problems and problems presented in games played by students. This is an important finding because students expressed enjoying new challenges and various types of problem solving as main motivators in their gaming. A new challenge may be similar to a short-term goal, and if attached to a series of tasks, may help drive students' commitment to the tasks at hand and attainment of a set goal.

Research Question Two

This study found differences in game play motivations among gender. Males participating in this study reported a statistically significant higher percentage for *Becoming Powerful*, *Acquiring Rare Items*, *Optimizing Your Character as Much as Possible*, *Competing with Other Players*, *Chatting with Other Players*, *Grouping with Other Players,* and *Keeping in Touch with Your Friends* compared to females. The results have some similarities to prior studies, which utilized comparable game play motivations. Characteristic to findings in prior studies, females in this study did not report a significantly higher percentage for any of the game play motivations. For example, Greenberg et al. (2010) also found that all measured gratifications had significantly higher percentages for males than for females. In contrast to this study, however, Yee (2006a) found no significant gender differences for game play motivation. Again, this study's sample size and regional location differed from this these two studies. However, these finding are important because they may indicate that the breadth of motivations may be too narrow to capture all of females' game play motivations. The descriptors of the motivations may need revision to better capture responses from females at either *Important* or *Very Important* on the Likert scale.

In Greenberg et al.'s (2010) study, competition and challenge were both genders' main gratifications for playing videogames, with the largest gender differences in mean gratification being found in arousal and social interaction. Overall for this study for both genders, *Optimizing Your Character as Much as Possible*, *Competing with Other Players*, and *Keeping in Touch with Your Friends* had the largest game play motivations, each having nearly two-thirds of all students selecting *Important/Very Important*. However, unlike Greenberg et al.'s (2010) study, this study found neither males nor females selected competition or *Competing with Other Players* as their main game play motivation. Interestingly though, NVivo analysis did show that "competition", and "beating someone" were coded at one of the high frequencies by focus group members. While males in this study reported a significantly higher frequency than females for *Competing with Other Players* on the survey, females coded for "competition" and "beating someone" at double that of males. These are important findings because students often expressed competition as important to holding their interest and persistence within tasks, a campaign, or a level within games they play and connected these skills to real-life parallels., such as working through problems in STEM disciplines, learning skills, or competing with others

Like Greenberg et al. (2010), this study found that social game play motivation (*Competing with Other Players*, *Chatting with Other Players*, and *Grouping with Other Players*) was also significantly more important to male students than females. Game play motivation as a predictor of social capital, civic engagement, and political participation was studied by Dalisay et al., 2015. Results of Dalisay et al.'s (2015) study showed discovery game play motivation predicted trust and political participation; social game play motivation predicted neighborliness. It is important to note, while males reported higher frequencies for social motivations on the survey, females had nearly equal frequency in focus group responses for social codes, such as "online-playing with stranger," "playing with friends," "social," and "texting". However, more males elaborated on their online game play with people around the globe.

The focus group data does not correlate exactly to Dalisay et al.'s (2015), as the discussion questions did not inquire about political participation or neighborliness; although some similarities with qualities of these two concepts were found. For example, students in the focus groups shared about learning from other players online and from people living in places around the globe. Some learning was stated as game based, such as new strategies or engaging different styles of play. Other students shared that they learned about "different people's opinions," that world events were discussed, found people with "similar interests," and as one stated, "learn about life." A few others shared that talking with people online was a safe space to "break out of his shell" and work things out, and where in real-life they were shy or felt that they could not as easily talk with their peers about an issue that they were experiencing. Even with texting while gaming, students felt this was a fun way to stay in touch with friends, make friends, and play with people at school whom they do not in reality have a close relationship. Also, students who like immersive and discovery game play did often state that they enjoyed interacting and supporting other players. This is an important finding because the data demonstrates that interpersonal relationships and learning from others do occur through interactions with the various people students encounter in their gaming.

Gender differences in game play motivations were found to relate to vocational aspirations as seen in Giammarco et al.'s (2015) study where males scored higher than females in the following game play motivations: arousal, competition, and social interaction. Comparisons of competition and social interaction game play motivations were previously explored with respect to the results of this study and other authors; yet, Giammarco el al.'s findings again parallel to this study's findings for males' higher selection of competition and social game play motivations. Challenge as a game play motivation is an inherent attribute of competition.

Like Greenberg et al. (2010), Giammarco et al. (2015) also examined challenge as a game play motivation. Where Greenberg et al. (2010) found challenge as one of the main motivations for both males and females, Giammarco et al. (2015) found that neither challenge nor diversion motivations were significant for gender. Progressing through a game, becoming powerful, and competition with other players are characteristics of the achievement game play motivation (Yee et al., 2012). This study did find a statistically significant difference where more males than females selected *Important/Very Important* for *Becoming Powerful*. However, numerous students in this study also stated "challenge," "leveling up," and "sense of achievement and accomplishment" were regarded as main game motivations in focus group discussions. In addition, over twice the number of females than males were coded for stating their game play motivation was the "control" they perceived when gaming. While the survey and focus group data did not fully align, students clearly articulated that challenge and competition were important game play motivations. Having a sense of “control” was described by students in may ways, from having choices in game play, such as with the story line or a character’s actions, or through leadership in a multiplayer game, or even a sort of managing role as in governing. This finding illustrates the importance of choice for students, in addition to having a variety of options within gameplay for engagement and motivation.

Research Question Three

Overall, students’ main game preferences in this study were *Race with Obstacles and Challenges*, *Engage in Battles That Might Include Shooting or Fighting*, *Solve Puzzles or Word Challenges*, and *First Person Shooter Games (FPS)*. Fraser et al. (2014), somewhat similarly, except for playing or making music/dancing, found that the other top games were solving puzzle and word games, racing with obstacles and challenges, engaging in battles, and first person shooter games. There was no significant difference found between gender and *Build Cities or Environments, Race with Obstacles and Challenges*, *Role Play in Fantasy or Role-Playing Environments*, *Conduct Scientific Investigations,* and *Learn New Facts or Information*. While there was no significant gender difference found for these game preferences, there was a relatively high frequency for students referencing these game activities. Thus, there is opportunity to design instruction which embeds these preferred activities for students’ learning experiences and engagement.

