SOURCES OF MATH SELF-EFFICACY: A CASE STUDY OF STUDENTS IN GAME DESIGN

by

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A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at George Mason University

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ABSTRACT

SOURCES OF MATH SELF-EFFICACY: A CASE STUDY OF STUDENTS IN GAME DESIGN

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Within the past 20 years, the concept of self-efficacy has received considerable attention from educational researchers as they seek to understand student beliefs related to academic activities and academic performance. Recent findings have suggested that sources of self-efficacy differ across race and ethnicity among students. Much more research however, is still needed to further examine this claim. The present study, one of few qualitative studies examining sources of self-efficacy, recruited African American participants from the Game Design @ Mason program and used the Morgan-Jinks Math Self-Efficacy scale to select and interview students. The following research questions were explored: (a) What sources of math self-efficacy do African American students with interests in game design rely upon most? (b) How do sources of self-efficacy differ for students with high math self-efficacy ratings as compared to students with lower math self-efficacy ratings? (c) How do students with high math self-efficacy ratings compare to students with lower math self-efficacy ratings in their preferences for the Game Design

@ Mason program? (d) How do students with high math self-efficacy ratings compare to students with lower math self-efficacy ratings in their willingness to share with peers their association to the Game Design @ Mason program? (e) How do female students compare to male students in their descriptions of their sources of math self-efficacy? Results suggest that students primarily relied on mastery experiences and affective states to define their math self-efficacy.

1. INTRODUCTION

The current study examined the sources of math self-efficacy of African American students enrolled in an afterschool Game Design program. This was an effort to explore the evidence base for conducting further research on sources of math self-efficacy for students of color and its implications for STEM education.

Nature of the Problem

In September of 2010, President Barack Obama announced a new goal to recruit 10,000 science, technology, engineering, and math (STEM) teachers over the course of two years citing the vital need to strengthen STEM education to prepare students to compete in the 21st century economy (The White House, Office of the Press Secretary, 2010). The question of what can be done to enhance the science and technology enterprise of the United States and secure its global community within the 21st century has begun to plague policymakers (National Academy of Sciences, 2007). In response to this question, the National Academy of Science, the National Academy of Engineering, and the Institute of Medicine drafted a report to address this concern. In it, committee members expressed deep concern that “the scientific and technical building blocks” of the United States’ economic foundation were deteriorating while simultaneously other nations innovatively expanded (National Academy of Sciences, 2007). The top action item on the committee's agenda was to increase America's talent pool by vastly improving K-12 science and mathematics education.

Increasing America's STEM talent pool is needed in light of the recent international and national standardized test scores reported from the Program in International Student Assessment (PISA) and the National Assessment of Educational Progress (NAEP). The results of the PISA scores show that out of 58 countries, the United States ranked 27th in science and 30th in mathematics. Demographic data collected from the National Assessment of Educational Progress (NAEP) consistently shows that students of color perform below the national average in areas of math and science. On the 2011 version of the test, only 5% of African American students scored above the 75th percentile for Grades 4 and 8, which is the lowest percentage of the racial categories reported. Additionally, African American students had the largest score gaps among racial categories when compared to Caucasian students (National Center for Education Statistics, 2011). The average math score for fourth grade African American students on the math portion of the most recent NAEP was 224 as compared to Caucasian students who averaged a score of 249 (National Center for Education Statistics, 2011). This reflects a 25 point score difference. Similarly, the average math score for eighth grade African American students was 262 as compared to Caucasian students who averaged a score of 293, representing a 31 point difference (National Center for Education Statistics, 2011). The achievement gap apparent in both national and international assessment scores seems to relate to the achievement gaps overall and in STEM most noticeable in post-secondary education.

These statistics also reflect the demographic of students enrolled in degree-granting institutions. In 2008, Caucasian students accounted for 63% of college student enrollments as compared to African American students who represented 14% (Aud, Hussar, Planty, Snyder, Bianco, Fox, Frohlich, Kemp & Drake, 2010). Achievement gaps between students of color and Caucasian students are also found when reviewing the demographic data of students with STEM degrees conferred. In 2006, 8.3% of bachelor degrees in science and engineering were awarded to African Americans as compared to 64.7% of Caucasians. Of the total doctoral degrees in science and engineering awarded in 2006, 2.5 % were awarded to African Americans as compared to 42.4% of doctoral degrees in science and engineering awarded to Caucasians (National Science Foundation, 2010). In light of these large percentage gaps, particular focus has been placed on increasing the enrollment, retention, and persistence of students of color in STEM education as such students are underrepresented in STEM disciplines.

This underrepresentation reflects more than an achievement gap, this disparity reflects an even wider excellence gap (Plucker & Burroughs, 2010). The excellence gap is best defined as an unintended consequence of No Child Left Behind best illustrated within classrooms where struggling students are given preference by teachers and gifted students are overlooked (Loertscher, 2010). The NAEP also reflects this excellence gap (Plucker & Burroughs, 2010). In looking at Grade 4 mathematics from 1996 to 2007, the percentage of Caucasian students scoring at the advanced level increased from 2.9% to 7.6%, as compared to African American and Hispanic students who increased from 0.7% to 1.3%. When looking at Grade 8 mathematics from 1996 to 2007, the percentage of

Caucasian students scoring at the advanced level increased from 5.0% to 9.4% as compared to African American students who increased from 0.3% to 0.4% and Hispanics who increased from 0.6 % to 0.7% (National Center for Education Statistics, 2009).