Males in this study reported a significantly higher percentage for *Simulate Playing Sports, Engage in Battles,* and *First Person Shooter games* compared to females. Similarly, in a study by Homer et al. (2012), significant gender differences were found, with more males preferring first person shooter, fighting, sports, and MMORG games.

Greenberg et al. (2010) also found males preferred physical games, followed by imagination games. These findings further demonstrate that genre/activity-type preferences have not considerably altered for approximately two decades' of research literature. They continue to express some long-standing gender stereotypes, but more crucially, they may reveal little has changed for female access to sports, physical activities, and opportunities to confidently engage with others in competitive, combat scenarios or on a large scale, such as with MMORGs.

Females reported a significantly higher percentage for *Simulate Taking Care of Animals, Make Art, Change the Look of Something, Solve Puzzles or Word Challenges, Play, Make Music, or Dance, Simulate Cooking*, and *Take quizzes to Help Me with School* compared to males. Again, these results paralleled Homer et al. (2012), where females reported a significantly higher preference for virtual life, puzzle, and party games. Similarly, Greenberg et al. (2010) also found females preferred traditional games compared to males. Sherry et al. (2013) reported females' preference for simulation genre games and males' preference of strategy based game genres. Like the males, the findings are stereotypical for game play motivations with statistically higher frequencies for females compared to males. One could argue that, like the activities for males, society has failed to cultivate more nurturing or even domestically independent males. Females' higher frequency for *Take quizzes to Help Me with School* was interesting knowing that students from similar classrooms took similar course exams, yet more females sought out online apps and websites to help them prepare and study for school.

This study revealed that males and females both like simulation games, but they shared different titles and genres/activity-types. Students of both genders stated that they enjoyed playing simulation games, such as the Sims series (2000), 2K17 (2016), GTA series (1997), and Black Ops series (2017). However, more females stated they enjoyed the Sims series (2000) and other simulation type games such as Kim Kardashian (2014). More males stated they preferred sport related games where they could simulate sport scenarios and simulate various athletes or coach teams. This data was important because students valued the real-life parallels and the "real" feeling they perceived while gaming and many would practice specific moves that they had learned while gaming on the field or on the court. The potential to use digital simulation in the classroom or work place for learning skills with embedded content is vast. Simulation activities in gaming illustrate a form of apprenticeship, learning by trial and error, a virtual hands-on experience, and even an opportunity for peer learning.

Fraser et al.'s (2014) study examined game preferences with respect to activities and how these related to science learning, finding a small number of respondents indicated those activities, which featured scientific investigations, and a strong correlation with activities involving "learning." This is in contrast with this study's findings, where numerous students discussed the learning that they perceived through gaming, such as problem solving, patience, perseverance, and flexible thinking for multimodal solutions. Additionally, many students found that their gaming preferences related to the content and career interests, as in adding in content learning and in preparation for a career aspiration. The findings from the focus group provided a breadth of learning perceived by students from their gaming, even from games that were more action oriented.

Research Question Four

No literature comparison was found for a relationship between game play motivations and identity. The findings in this study were generated by examining cross-tabulations between constructs not previously examined for a potential relationship. Several game play motivations were found to have a statistically significant relationship to STEM identities. *Becoming Powerful* had a relationship *to Chemistry*, *Physics*, *Technology*, *Computer Science*, and *Engineer Person. Acquiring Rare Items* had a relationship to *Technology* and *Computer Science Person. Optimizing Your character as Much as Possible* had a relationship to *Physics*, *Technology*, and *Computer Science Person. Competing with Other Players* had a relationship to *Chemistry*, *Physics*, *Technology*, and *Engineer Person. Grouping with Other Players* had a relationship to *Physics Person*. *Keeping in Touch with Your Friends* had a relationship to *Physics*, *Technology*, *Computer Science*, and *Engineer Person.*

Learning about Stories and Lore of the World had a relationship to *Technology* and *Computer Science Person. Feeling Immersed in the World* had a relationship to *Technology* and *Computer Science Person. Exploring the World Just for the Sake of Exploring It* had a relationship to *Technology* and *Computer Science Person.* Game play motivations that did not have a statistically significant relationship with gender were *Being Part of a Guild*, *Learning about Stories and Lore of the World*, *Feeling Immersed in the World*, *Exploring the World Just for the Sake of Exploring It*, and *Creating a Background Story and History for Your Character*.

These results need to be considered in context to research question one and two, where only males had statistically higher average ranks (Mann-Whitney U) for both

STEM identities and game play motivation items, the results for Chi-square test of independence between game play motivations and STEM identities are interesting for a few reasons. One, this question provided further results examining males' *Important/Very Important* game play motivations and their *Agreed/Strongly Agreed* upon STEM identities. Second, this question provided results between game play motivations with frequencies that were not statistically higher for males compared to females. Thus, seeing how other game play motivations connected to STEM identities, where some of the motivations were insignificant for gender. Third, this question creates an opening for future research to discover other game play motivations, or motivations of any type, that may prove to be more significant for females and connect to their STEM identities.

These findings between game play motivations and STEM identities may have significance in designing instruction. If game play motivations were utilized in instruction, students' identities may be further reinforced, especially if said identity were weakly developed. Moreover, understanding and utilizing student motivations, of any kind, to improve instruction for student engagement and participation would be beneficial for student learning. Many of the game play motivations that were not found significant for gender may indeed be similarly motivating for males and females and therefor mutually beneficial in a classroom setting. Students expressed enjoying the feeling of immersion, commonly found in simulation games, and participating in the game's story path. Others also stated that games with a strong story were interesting, stating literary elements, or those with historical background were helpful in school courses, such as history and social studies.

Research Question Five

No literature comparison was found for a relationship between play preference and identity. The findings in this study were generated by examining cross-tabulations between constructs not previously examined for a potential relationship. Several game preferences or genres in this study showed a statistically significant relationship to STEM identities. *Building Cities or Environments* had a relationship to *Computer Science* and *Engineer Person. Simulating Taking Care of animals* and *Making Art* had relationships to *Biology Person. Change the Look of Something, like fashion or make up* had a relationship to *Physics* and *Math Person. Solve Puzzles or Word Challenges* had a relationship to *Math Person. Engage in Battles* had a relationship to *Physics, Technology*, and *Computer Science Person. First Person Shooter* had a relationship to *Physics, Technology, Computer Science*, and *Engineer Person.*

Role-play in Fantasy or Environments had a relationship to *Technology* and *Computer Science Person. Simulate Cooking* had a relationship to *Biology* and *Computer Science Person. Conduct Scientific Investigations* had a relationship to *Biology, Physics, Technology, Computer Science, Engineer*, and *Math Person. Learn New Facts or Information* had a relationship to *Physics, Technology*, and *Computer Science Person. Take Quizzes to Help Me with School* had a relationship to *Biology* and *Chemistry Person.* Game preferences that did not have a statistically significant relationship with any STEM identities were *Build Cities or Environments*, *Race with Obstacles and Challenges*, and *Play, Make Music, or Dance*.

These results need to be considered in context to research question one where only males had statistically higher average ranks (Mann-Whitney U) than females for

STEM identities. Also, for research question three, males reported higher average ranks (Mann-Whitney U) than females for *Simulate Playing Sports*, *Engage in Battles That Might Include Shooting or Fighting*, and *First Person Shooter (FPS)* games; meanwhile, females reported higher average rank (Mann-Whitney U) than males for *Taking Care of Animals*, *Simulate Cooking, Play, Make Music, or Dance*, *Change the Appearance of Something, Like Fashion or Makeup*, *Solve Puzzles or Word Challenges*, and *Take Quizzes to Help Me with School or Entrance Exams*. Keeping these last two statements in mind, the results for Chi-square test of independence between game preferences and STEM identities are interesting for a few reasons.

One, this question provided further results examining males' selected game genres/activity-types (*Yes*) and their *Agreed/Strongly Agreed* upon STEM identities. Second, this question provided results between game preferences with frequencies that were not statistically higher for males compared to females. Thus, seeing how other game preferences connected to STEM identities, where some of the preferences were insignificant for gender. Third, this question creates an opening for future research to discover game preferences, or preferences of any type, that may prove to be more significant for females and connect to their STEM identities.

These findings between game play preferences and STEM identities may have significance in designing instruction. If game preferences were utilized in instruction, students' identities may be further reinforced, especially if said identity were weakly developed. Moreover, understanding and utilizing students' preferred activities to improve instruction for student engagement and participation would be beneficial for student learning. Many of the game play preferences that were not found significant for gender may similarly engage males and females and therefor mutually beneficial in a classroom setting.

Research Question Six

No literature comparison was found for students' perceptions of possible relationship between game play motivations, with respect to game preference and identity. Some students could perceive a direct relationship between their gaming and STEM identities and more could articulate an indirect relationship, while others could not observe any relationship. Still, others found connections between their gaming and other identities, discipline areas, future career interests or how they saw their future selves. Game play motivations that did not have a statistically significant relationship with any STEM identities were *Chatting with Other Players*, *Being Part of a Guild*, and *Creating a Background Story and History for Your Character*.

In other studies, identity, as a type of person, has been found to be a significant predictor of interest in STEM careers (Aschbacher et al., 2014; Hazari et al., 2013) and one's actions (van der Weff et al., 2013). Several participants across the focus groups perceived either explicit or implicit relationships between their game play motivations and game preferences as linked to their STEM identities. Future career aspirations, college major, and discipline interests were also linked to participants' gaming.

Types of thinking, focus, or mental challenge were related to participants' game choices and often connected to science preferred or self-identified by some participants. Linear and non-linear thinking and games were discussed as well as how choices or a part of the came related to the entire game or system. Problem solving was frequently discussed and related to personal goals, beating the game, or beating others by being faster or using a better strategy. However, participants also spoke about patience, perseverance, and tenacity to learn and stick with a game to reap the benefits, whether it being just finishing the objective, learning how to get to the goal multiple ways, or winning points and getting to the next level.

Finding objects, such as Easter eggs, loot, and collectables, or completing tasks and objectives were important to several participants and often seen as a benefit to leveling up or a sense of achievement. Management of resources collected was an important skill, not just within the game, but for practice or future use and knowledge. Participants found value and real-life parallels to practical skills used in games such as management and improving a team, communication, trading stock, decisions to purchase something based on statistics, having a counter argument, negotiating trade or issues in virtual worlds, or performing duties of a personal assistant. The virtual experience of building and creating things, from weapons, to structures, or even entire civilizations were appealing to many participants. Often, these tasks require accumulation of materials and skills, as well as decision-making on how to best use these to the participants' advantage.

Several students claimed they felt accomplished when successfully moving through levels and attaining a rank. Some felt personal satisfaction with this feat, where others enjoyed the peer recognition. Digital games provided participants virtual realities to escape in or to explore and create in. Participants' games offered inspiration to possible selves, future aspirations, and future technical realities. Many participants felt that there was learning of some kind in the games that they played.

Implications

As technology continues to advance, and video games and gaming apps continue to expand and change over time; it is important to generate both current and medium specific data as new variables may arise. This study revisited gender differences with respect to gaming and STEM constructs and made comparisons to the findings of prior literature. Moreover, this research attempted to discover an innovative factor to the gender gap in STEM participation through the construct of game play motivations, and the results revealed new associations between ones' game play motivations and the three STEM constructs. While this study may not fully explain the continued gender gap in STEM participation, it does illustrate connections between game play motivations as well as game preferences and STEM identities. These are both important findings because research as shown connections between STEM identity and STEM participation and retention in STEM programs, within a STEM college major or STEM career choices.