The U.S. Census Bureau (2008) projects that minority groups, namely, African Americans, Hispanics, Asians, and Native Americans are expected to grow and comprise approximately 50% of the total U.S. population by 2050. The nation is not preparing to address the possibility of an even larger achievement gap between Caucasian students and students of color in the future (Adams, Robinson, Osho & Adejonwo, 2006). Yet, an achievement gap should not be the nation's only concern. As emphasis has been placed on reconciling the achievement gap within STEM education, emphasis must be placed on the excellence gap as well as it also reflects a large difference in the academic achievement of Caucasian students and students of color (Plucker & Burroughs, 2010). In order to enhance the United States' competitiveness on the international STEM front, the U.S. will need to place a concerted effort to research and employ schooling practices and academic interventions for all children, but especially for students of color that will increase their college enrollment, retention, and persistence in STEM (Museus, S.D, Palmer, R.T., Davis, R.J., & Maramba, D., 2011; Palmer, Maramba & Dancy, 2011; Usher & Pajares, 2006). To enhance the United States' STEM workforce it is essential that students of all racial backgrounds be able to excel in STEM disciplines (Executive Office of the President, 2010). Accomplishments within STEM at the secondary level have been linked to post-secondary academic acceleration and efficacy (Subotnik, Olszewski-Kubilius & Worrell, 2011). Presently, only a small share of students and an even smaller share of students of color, at the secondary level, achieve the necessary STEM accomplishments that equip students to later excel in STEM disciplines at higher institutions (Plucker & Burroughs, 2010). As a result, few students in general and fewer students of color are equipped for the STEM workforce.

Specific factors have been linked to the STEM achievement gap between students of color and Caucasians. These factors include lack of access to qualified teachers, low teacher expectations, and stereotype threat (Palmer, Maramba, & Dancy, 2011; Museus et al., 2011). Despite these factors, it seems that environments that foster STEM communal learning environments propel struggling students towards academic success. From self-efficacy research, it would appear that students of color rely on the feedback received in such learning forums as well as from within the household from parents as primary sources of self-efficacy (Berryman, 1983; Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose, Gary, 2009). As self-efficacy is predictive of academic success, this finding is important. However, studies also indicate that gender influences the sources of self-efficacy identified as most important to individuals (Espinosa, 2011). The present study seeks to examine the dynamic relationship between sources of self-efficacy and academic success, specifically examining how communal learning environments, gender, and sources of self-efficacy influence the math self-efficacy development of African American students with a shared interest in computer game design.

2. LITERATURE REVIEW

Specific factors such as lack of access to qualified teachers, low teacher expectations, and stereotype threat contribute to the insufficient academic preparation of African American students in STEM. Alternatively, research draws attention to the importance of communal learning forums for African American students in STEM disciplines. In light of these findings, current literature on self-efficacy is important to further unpack the influence of educational support systems for students of color. This literature as well as previous studies on self-efficacy differences between genders are overviewed as the development of math self-efficacy for the double minority student (e.g. African American females in STEM) is not yet fully understood.

Qualitative Investigations of Academic Support

Specific contributors are related to the insufficient academic preparation of students of color in STEM. The American Society for Healthcare Engineering (ASHE) has identified eight factors that directly relate to student's experiences and classroom instruction. Five systemic factors include school district funding disparities, tracking to remedial courses, underrepresentation in Advanced Placement (AP) courses, oppositional culture and premature departure from high school. These factors incite the lack of STEM preparedness within the African American community. These factors not only limit the potential influence that African American students could have within the STEM circuit, but also compromise their overall academic success. Considering that a disproportionate number of African American students are tracked into remedial courses it seems probable that such tracking promotes racial and ethnic inequality (Museus et al., 2011). Three factors that relate to the students' experiences and classroom instruction include lack of access to qualified teachers, low teacher expectations, and stereotype threat (Museus et al., 2011).

Lack of Access to Qualified Teachers

A primary factor contributing to the STEM achievement gap is the lack of access to qualified teachers that many students of color experience. The underrepresentation of qualified teachers among educators who teach students of color further contributes to African American students' lack of academic preparedness in STEM (Museus et al., 2011). Flores (2007) found that Caucasian fifth graders were 51% more likely to be taught by teachers with advanced degrees as compared to African American and Hispanic students. The American Society for Healthcare Engineering reported that the lack of access to experienced teachers is not only a racial issue but also a socioeconomic one (Museus et al., 2011). It was reported that 20% of teachers in high-poverty schools were inexperienced as compared to 11% in low-poverty schools where African American and Latino students were twice as likely to be taught by teachers with three years or less teaching experience (Flores, 2007; Mayer, Mullens & Moore, 2000). Flores (2007) found that within high-poverty schools, 34% of teachers were categorized as "out-of-field" teachers whereas in low-poverty schools, 19% of teachers instructed outside of their field. Researchers have proposed that students taught by individuals with a degree in the subject being taught resulted in more positive educational outcomes for students (Archer, 1999; Chaika, 2000; Jerald, 2002; Ingersoll 1998, Steyn, 2007). Another factor congruent to poor teacher quality is low teacher expectation that can also hinder the achievement of African American students in STEM.

Low Teacher Expectations

Research has consistently indicated that teacher expectations strongly influence the academic achievement of students of color within the classroom. In a review of the literature, Persell (1977) concluded that lower class and minority students were more influenced by teacher expectations. Likewise, Brophy & Good (1974) found in their work, specific to students of color, that teachers with high expectations for select students gave students more praise when they were correct and less criticism when they were incorrect. Kester & Letchworth (1972) also found in their research related to teacher expectations and students of color that teachers exhibited more encouraging behavior with "bright" students. Oakes (1990) argues that teacher expectations from the "earliest grades" through senior high school influence whether students of color continue towards the precollege STEM pipeline. Alderman (2008) further argues that teacher expectations within the classroom determine the level of student engagement, and that a caring community cultivated by the teacher "conveys a set of values and helps establish the [student's] motivation to abide by them" (p.216). When a student's psychological needs for belonging, autonomy, and competence are met a sense of membership and engagement is much more likely to be cultivated in the classroom (Alderman, 2008). Therefore, access to a positive communal environment or lack of access to an environment (e.g. stereotype threat) may influence the outcomes of African American students in STEM throughout their schooling and careers.