For Curriculum and Instructional Design

The focus group findings for perceived relationships between game play motivations, with respect to game preferences, and STEM identities revealed a need for educators to pay closer attention to students' perceptions and to learn how to better understand how to utilize these perceptions to drive curriculum and instructional design. Professional development for digital game play, digital learning, and immersive learning which is embedded into curriculum and instruction, should be provided to school administrators and teachers in order to change perceptions and accurate attitudes towards integrating gaming in the educational settings. Cognitive and learning theory with respect to digital game play must be further explored and results disseminated into practitioners' toolkits.

Educational institutions and game design companies could cultivate new learning experiences with virtual and immersive technology. Thus, industry could influentially create curricular changes that include new tools and digital resources that classroom teachers could utilize to provide to students to motivate and enhance student learning. Moreover, universities and textbook-curriculum publishers should collaborate with national and state educational agencies to develop gaming opportunities aligned to state and national standards.

For School Administrators

Furthermore, school districts should be encouraged to develop a strategic plan for digital and game-based learning, in coordination with the technology departments and digital-learning departments. Stakeholder education and corporate partnerships would be necessary for not only buy-in and sponsorship, but to help determine short and long-term goals for technology implementation in the classroom. Yet, this author argues, that such goals should go beyond simply the need for providing professional development and sufficient infrastructure to school campuses, but seek revisions to curriculum that embeds immersive technology and digital gaming. Building teachers' self-efficacy and seeking stakeholders' feedback would be important for meeting any benchmarks within a district's strategic plan. Instructional models would need to be practical, as well as grade level and context-appropriate for teachers to successfully implement. Reshaping curriculum and instructional resources would be necessary for integration and classroom applications

For Teachers

Educators must understand the critical connections between gaming and learning and seek to provide learning opportunities through gaming and immersive experiences where students take on role play and discovery, constructing new knowledge and collaborating with peers. Perceptions and mindset can only change through new experiences and exposure to alternative mindsets, based in research, which positively support students' educational outcomes. The findings for game play motivations and game preferences suggest possible associations between gaming and STEM constructs, such as STEM identity, interest in STEM careers, and even perceived skills and problem solving. This study has theoretically provided two new factors, game play motivations and game preferences, which may be responsible, or at least a variable, for driving gender gaps in STEM and should not be overlooked by the educational field.

Recommendation for Future Research

Many times, participants in the focus groups would be confused by game preference (by title or activity type) and by game play motivations (why they were motivated to play a game). Trying to separate the two constructs was difficult in focus group discussions, as students participating could not easily speak of one without the other. The intertwining of game play motivations and game play preferences was allowed and important for flow of discussion and participation by member; however, it also become imperative for meaning and depth of perceptions for addressing question three.

For a future study considering gender, a more in-depth examination of students' technology access, online game play, and interactions with older siblings and/or parents who play digital games would be interesting. Across focus groups, students shared that they played with a parent or sibling. Familial contexts such as playing peers and/or other competitors, which speaks to interesting familial dynamics and social interactions, is one that inspired this author's germinal interest in gaming as a research topic and recommended by Greenberg et al.'s (2010).

Another recommendation would be to have a study with a more unified focus on game play motivations or game preferences and one of the STEM identities, such as just physics identity or just math identity. By narrowing the discussion topics in the focus groups, participants would be given more time to form richer responses that personally and meaningfully link to a STEM identity with respect to game play motivations and game preferences. Both measures would aide to facilitate the mixed method research approach with more clarity and perhaps better validity from fuller data triangulation and better opportunity for member checking.

Lastly, interesting data were generated from the focus groups for students' perceived relationships between their game play motivations, with respect to game preferences, and their STEM identities, as well as other identity types and constructs. Students in this study did perceive a relationship between their gaming and other identity types, further validating a relationship between game play motivations, with respect to game preferences, and one's identity. These perceived relationships and students' participation in disciplines, college major choices, and career aspirations should be further explored and even tracked longitudinally. In addition, the data revealed a need to more deeply evaluate students' perceptions regarding learning through and from gaming. Many students shared their perceived value and learning from and through gaming.

Future research in this area would improve the current research in perceptions of utilizing gaming in the classroom and school environment as an accepted mode of instruction and with respect to poorly approved students' cognitive participation within a content area. Current research focuses on teachers' and school administrators' perceptions for digital integration and have examined these perceptions through the lens of curriculum design and professional development. This study provided students' perceptions of gaming and digital integration for learning curriculum, as well as their accounts of adults' negative perceptions of gaming. This author would suggest further research into all stakeholders' perceptions, as well as program review of any district strategic plan, for implementation of gaming and digital integration for learning curriculum. Such studies and program reviews would provide valuable feedback and insight into district programs, as well as assist curriculum and instruction departments in shaping curriculum design and instructional methods embedding gaming and immersive digital learning experiences.

Conclusion

This study examined student differences with respect to game play motivation, game preferences, and STEM identity constructs. Chapter V served to make comparisons between the results of this study and prior literature. Moreover, this research strove to discover and successfully found novel associations between ones' game play motivations and game preferences with respect to discipline specific STEM identities. Professional development for school administrators and teachers must happen to change perceptions and provide accurate attitudes towards integrating gaming in the educational settings. Furthermore, school districts' technology departments, digital-learning departments, and curriculum and instruction departments need to better collaborate to provide meaningful and practical professional development to administrators and teachers as well as secure the necessary resources and infrastructure to school campuses. By creating curricular changes that include immersive game play and developing instructional digital games, educators would have more current and relevant instructional tools and new learning environments that would cognitively engage students in context of the course content. The findings in this study suggest associations between game play motivations and game preferences with respect to STEM identities. Thus, this study theoretically offers two new factors, game play motivations and game preferences, which may influence the gender gaps in STEM participation. Understanding students' game play motivations and game preferences for purposes of improving curriculum and instructional design may potentially have a positive impact where more students participate in STEM disciplines, see them selves as a STEM type person, as well as inspire greater interest in a STEM type careers.

This study is significant to both the field of STEM education and gaming in that it provides insight into students' STEM identities in relation to game play motivations and game preferences through quantitative and qualitative data analysis. Students' perceptions between the constructs demonstrated important awareness between how students see themselves currently, as well as future selves through career aspirations. With increased use of technology in the classroom, further research could greatly impact future curriculum design and instructional theories to determine and support best practices which use digital game play and immersive experiences for student learning classroom environments.

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APPENDIX A

SURVEY: GAMING AND STEM

APPENDIX A

SURVEY: GAMING AND STEM

Introduction

Dear Student, Welcome to the Gaming and S.T.E.M. Survey! I value your input as a student between the ages of 14 and 19 years of age.

By clicking "Agree and continue to the Gaming and S.T.E.M. Survey" you agree to participate in the following survey on your opinions and experiences using online games and S.T.E.M. (Science, Technology, Engineering, and Math) topics.

The survey will take approximately 10-15 minutes or less.

The procedure does not pose any risk and/or discomfort. Your participation is entirely voluntary and you may decline to enter this study or may withdraw from it at any time without risk. The survey will not have a name or any other identifying feature attached to it.

* 1. By clicking on “agree and continue to the Gaming and S.T.E.M. Survey” below, you acknowledge that you are between the age of 14 and 19 years and you agree to be asked a series of questions in this survey.

If you are between 14 to 19 years old and agree to participate, please click on "Agree and continue to the Gaming and S.T.E.M. Survey."

◯ Agree and continue to the Gaming and S.T.E.M. Survey

◯ I do not wish to continue with this survey

About Yourself

2. Tell me how you see yourself:

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
Do you see yourself as a Biology Person?	◯	◯	◯	◯	◯
Do you see yourself as a Chemistry Person?	◯	◯	◯	◯	◯
Do you see yourself as a Physics Person?	◯	◯	◯	◯	◯
Do you see yourself as a Technology Person?	◯	◯	◯	◯	◯
Do you see yourself as a Computer Science Person?	◯	◯	◯	◯	◯
Do you see yourself as a Engineer Person?	◯	◯	◯	◯	◯
Do you see yourself as a Math Person?	◯	◯	◯	◯	◯

Gaming Habits

3. How often do you play digital games at each of these places?

	Daily	4 to 6 Days Per Week	1 to 3 Days Per Week	Never
At home	○	○	○	○
At school as part of class	○	○	○	○
At an after school program or camp	○	○	○	○
At my friends' homes	○	○	○	○
At the library as part of formal programs	○	○	○	○
At school during free time	○	○	○	○
At the library on my own or with friends	○	○	○	○
Other Location	○	○	○	○

4. What types of activities do you like to do in digital games? Select all of the ones that you like to play. I like when I get to:

	Yes	No
Build cities or environments	○	○
Simulate playing sports	○	○
Simulate taking care of animals	○	○
Make art	○	○
Change the look of something, like fashion or makeup	○	○
Race with obstacles and challenges	○	○
Solve puzzles or word challenges	○	○
Engage in battles, that might include shooting or fighting	○	○
First person shooter games [FPS]	○	○
Play, make music, or dance	○	○
Role play in fantasy or role playing environments	○	○
Simulate cooking	○	○
Conduct scientific investigations	○	○
Learn new facts or information	○	○
Take quizzes to help me with school or entrance exams	○	○

Another activity (please specify)

5. I like to play games where...

	Yes	No
I get to play with my friends in the same room	○	○
I get to play online with people I know	○	○
I get to play online with people I have never met	○	○
I like to play my games on my own	○	○

Game Play Motivations

6. Please rate how important each of the following game play elements is to you when playing online games.

	Unimportant	Of Little Importance	Moderately Important	Important	Very Important
Becoming powerful	○	○	○	○	○
Acquiring rare items	○	○	○	○	○
Optimizing your character as much as possible	○	○	○	○	○
Competing with other players	○	○	○	○	○
Chatting with other players	○	○	○	○	○
Being part of a guild	○	○	○	○	○
Grouping with other players	○	○	○	○	○
Keeping in touch with your friends	○	○	○	○	○
Learning about stories and lore of the world	○	○	○	○	○
Feeling immersed in the world	○	○	○	○	○
Exploring the world just for the sake of exploring it	○	○	○	○	○
Creating a background story and history for your character	○	○	○	○	○

S.T.E.M. Interests and Attitudes

7. Math

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Math has been my worst subject.	◯	◯	◯	◯	◯
I would consider choosing a career that uses math.	◯	◯	◯	◯	◯
Math is hard for me.	◯	◯	◯	◯	◯
I am the type of student to do well in math.	◯	◯	◯	◯	◯
I can handle most subjects well, but I cannot do a good job	◯	◯	◯	◯	◯
I am sure I could do advanced work in math.	◯	◯	◯	◯	◯
I can get good grades in math.	◯	◯	◯	◯	◯
I am good at math.	◯	◯	◯	◯	◯

8. Science

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am sure of myself when I do science.	◯	◯	◯	◯	◯
I would consider a career in science.	◯	◯	◯	◯	◯
I expect to use science when I get out of school.	◯	◯	◯	◯	◯
Knowing science will help me earn a living.	◯	◯	◯	◯	◯
I will need science for my future work.	◯	◯	◯	◯	◯
I know I can do well in science.	◯	◯	◯	◯	◯
Science will be important to me in my life's work.	◯	◯	◯	◯	◯
I can handle most subjects well, but I cannot do a good job with science.	◯	◯	◯	◯	◯
I am sure I could do advanced work in science.	◯	◯	◯	◯	◯

9. **Engineering and Technology**

Engineers use math, science, and creativity to research and solve problems that improve everyone's life and to invent new products. There are many different types of engineering, such as chemical, electrical, computer, mechanical, civil, environmental, and biomedical. Engineers design and improve things like bridges, cars, fabrics, foods, and virtual reality amusement parks. **Technologists** implement the designs that engineers develop; they build, test, and maintain products and processes.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I like to imagine creating new products.	○	○	○	○	○
If I learn engineering, then I can improve things that people use every day.	○	○	○	○	○
I am good at building and fixing things.	○	○	○	○	○
I am interested in what makes machines work.	○	○	○	○	○
Designing products or structures will be important for my future work.	○	○	○	○	○
I am curious about how electronics work.	○	○	○	○	○
I would like to use creativity and innovation in my future work.	○	○	○	○	○
Knowing how to use math and science together will allow me to invent useful things.	○	○	○	○	○
I believe I can be successful in a career in engineering.	○	○	○	○	○

Your Future

Here are descriptions of subject areas that involve math, science, engineering and/or technology, and lists of jobs connected to each subject area. As you read the list below, you will know how interested you are in the subject and the jobs. Fill in the circle that relates to how interested you are.