Stereotype Threat

Museus et al. (2011) defines stereotype threat, as a situational threat that can affect the members of any group about whom a negative stereotype exists. More specifically, stereotype threat has been defined as “the event of a negative stereotype about a group to which one belongs becoming self-relevant, usually as a plausible interpretation for something one is doing, for an experience one is having, or for a situation one is in, that has relevance to one’s self-definition” (Steele, 1997, p.616). Stereotype threat has an adverse effect on individuals in the learning environment because it leaves its victims vulnerable to underperformance in the content area to which the stereotype pertains (Fischer, 2010). Stereotype threat has been found to be a significant influencer in the academic outcomes of minorities in STEM, specifically impeding the academic outcomes for minority students (Good, Aronson & Harder, 1999; Inzlicht & Ben-Zeev, 2000). Studies indicate that stereotype threat negatively impacts the academic outcomes of students with intellectual disabilities, students of low socioeconomic status, female students, and minority students in STEM education (Museus et al., 2011, Steele, 1997; Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose, & Gary, 2009). Specific negative environmental factors, such as stereotype threat, impacts the STEM academic preparation of minority students, and perpetuates the lack of minorities in STEM fields, specifically African Americans.

To eradicate stereotype threat, Perna et al. (2009) suggested that African American students in STEM actively engage in proactive behaviors. For example, task completion is important as it relates to academic efficacy and academic achievement (Perna et al. 2009). Therefore, African American students in STEM must shift their mindset from one of worrying about low performance and confirming a negative stereotype to actually completing tasks. In addition, individuals must form support networks. After interviewing 15 women in math-related careers where they were underrepresented, Zeldin and Pajares (2000) found that the support and encouragement participants received from family members, teachers, and peers were critical to the development of positive self-efficacy beliefs for the women. From this finding, Zeldin and Pajares (2000) concluded that a woman's perception of her ability to succeed in a math-related career was highly dependent on the positive feedback she received from others. This type of communal support from family members, teachers, and peers is also critical to the development of positive self-efficacy beliefs for students of color, especially women of color in STEM (Espinosa, 2011; Usher & Pajares, 2008).

Within the context of this research, the importance of communal support for African American students in STEM becomes particularly pertinent as it is linked to academic and career success in STEM. In keeping with self-determination theory, all students require autonomy support, competence, and relatedness in order to achieve (Niemiec, Ryan, & Deci, 2009). Stereotype threat deprives students of their need to relate and belong. With this background in mind, initiatives and programs that foster autonomy support, competence, and relatedness provide unique opportunities to understand how

African American students within these contexts perceive motivation and academic success (Graham, 1994). Research capturing the opinions of students is needed to validate that program structures akin to the ones previously referenced actually contribute to student success in STEM. The conceptual framework of self-efficacy has been used to capture the opinions of students of color and to further understand factors that contribute to their persistence in STEM.

The Importance of Self-Efficacy

Self-efficacy and its sources, as theorized by Bandura (1997), provide the appropriate theoretical framework to investigate how and why communal and social environments positively influence the academic success of African American students in STEM. Bandura (1997) defined perceived self-efficacy as “people’s beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives” (p. 71). For the past two decades, the construct of self-efficacy has received considerable attention from educational researchers as it has been reported that the beliefs students possess about their academic activities powerfully influence their academic performance (Bandura, 1997; Pajares, 1996, 1997; Pajares & Schunk, 2005). Self-efficacy is also related to selection of a college major and subsequent career choice (Britner & Pajares 2001). In short, students who believe that they have the academic capabilities to succeed, demonstrate greater interest in academics, set higher goals, put forth stronger concerted effort and display more resilience when faced with difficulties (Bandura, 1997; Pajares, 1996). These beliefs developed by students are influenced by four sources of self-efficacy identified by Bandura (1986).

These sources include mastery experiences, vicarious experiences, social persuasions, and affective states.

Bandura hypothesized that mastery experience was the most powerful source of self-efficacy for individuals (Bandura, 1997; Usher & Pajares, 2006, 2009). The interpretation of experienced events and the result of actions cognitively appraised describe one's mastery experience (Usher & Pajares, 2006). In addition to interpreting and evaluating one's actions, students also build their self-efficacy beliefs through vicarious experience, the observation of another's actions. It is during this experience that the success or failures of peers in close proximity alter student's self- beliefs. An example cited by Usher and Pajares (2006) is a student's observation of a peer's success on a challenging academic task that then convinces the uncertain student that he or she is also capable of success. All students, but specifically students not skilled at making self-appraisals, depend upon others to provide feedback or judgments on their academic performance. The encouragement that a student receives from parents, teachers or peers has the capability to boost their confidence and thus exemplifies the influence of social persuasions (Usher & Pajares, 2006, 2009).

The final source of self-efficacy information that Bandura identified is the emotional and psychological states that students often interpret as indicative of their personal competence (Usher & Pajares, 2006). Usher and Pajares (2006) report that a student's academic capability is undermined by his or her anxious feelings towards academic assignments. In short, strong emotional reactions to academic tasks or performances serve as indicators of students' future successes or failures.