Physics	aviation engineer, alternative energy technician, lab technician, physicist, astronomer
Environmental Work	pollution control analyst, environmental engineer or scientist, erosion control specialist, energy systems engineer and maintenance technician
Biology & Zoology	biological technician, biological scientist, plant breeder, crop lab technician, animal scientist, geneticist, zoologist
Veterinary Work	veterinary assistant, veterinarian, livestock producer, animal caretaker
Mathematics	accountant, applied mathematician, economist, financial analyst, mathematician, statistician, market researcher, stock market analyst
Medicine	physician's assistant, nurse, doctor, nutritionist, emergency medical technician, physical therapist, dentist
Earth Science	geologist, weather forecaster, archaeologist, geoscientist
Computer Science	computer support specialist, computer programmer, computer and network technician, gaming designer, computer software engineer, information technology specialist
Medical Science	clinical laboratory technologist, medical scientist, biomedical engineer, epidemiologist, pharmacologist
Chemistry	chemical technician, chemist, chemical engineer
Energy	electrician, electrical engineer, heating, ventilation, and air conditioning (HVAC) technician, nuclear engineer, systems engineer, alternative energy systems installer or technician
Engineering	civil, industrial, agricultural, or mechanical engineers, welder, auto-mechanic, engineering technician, construction manager

There are no "*right*" or "*wrong*" answers. The only correct responses *are those that are true for you.*

10. Careers

	Not at all Interested	Not So Interested	Interested	Very Interested
Physics	◯	◯	◯	◯
Environmental Work	◯	◯	◯	◯
Biology and Zoology	◯	◯	◯	◯
Veterinary Work	◯	◯	◯	◯
Mathematics	◯	◯	◯	◯
Medicine	◯	◯	◯	◯
Earth Science	◯	◯	◯	◯
Computer Science	◯	◯	◯	◯
Medical Science	◯	◯	◯	◯
Chemistry	◯	◯	◯	◯
Energy	◯	◯	◯	◯
Engineering	◯	◯	◯	◯

11. More about you.

	Yes	No	Not Sure
Do you know any adults who work as scientists?	◯	◯	◯
Do you know any adults who work as engineers?	◯	◯	◯
Do you know any adults who work as mathematicians?	◯	◯	◯
Do you know any adults who work as technologists?	◯	◯	◯

* 12. **What is your gender?**

◯ **Male**

◯ **Female**

* 13. **What is your current grade level?**

◯ **Freshman**

◯ **Sophmore**

◯ **Junior**

◯ **Senior**

* 14. **What is your race/ethnicity?**

- ◯ Asian
- ◯ Black
- ◯ Hispanic
- ◯ White
- ◯ American Indian/Alaskan Native
- ◯ Native Hawaiian/Other Pacific Islander
- ◯ Two or more races

Subject:	Re: Game Play Motivations survey
From:	Nick Yee ()
To:	ksjeremiassen;
Date:	Monday, October 16, 2017 7:30 PM

Hi Kathleen,

This is fine with me. All the best with your dissertation!

Nick

----- Original Message -----
From: "Kathleen Jeremiassen" <ksjeremiassen>
To: "Nick Yee" <>
Cc:
Sent: Mon, 16 Oct 2017 23:21:21 +0000 (UTC)
Subject: Re: Game Play Motivations survey

Hello Dr. Yee,

I previously sought permission to use your game play motivation survey. I am soon approaching final defense and learning that there are some new library rules. Namely, I need to seek permission to allow that the motivation survey be allowed to be published in my dissertation appendix with some modifications. The modifications are that I added anchors, as per my committee chair and statistician. May I please have permission to publish the survey with the added anchors. Anchors were added due to concern of high schoolers understanding how to respond to survey.

I greatly appreciate your time and consideration. Please see the attachment, it demonstrates how the questions were utilized in the survey.

With respect,

Kathleen Jeremiassen
Doctorate Candidate
□
□

From: Nick Yee <>
To: Kathleen Jeremiassen <ksjeremiassen>
Sent: Thursday, March 17, 2016 10:45 AM
Subject: Re: Game Play Motivations survey

Hi Kathleen,

Please feel free to use the gaming motivations survey for your research.

All the best with your studies!

Nick

On Mar 15, 2016, at 10:51 AM, Kathleen Jeremiassen <> wrote:

Dear Dr. Yee,

Hello, my name is Kathleen Jeremiassen. I am a graduate student working on my dissertation at University of Houston, Clear Lake. My dissertation topic is regarding STEM and gaming, with respect to science identity, STEM interests, game preferences and game motivations. I am still fairly new in the development of my dissertation and I am reworking my Chapter 2. I am still fleshing out my constructs and shaping my research questions. Originally, I wanted to look at just females and a high school population. This was due to what I felt a need for more intra-gender research in both STEM and gaming. However, under the direction of my adviser, Dr. Jana Willis, she suggested looking at college students and both genders. This suggestion was made largely due to the two levels of consent needed for high school students.

I read your papers on game play motivation and I am extremely interested in the survey (Game Motivations Scale) you developed and tested. I am seeking your permission to use this survey for my dissertation data gathering. May I please have your permission to use your survey for my dissertation? I would greatly appreciate any correspondence with you and any suggestions you may have.