Researchers have explored these sources as they relate to gender and ability (Anderson & Betz, 2001; Lent, Lopez, Brown & Gore, 1996); however researchers have marginally explored the topic as it relates to student race or ethnicity (Usher & Pajares, 2006). From the limited research that has been conducted, findings indicate that different motivational patterns may operate according to differing racial or ethnic groups. According to Graham (1994), African American students have a tendency to retain optimistic beliefs despite "achievement failure" (p.95), akin to low performing academic behavior. Such research suggests that African American students respond more strongly to environmental social persuasions as opposed to cognitive appraisals affiliated with mastery experiences (Usher & Pajares, 2006). From the qualitative research that has been conducted, mastery experiences have been identified as a very powerful source of self-efficacy. Usher (2009) sought to understand the heuristics that students with high and low self-efficacy used to define their perceptions of their math ability. Interviews with 8 participants demonstrated that students with high math self-efficacy reported having high levels of achievement in math, while students with low self-efficacy reported their poor performance and struggles. To illustrate these past performances students provided anecdotal evidence related to their class ranking, performance on assessments, and experiences (or lack thereof) in advanced math classes. Though mastery experiences seem to be central to the math self-efficacy of individuals regardless of race, social persuasions seem to be of particular importance to African American students.

Researchers have also evaluated the high academic expectations of African American students in the midst of obstacles. Usher and Pajares (2006) have begun this work and in a recent comparative study found that social persuasions prove to be a higher predictor of self-efficacy for African American students as opposed to Caucasian students who rely primarily upon their mastery experiences. In examining the sources of math self-efficacy among 7th grade students, Klassen (2004) also found that students from different ethnic backgrounds identified different sources of self-efficacy. It was reported that Indo-Canadians (immigrant students) experienced a more "other-oriented" self-efficacy (e.g. forms of social persuasion) whereas Anglo-Canadians experienced a more "self-oriented" self-efficacy (e.g. mastery experiences).

A reoccurring theme in research on African American academic success and motivation is the influence of community (Bandura, 1997), specifically the influence of social persuasions (Treisman, 1992). Though mastery experiences are important to all students, social persuasions particularly from parents, teachers, and peers more positively impact the academic success and persistence of African American students in STEM (Zeldin & Pajares, 2000). Research is showing that these sources of self-efficacy (mastery experience and social persuasions) positively contribute to the persistence of students of color in STEM.

STEM Persistence

Vocational psychology researchers have long been interested in factors that promote interest in and choice of math and science intensive fields. Most recently, social cognitive career theory has been used to guide inquiries related to this topic (Lent, Lopez, Lopez & Sheu, 2008). Much of the early research on academic and career-centered self-efficacy has sought to examine catalysts of math and science interests, choices and performance particularly with regard to women and people of color. As social cognitive career theory has come to guide these investigations, researchers are very interested in understanding how social cognitive variables such as self-efficacy, interest, outcome expectations, and choice goals (persistence in a specific course of action resulting from self-efficacy, outcome expectations, and interests) affect the academic and career performance of individuals (Lent, Brown, & Hackett, 1994, 2000; Lent et al., 2008).

According to social cognitive career theory, emergent interests in addition to self-efficacy and outcome expectations promote choice goals that describe one's intent or persistence towards a course of action. People develop an affinity for an activity for which they already feel efficacious and expect positive outcomes, forming goals that sustain and increase their likelihood of persisting towards their choice goals (persistence in a specific course of action) (Lent et al., 2008). Attainments and judgments of competence accrued from sources of self-efficacy form an important feedback loop. Thus one's affinity for an activity and desire to persist towards an activity is based on one's interest for the activity, expectations for favorable results, sources of self-efficacy, and sense of self-efficacy (Lent et al., 2008). The feedback loop that Lent, Brown, and Hackett (2002) describe is a component of their social cognitive choice model of interest and choice goals. This model has been used to accurately portray African American students' affinity for STEM at one predominantly White and two historically Black universities (Lent et al., 2008). It is clear that cultivating and sustaining students' of color interests in STEM and enhancing their self-efficacy levels contributes to their STEM persistence. Despite this research, the relationship between the sources of self-efficacy most commonly identified by African Americans and their effect on student interest and choice goals in STEM still remains unclear.

Sustaining STEM Interest and Enhancing Self-Efficacy

Game design, mentorship, and research experiences have been identified as unique ways to garner the interest of students of color in STEM (Clark, 2005; Palmer, Maramba, & Dancy, 2011), yet in order to maintain the interests of students of color in STEM, students must perceive themselves as capable of completing STEM-related tasks, students must expect successful outcomes of STEM-related tasks, and students must perceive STEM-related tasks as valuable (Eccles, Adler, & Meece, 1983).

Self-efficacy, particularly, has been found to explain the direction and maintenance of goal-oriented behaviors for women and students of color in STEM (Bandura, 1986; Hernandez, Woodcock, Schultz, Estrada & Chance, 2013). Therefore, self-efficacy in combination with expectancies of success and task value define the core components of optimal motivation (Eccles, Wigfield, Flanagan & Miller, 1989; Hernandez et al. 2013). For students of color in STEM, all three of these components have been found to be positively and powerfully influenced by minority training programs, mentoring, and research experiences that not only cultivate interest but also sustain interest and optimal motivation of students over time (Denofrio, Russell, Lopatto & Lu, 2007; Hernandez et al., 2013) The positive impact of training programs, mentoring, and research experience on the persistence of students of color has consistently been reported in research (Hernandez et al., 2013; Palmer et al., 2011). Yet, training programs, mentoring, and research experiences alone do not guarantee the persistence of students of color in STEM. These efforts in conjunction with positive self-identity growth within students are needed for students of color to persist in STEM (Chemers, Syed, Goza, Zurbriggen, Bearman, Crosby, & Morgan, 2010; Estrada, Woodcock, Hernandez, & Schultz, 2011; Hernandez et al. 2013).

Identity

The subject of racial identity has been posited as a possible explanation for the declines in the academic performance of students of color beyond middle school (Miller, 1995). Graham (1994) found that African American youth and parents have high academic and occupational aspirations, in fact higher than Caucasians when controlling for socio-economic status. It seems plausible that students begin to view academic achievement as “non-black” behavior impacting identity, thus resulting in low levels of academic self-efficacy among African Americans, particularly African Americans in STEM (Estrada, 2011; Ogbu, 1991).

Oyersman and Bybee (2001) argue that there are three aspects of racial identity that affect the academic efficacy of African American students. These aspects include, ingroup identification, awareness of negative outgroup perceptions, and viewing academic achievement as part of one’s racial identity. Ingroup identification, also referred to as connectedness, describes the degree that an individual feels a positive sense of connection to their racial ethnic group (Oyersman, D, Brickman, D, & Rhodes, 2007). Oyersman et al. (2001) report that connectedness alone does not relate to academic self-efficacy, however, it may help balance out the emphasis on autonomy often characteristic of male gender socialization. The second racial identity aspect is awareness of negative outgroup perceptions. This aspect of racial ethnic identity involves one's need to grapple with how others may be likely to view one's self negatively. The awareness of negative outgroup perceptions has been found to affect males and females differently as an awareness of racism seems to have negative identity effects on girls. Relationality and positive opinions from others seem to be much more self-defining for girls as compared to boys. However, awareness of racism seems to be much more liberating for boys as their autonomy is more valued and failure no longer is tied to personal performance and becomes depersonalized as result of racism (Oyersman, et al. 2001). The final aspect of racial identity is viewing academic achievement as a part of one's identity. According to Oyersman (2007) and his colleagues, for individuals who believe that doing well in school is characteristic of good group members, engaging in academic behavior becomes an avenue to express one's racial identity. These three aspects of racial identity comprise the tripartite model of racial-ethnic identity where all three aspects of racial identity promote both well-being and academic achievement (Oyersman, Harrison, & Bybee 2001; Oyersman, Brickman & Rhodes, 2007). Individuals who strongly endorse all three aspects of the tripartite model are more likely to achieve academic success as compared to individuals who do not (Oyersman, Brickman, & Rhodes, 2007).

Several studies have been used to support the tripartite model that Oyersman, Harrison, and Bybee (2001) propose. An initial study was conducted with African American eighth graders. Students were asked to respond to open questions about what it meant to be Black or African American either before or after solving a math problem. It was expected that racial identity would have positive influence on effort on subsequent math tasks only when the racial identity of students were primed before doing the math task and when racial identity was brought to mind in conjunction to all three components of the tripartite model. The expected results were found as students who wrote about their racial-ethnic identity before completing the math tasks and who described their racial identity in terms of the three aspects of the tripartite model performed better than students who did not exhibit the same responses (Oyersman et al. 2007). None of the racial identity aspects alone had significant effects. One-year longitudinal tests that followed this initial research where prior school grades were controlled, allowed Oyersman, Bybee, and Terry (2003) to find that African American eighth grade students who identified with all three aspects of the racial identity tripartite became more concerned with school performance over the course of the year. Oyersman et al. (2003) also found gender effects, where the connectedness component of racial identity had positive effects for boys specifically predicting improved grades, longer study times, and increased classroom attendance. For girls, embedded achievement had more positive effects for girls predicting improved grades (Oyersman et al. 2003).

The concept of identity is very important to the persistence of students of color in STEM, specifically the centrality of a student's identity as a scientist. African American students who are able to identify themselves as scientists in light of the ingroup identification, possess an awareness of negative outgroup perceptions and possess the ability to view academic achievement as part of one's identity are much more likely to persists in STEM (Chemers, 2010; Estrada et al. 2011; Oyersman et al. 2007).

Student Perceptions and Preferences Within STEM Interventions

Little is known about the perceptions and preferences of students of color who engage in STEM intervention programs (Hernandez et al. 2013). As such programs are structured to meet the academic needs of underserved populations in STEM it is critical that researchers capture the opinions and preferences of students that motivate their desire for academic achievement (Graham, 1994). With this in mind, it is necessary that research, much like the present study, provide students with the opportunity to express their "likes" and "dislikes" with regards to the intervention program structures in order to better tailor future initiatives (Graham, 1994). The likelihood of students of color to persist in STEM fields is not only influenced by stimulating academic environments but also influenced by one's home life, specifically parental feedback.

Parental Influence

Parental feedback, encouragement, and appraisals significantly impact the math self-efficacy of students of color (Usher, 2009). Yet, it seems that a parent's educational background or lack thereof determines his or her likelihood of offering forms of social persuasion to children. Berryman (1983) found that a parent's educational background greatly influenced their perception and value of postsecondary education. These perceptions affected the high school performance and postsecondary education plans of minority students as parents who had been to college were more likely to expect their children to also attend (Berryman, 1983; Ware, Steckler, & Leserman, 1985). From these findings Berryman (1983) concluded that parent education was a critical component to minority participation in STEM, as parents with college degrees were more likely to support precollege academic preparation and college career advancement. According to Oakes (1990), analysts have concluded that socio-economic measures such as parental occupation or income are of tremendous importance as they serve as signals of parent education levels. As parent education has been found to be predictive of achievement and participation in science for women and students of color (Thomas, 1984: Ware et al., 1985), collecting SES indicators for students of color is necessary to further understand factors that influence the self-efficacy of students of color in STEM.