Thank you for your time and consideration,

Kathleen Jeremiassen

Subject:	Re: Permission to use 3 questions from PRiSE survey for dissertation
From:	Sonnert, Gerhard ()
To:	ksjeremiassen;
Date:	Tuesday, October 17, 2017 9:27 AM

Hi, Kathleen,

I am happy to give you permission to publish the three PRiSE questions in your dissertation appendix.

It looks like you have almost reached the successful conclusion of your dissertation project. Many congratulations and best wishes for the final steps!

Cheers,
Gerhard

On Mon, Oct 16, 2017 at 7:18 PM, Kathleen Jeremiassen <ksjeremiassen> wrote:

Hello Dr. Sonnert,

I previously sought permission to use three questions from the PRiSE survey. I am soon approaching final defense and learning that there are some new library rules. Namely, I need to seek permission to allow that the three identity questions from the PRiSE survey be allowed to be published in my dissertation appendix with some modifications. The modifications are that I added additional specific disciplines to capture additional STEM-type identites, as well as added anchors, as per my committee chair and statistician. May I please have permission to publish the three identity questions from PRiSE, along with additional STEM-type discipline identities and with the added anchors. Anchors were added due to concern of high schoolers understanding responding to survey.

I greatly appreciate your time and consideration. Please see the attachment, it demonstrates how the questions were utilized in the survey.

With respect,

Kathleen Jeremiassen
Doctorate Candidate
UHCL
□

From: "Sonnert, Gerhard" <>
To: Kathleen Jeremiassen <>
Sent: Wednesday, January 4, 2017 1:12 PM
Subject: Re: Permission to use 3 questions from PRiSE survey for dissertation

Hi, Kathleen,

You can cite the file I sent you as "personal communication." This is the most comprehensive description of the data and methods that we have. It usually gets modified and shortened in articles published from the PRiSE dataset. I attach an example. There are more published PRiSE articles (looking for Hazari&Sadler&Sonnert in databases, you should easily find a few of them, if that is of interest).

Cheers,
Gerhard

On Tue, Jan 3, 2017 at 7:11 PM, Kathleen Jeremiassen <ksjeremiassen> wrote:

THANK YOU, THANK YOU, THANK YOU!!!! I so appreciate you taking the time to send me this information. What citation or citations would you suggest for this?

Kathleen Jeremiassen

From: "Sonnert, Gerhard" <gsonnert>
To: Kathleen Jeremiassen <ksjeremiassen>
Cc: "psadler" < psadler>
Sent: Tuesday, January 3, 2017 9:05 AM
Subject: Re: Permission to use 3 questions from PRiSE survey for dissertation

Hi, Kathleen,

I am attaching a description of the PRiSE samples and methods in hopes this will be useful for your project.

Happy New Year!

Gerhard

On Sun, Jan 1, 2017 at 3:44 PM, Kathleen Jeremiassen <ksjeremiassen> wrote:

Hello there Dr. Sonnert:

Happy New Year! I have been searching for a paper or article that discusses the validity and reliability of the survey. I need this element when I write about instrumentation. I can't see to find it. Can you help me out?

Thank you,

Kathleen Jeremiassen

From: "Sonnert, Gerhard" <gsonnert>
To: Kathleen Jeremiassen <ksjeremiassen>
Cc: Jana Willis <willis>; Philip Sadler < psadler>
Sent: Tuesday, August 30, 2016 1:37 PM
Subject: Re: Permission to use 3 questions from PRiSE survey for dissertation

Dear Ms. Jeremiassen,

I am happy to give you permission to use questions from the PRiSE instrument under the stated conditions.

I have attached an electronic version of the PRiSE questionnaire.

Good luck with your doctoral research!

With best regards,
Gerhard Sonnert

On Sun, Aug 28, 2016 at 5:07 PM, Kathleen Jeremiassen <ksjeremiassen> wrote:

Dear Dr. Gerhard Sonnert:

I am a doctoral student from University Houston Clear Lake writing my dissertation tentatively based on differences in levels of interest and attitudes towards STEM and science identity under the direction of my committee chaired by Dr. Jana Willis (email: willis). I am only in my second year and my things are still being ironed out. I'm about to start by pilot study. The expected date of my dissertation completion is 7/2018.

I would like for your permission to obtain access and reproduce for use in my study: the survey instruments from the Project PRiSE; specifically the three questions regarding identity: Do you see ourself as a Biology Person?, Do you see yourself as a Cheistry Person? Do you see yourself as a Physics Person?. I would like to use these questions in a survey under the following conditions:

- I will use this survey only for my research study and will not sell or use it with any compensated or curriculum development activities.
- I will include the copy right statement on all copies of the instrument.

If these are acceptable terms and conditions, could you be so kind as to please indicate your permission by emailing me or contacting me by mail (see below)? If use of the entire survey is possible, could you kindly please make the survey items available to me in electronic form if possible?

Thank you,

Kathleen Jeremiassen

APPENDIX B

FOCUS GROUP QUESTIONS

APPENDIX B

FOCUS GROUP QUESTIONS

1. What STEM identities do you identify with? If none, how do you see yourself as a "type of person" (Carlone & Johnson, 2007)?
2. What types/genres of games or game activities do you prefer?
3. Why do you like to play those games? What motivates you to play those games?
4. Do you think there is any connection between your STEM identities (how you identify yourself) and the types/genres of games you prefer?
5. Do you think there is any connection between your STEM identities and why you like to play (what motivates you to play) the games you prefer?

APPENDIX C

PARENT/GUARDIAN CONCENT COVER LETTER

APPENDIX C

PARENT/GUARDIAN CONCENT COVER LETTER

Parental/Guardian Consent Cover Letter

You are being asked to allow your child to participate in a research study titled DIFFERENCES IN STUDENTS' IDENTITY, GAME PLAY MOTIVATIONS, AND GAME PREFERENCES.