Gender Differences

Gender differences must also be accounted for when considering factors that influence the self-efficacy of students of color in STEM. It is important to recognize that predominantly Caucasian populations are featured in this type of research. Therefore, there is a great need for culturally attentive research particularly research that considers the complex relationships between female students of color in STEM and their sources of self-efficacy (Usher & Pajares, 2008). Joët, Usher and Bressoux (2011) examined the sources of self-efficacy of third graders within the domains of math and French. Students were given two questionnaires and two achievement tests that captured students' self-beliefs and abilities in math and French. Joët et al. (2011) found that girls reported lower self-efficacy scores in math as compared to boys. Though girls outperformed boys on the French achievement test, they still reported having lower self-efficacy in the subject area. Both girls and boys relied on mastery experiences and social persuasions to inform their self-efficacy beliefs in math and French. However, girls reported having less mastery experiences, and fewer positive social messages. Girls also reported greater feelings of anxiety than boys when approaching math. These findings seem to suggest that before reaching middle school, females may already begin to question their academic ability particularly in math.

Louis and Mistele (2011) reported similar findings. Using Trends in International Mathematics and Science Study (TIMSS) 2007 data, the math self-efficacy and math achievement scores of 7,377 eighth grade students were examined. Using ANOVAs to compare gender and math self-efficacy scores and gender and overall math scores, Louis and Mistele (2011) found that males reported higher self-efficacy levels than female students. Additionally, males had higher math scores than females.

In addition to examining self-efficacy ratings and gender differences, researchers have examined sources of self-efficacy and gender differences. Using self-efficacy scales, Usher and Pajares (2006) examined the sources of academic self-efficacy of entering middle school students. Gender differences were found, beyond the expected influence that mastery experiences had on the academic self-efficacy of students, girls reported that social persuasions also powerfully informed their academic self-efficacy. Erikson's (1968) research confirms these findings and suggests that boys tend to define their developing identity based on past accomplishments while girls tend to define their identity on satisfaction with relationships.

Thus far, self-efficacy research that has examined gender differences in math achievement has captured the perceptions of American and European students (Pajares & Graham, 1999). Within the research that has captured the mathematics attitudes of Americans, it seems that boys and girls report equal confidence in their math ability during elementary school. However, by high school, boys report higher levels of confidence in their math ability (Pajares & Graham, 1999). It seems that by middle school, boys begin to rate themselves as more efficacious than girls (Wigfield, Eccles & Pintrich, 1996). Though boys begin to report higher levels of confidence in math, it is unclear why they may not share their academic success or interests with peers. Additionally, it is unclear why girls report lower levels of confidence in their math ability. The middle school years, therefore, becomes an optimal time to examine self-efficacy as it develops while students become more aware of social comparative information (Eccles, Midgley & Adler, 1984; Usher, 2009). It is clear that peer support within the classroom positively impacts the self-efficacy of middle school students of color. However, research has just begun to consider how factors such as race and culture may influence reported gender differences in math self-efficacy (Joët et al., 2011). Unfortunately, the heuristics of how gender differences and sources of self-efficacy apply to students of color within the classroom are unclear. The aim of my present study is to help close this gap within the literature.

Peer Influences

Several researchers have examined how African American student's self-constructed perceptions are shaped by school factors, most notably by their peers (Howard, 2003). When not provided mediums of social support, disenfranchised students consciously choose to "not learn" when they feel their cultural identity is disrespected (Kohl, 1994). Fordham and Ogbu (1986) have documented the dissonance that many African American students face when their social environment requires them to choose between an identity of academic success, in some cases referred to by peers as "acting white", and their ethnic identity (Fordham & Ogbu as cited in Howard, 2003). Psychological and social-emotional needs, particularly a student's desire to belong and receive validation from peers, have long been attributed to the educational outcomes of African American students. Ford and Harris (1996) write, "The need to belong and peer allegiance often take precedence in the lives of minority students". This research compliments the work of Usher and Pajares (2006) that illustrated how the influence of peers greatly impacts the self-efficacy and academic success of African American middle school students. Peer influence has been found to greatly impact the self-efficacy of college-aged students of color in STEM as well. However, to understand how peer influence impacts their persistence, the importance of theory-driven STEM intervention programs must also be considered.

STEM Interventions for Students of Color

Thus far, numerous initiatives and intervention programs (funded by the National Science Foundation or by the National Aeronautics and Space Administration (NASA)) such as MUREP (Minority University Research in Education Program), MUST (Motivating Undergraduates in Science and Technology), and Jenkins (a pre-doctoral fellowship) have been implemented to address the STEM achievement gap among students of color (C.S. Person, personal communication, July 15, 2012). Research conducted by NSF and their university affiliates suggest that reoccurring themes such as (a) student early exposure to careers in STEM, (b) the promotion of interest in STEM subjects, and (c) the enhancement of student self-efficacy in STEM (McAllister, 2011; Museus et al., 2011) significantly contribute to STEM retention and persistence among minority students. Though all these factors contribute to STEM retention and persistence, early exposure to STEM has been identified as a strong influencer in a student's course and discipline selection (Museus et al., 2011). Early exposure has been linked to higher levels of student self-efficacy in STEM as these students have the opportunity to gain more mastery experiences (Leslie, McClure & Oaxaca, 1998). This is important since higher self-efficacy levels are predictive of higher levels of persistence in STEM (Zeldin & Pajares, 2000). As a result, targeting and enhancing student self-efficacy has become a top priority for numerous intervention programs (Leslie, McClure & Oaxaca, 1998).