Your consent to provide permission for your student to participate in this study is entirely voluntary. You and your student may refuse to participate. Participants' identities will be kept confidential. Participation consists of completing a survey and the option to participate in a focus group. The purpose of this study will be to identify differences in students' Science, Technology, Engineering, and Math (STEM) identity relative to their game play motivations and game preferences.

This attached document provides you with information about this study and the researchers Kathleen S. Jeremiassen and Jana M. Willis, Ph.D. can be reached at _____to answer all of your questions. Please read the information in the attached consent (permission) form and ask any questions you might have before deciding whether or not to allow your student to take part.

Sincerely,

Kathleen S. Jeremiassen

Kathleen s. Jeremiassen

APPENDIX D

PARENT CONSENT AND STUDENT ASSENT FORM

APPENDIX D

PARENT CONSENT AND STUDENT ASSENT FORM

Informed Consent to Participate in Research

You are being asked to participate in the research project described below. Your participation in this study is entirely voluntary and you may refuse to participate, or you may decide to stop your participation at any time. Should you refuse to participate in the study or should you withdraw your consent and stop participation in the study, your decision will involve no penalty or loss of benefits to which you may be otherwise entitled. You are being asked to read the information below carefully, and ask questions about anything you don't understand before deciding whether or not to participate.

Title: DIFFERENCES IN STUDENTS' STEM IDENTITY, GAME PLAY MOTIVATIONS, AND GAME PREFERENCES.
Student Investigator(s): Kathleen S. Jeremiassen
Faculty Sponsor: Jana Willis, Ph.D.

PURPOSE OF THE STUDY

The purpose of this study will be to identify differences in students' Science, Technology, Engineering, and Math (STEM) identity relative to their game play motivations and game preferences.

PROCEDURES

Survey completion will be conducted in a variety of classrooms and advisory periods. The survey collection process will be monitored by a classroom teacher or Mrs. Jeremiassen, the student investigator. Surveys will be uploaded to a survey generator (e.g. Survey Monkey) and completed on students' hand-held devices or in the computer lab. Participants will record their responses for game genre preferences, game play motivations, interest in STEM careers, and attitudes toward STEM content. This survey portion will take the participants approximately 10-15 minutes. Approval from the Committee for the Protection of Human Subjects (CPHS) at the University of Houston Clear Lake (UHCL) was obtained and permission to conduct research were sought from the ------------School District as well as permission from participants' parents, in accordance to customary research protocol and requirements set forth by UHCL School of Education Department. Interviews will be conducted from focus groups, and will consist of a subset of participants from the surveyed participants from participating high schools. The focus groups will total no more than ten participants, and with the intent of representing the demographic makeup of each school. The interview portion of data collection process will be conducted during a time agreed upon and take approximately 30 minutes.

EXPECTED DURATION

The total anticipated time commitment will be approximately a total of 45 minutes, including both the survey and the focus group session; however, these will be conducted separately.

RISKS OF PARTICIPATION
There are no anticipated risks associated with participation in this project.

BENEFITS TO THE SUBJECT
There is no direct benefit received from your participation in this study, but your participation will help the investigator(s) better understand possible relationships between gaming and STEM identity.

CONFIDENTIALITY OF RECORDS
Every effort will be made to maintain the confidentiality of your study records. The data collected from the study will be used for educational and publication purposes, however, you will not be identified by name. For federal audit purposes, the participant's documentation for this research project will be maintained and safeguarded by Kathleen S. Jeremiassen, M.Ed. or Jana Willis Ph.D. for a minimum of three years after completion of the study. After that time, the participant's documentation may be destroyed.

FINANCIAL COMPENSATION
There is no financial compensation to be offered for participation in the study.

INVESTIGATOR'S RIGHT TO WITHDRAW PARTICIPANT
The investigator has the right to withdraw you from this study at any time.

CONTACT INFORMATION FOR QUESTIONS OR PROBLEMS
The investigator has offered to answer all your questions. If you have additional questions during the course of this study about the research or any related problem, you may contact the Principal Investigator, Kathleen S. Jeremiassen, M.Ed., at phone number ----------- or by email at ----------------.
If you have additional questions during the course of this study about the research or any related problem, you may contact the Student Researcher, Kathleen S. Jeremiassen, M.Ed., at phone ------------- or by email at --------------. The Faculty Sponsor Jana Willis, Ph.D., may be contacted at phone number ------------- or by email at ----------------.

SIGNATURES:

Your signature below acknowledges your voluntary participation in this research project. Such participation does not release the investigator(s), institution(s), sponsor(s) or granting agency(ies) from their professional and ethical responsibility to you. By signing the form, you are not waiving any of your legal rights.

The purpose of this study, procedures to be followed, and explanation of risks or benefits have been explained to you. You have been allowed to ask questions and your questions have been answered to your satisfaction. You have been told who to contact if you have additional questions. You have read this consent form and voluntarily agree to participate as a subject in this study. You are free to withdraw your consent at any time by contacting the Principal Investigator or Student Researcher/Faculty Sponsor. You will be given a copy of the consent form you have signed.

Student's printed name: ______________________________

Signature of Student:______________________________

Student's Parent printed name:______________________________

Signature of Student's Parent: ______________________________

Date: ______________________________

Using language that is understandable and appropriate, I have discussed this project and the items listed above with the subject.

Printed name and title: ______________________________

Signature of Person Obtaining Consent:______________________________

Date: ______________________________

THE UNIVERSITY OF HOUSTON-CLEAR LAKE (UHCL) COMMITTEE FOR PROTECTION OF HUMAN SUBJECTS HAS REVIEWED AND APPROVED THIS PROJECT. ANY QUESTIONS REGARDING YOUR RIGHTS AS A RESEARCH SUBJECT MAY BE ADDRESSED TO THE UHCL COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS (281-283-3015). ALL RESEARCH PROJECTS THAT ARE CARRIED OUT BY INVESTIGATORS AT UHCL ARE GOVERNED BY REQUIREMENTS OF THE UNIVERSITY AND THE FEDERAL GOVERNMENT. (FEDERALWIDE ASSURANCE # FWA00004068)