McAllister (2011) concluded that the enhancement of self-efficacy was an important component of the Meyerhoff Summer Bridge program in her qualitative study. The goal of this STEM intensive six-week intervention program was to provide students of color access to study groups, program community, counseling, tutoring, and summer research internships (Museus et al., 2011). Upon conducting focus groups with 134 program participants (representative of recent program graduates to program graduates with PhDs), McAllister (2011) found that participants consistently expressed higher levels of academic self-efficacy in STEM upon the program's end. During the study, the newly enrolled cohort represented the caliber of students selected to join the program. These students prior to their participation in the program were exceptional as the average SAT math scores was 657 (out of a possible 800 points) and the average SAT verbal scores was 623 (also out of a possible 800 points) (McAllister, 2011). Students also had not received a grade lower than a "B" in any math or science course during high school.

Though all students entered this program with strong academic standing, they left with feelings of enhanced academic self-efficacy and a determination that greatly impacted their drive to persist in the STEM circuit in college and beyond. This seems to indicate that the nurturing of academic self-efficacy through means such as fostering positive student experiences is important to the persistence of students of color in STEM. McAllister (2011) also reported that students who graduated from the Meyerhoff Summer Bridge program were twice as likely to graduate with a STEM bachelor degree and five times more likely to go on for their PhD (McAllister, 2011). Though programs such as the Meyerhoff Summer Bridge program have proven to be a success, very little qualitative research from the perspective of students has been conducted on how these programs impact the academic self-efficacy of participants. Though not explicitly stated in reports affiliated with the aforementioned programs, research suggests that communal support encourages students to develop positive self-efficacy beliefs.

Theory-Driven Intervention Programs and Peer Influence

In 1992, Uri Treisman examined the impact of communal influence on African American college students attending the University of California, Berkeley. In this qualitative investigation, he compared the study habits of African American and Chinese students enrolled in an introductory calculus course. Though he found that students in each racial group studied for hours, Chinese students would in the evening routinely review their coursework in study groups. By working in groups, Treisman observed that Chinese students were able to learn from one another and attributed their success to hard work and study. African American students on the other hand, typically worked alone and attributed success to external forces such as luck.

Based upon this observation, Treisman constructed what he described as an anti-remedial program. Pulling from the student population enrolled in remedial courses in mathematics (primarily minority students), Treisman revamped what was once a remedial program and transformed it into an intensive workshop by fostering group learning and community. The most salient features of this program included the academically challenging yet emotionally supportive environment that produced a community grounded in students with shared interests in mathematics. The results of these changes proved to be quite dramatic as these minority students enrolled in calculus began to outperform their peers including other Caucasian and Chinese students. One can conclude from this study that social support and feelings of belonging from peers are essential to the persistence of African American students in STEM.

Lewis (2003) wrote that STEM intervention programs often have questionable scholarly bases, as they often rely on anecdotal evidence rather than theory-driven research as rationale for intervention strategies. As a result, Lewis (2003) found that it is not uncommon for intervention programs to address factors that are not known to contribute to underrepresentation in STEM. Perhaps what contributed to the success of Treisman's 1992 study was that it was closely aligned with learning theory. With this information, it can be surmised that programs aligned with theory prove most effective in enhancing student academic achievement and persistence in STEM. The Game Design @

Mason program (from which students were recruited for the present study) is grounded in social cognitive theory specifically, the construct of self-efficacy.

Game Design @ Mason

The Game Design @ Mason program (Clark & Sheridan, 2010) was established in 2007 with the aim of recruiting middle and high school students (particularly targeting students of color) in order to expose students to computer game design technology and other STEM-related disciplines. Students used their imaginations to create their own unique online computer game. Training in Game Maker software taught students how to create a "platform" type game where a character jumps on structures to acquire objects while earning points. If the gamer is successful, each level in the game increases in difficulty.

Original program participants were recruited from a high school located in the mid-Atlantic region. However, more recent program participants (recruited by previous program participants through "word of mouth") constituted a cohort of predominantly middle school students. Sessions took place weekly on Saturdays from 10:00 a.m.-12 p.m. at a mid-Atlantic University. A unique aspect of the Game Design @ Mason program is that it is taught by high school and college-aged students referred to as instructors. Individuals with lesser degrees of teaching experience (referred to as mentors and mentors in training) assist and engage program participants throughout the lesson. Approximately 10 mentors and instructors were actively involved in the program this past semester. Clark and Sheridan (2010) found that one of the post powerful aspects of Game Design @ Mason was the social context it provides to traditionally underserved and underrepresented groups in STEM.

The collaborative learning environment, its use of a mentor and student model, "the design-studio environment", and the use of professional tools by students all provide Game Design @ Mason participants a powerful channel for STEM learning among students of color (Clark & Sheridan, 2010). Game design particularly not only provides unique learning benefits, but also provides a unique entry point to engage students of color in STEM disciplines (Clark, 2005). The program's emphasis on communal learning, its awareness of students' math self-efficacy, its high African American middle school student population and its mission to recruit underrepresented STEM populations to engage them in STEM provided a unique opportunity to learn more about the math self-efficacy of African American students. For this reason, participants from the Game Design @ Mason program were selected for interviews.

The Present Study

Studies thus far related to sources of self-efficacy have been conducted quantitatively primarily among high school and college-aged students where Caucasian participants were the overwhelming majority within sample populations (Usher, 2009). Few studies other than those cited previously (e.g. Klassen, 2004; Usher & Pajares, 2006) have examined how demographic factors such as race may influence the research outcomes within this area.

Additionally, researchers have identified strong math ability and math self-efficacy as foundational and predictive of a student's success in STEM fields (Holt, 2006; Piotrowski & Hemasinha, 2012). In light of the underrepresentation of students of color in STEM disciplines, the need for research focused on math self-efficacy among African American students becomes essential. The present study sought to address this gap within the literature as it was conducted qualitatively and examined sources of math self-efficacy identified by African-American middle school students. As Usher's 2009 study was the first of its kind to qualitatively examine sources of math self-efficacy among middle school students by comparing students with high and low self-efficacy beliefs, her work served as a model for the present study. Specifically, Usher's (2009) interest in differences between students with high self-efficacy and low self-efficacy were used to help formulate my research questions. Additionally, her interview protocol was adapted for the present study. Where her work and the present study diverge is her focus on the interrelated relationship between self-regulation and self-efficacy and her four subgroups of interests (Caucasian girls, Caucasian boys, African American girls, and African American boys).

The goal of this study is to examine sources of math self-efficacy identified by African American students with differing self-efficacy beliefs. Five research questions guided this investigation: (a) What sources of math self-efficacy do African American students with interests in game design rely upon most? (b) How do sources of self-efficacy differ for students with high math self-efficacy ratings as compared to students with lower math self-efficacy ratings? (c) How do students with high math self-efficacy ratings compare to students with lower math self-efficacy ratings in their preferences for the Game Design @ Mason program? (d) How do students with high math self-efficacy ratings compare to students with lower math self-efficacy ratings in their willingness to share with peers their association to the Game Design @ Mason program? (e) How do female students compare to male students in their descriptions of their sources of math self-efficacy?

In light of my research questions, African American middle school students with differing sources of math self-efficacy were recruited. Math self-efficacy of participants was of interest as math is foundational to all areas of STEM. As Game Design @ Mason evaluates the math self-efficacy of program participants, promotes communal learning, consistently recruits a high percentage of African American students, and requires individuals to draw upon concepts foundational to science, technology, engineering and math, it was selected as the environment from which the sample population would be recruited. As Game Design @ Mason recruits underserved and underrepresented students of color in STEM, it provided a unique opportunity to examine the math self-efficacy of African American middle school students with interests in game design. Gaming technology, specifically, has also been found to cultivate interest in STEM learning for underserved youth (Clark, 2005). Once provided access to this data, I was able to readily select students with high and low math self-efficacy ratings for interviews.

3. METHOD

Limited culturally attentive qualitative research has been conducted on sources of self-efficacy among middle-school aged students (Usher & Pajares, 2008). As Usher's (2009) study was the first of its kind to qualitatively examine sources of self-efficacy among middle school students, I decided to use her study as a model for my research. In order to address the gap within the literature pertaining to sources of self-efficacy and middle school students of color, I decided to recruit African American students representative of 5^{th} through 8^{th} grades where one male and one female student was accounted for in each grade. In this section, I discuss the sampling procedures, the criteria used for selecting participants, the research design, the sources for data, the data collection methods, and the data analysis procedures used during the course of the study. Finally, I conclude this section by describing the measures used to enhance the credibility and validity of the study.

Sampling Procedures

When selecting students, I sought to avoid pairs where males consistently reported higher self-efficacy ratings and where females consistently reported lower self-efficacy ratings. In short, I used purposeful selection to obtain participants for the study (Maxwell, 2005). Prior to enrolling in the Game Design@ Mason program, students were required to complete an adapted version of the Morgan-Jinks Math Self-Efficacy Scale

(Jinks & Morgan, 1999). The scale not only measured math self-efficacy but also considered factors such as talent and context. As defined by Jinks & Morgan (1999), talent pertains to a student's perceived abilities, as context pertains to the student's environment under which a task is completed. Students' scores on the scale were completed weeks prior to student recruitment and served as the basis for participant selection.

Participant Selection

I first rank ordered students by their mean response scores on the adapted version of the scale to select students with the highest and lowest math self-efficacy ratings. This measure also assessed student math talent (e.g. I get good grades in math), math task contexts (e.g. I feel confused during math class), and math task efforts (e.g. I usually give up when solving a math problem). By rank ordering the mean responses of students I anticipated selecting students with the highest and lowest math self-efficacy ratings.

Secondly, I reviewed student responses. Mean scores reflected the four points of the Likert-type response scale and ranged from 0 (lowest math self-efficacy rating) to 3 (highest math self-efficacy rating). African American participants with the highest and lowest math self-efficacy scores were then selected. It is essential to recognize that all students reflected high self-efficacy, therefore the distinction between high and low self-efficacy ratings became relative only to the sample population recruited (Table 1).

The lowest reported math self-efficacy mean score was 2.00 reflective of "Usually like me" statements on non-reverse coded items. The overall mode for statements associated with a positive attitude and interest towards math was 3.00, reflective of

"Always like me" statements. The overall mode for statements associated with negative statements towards math was 1.00, reflective of "Sometimes like me" statements. The majority of these statements related to a student's interest in math. Negative statements that evaluated a student's ability or other's perception of ability resulted in primarily "Never like me" statements (Table 2). Students with lower math self-efficacy ratings often reported that they did not like going to math class. This seemed to indicate that students with lower math self-efficacy ratings demonstrated ability in math however, reported lower levels of interest in math (Table 2).

MJSES Scale Reliability and Credibility

The original MJSES contained 34 items, however I used only the 13 items on the scale that were specific to math self-efficacy. As a result, it was important to evaluate the reliability and validity of these items as only a portion of the MJSES was used to evaluate the self-efficacy of students. Using Cronbach's alpha in SPSS, I examined the realibility of the 13 math self-efficacy Likert-type response items used. The reported Cronbach's alpha was .85. To measure the content validity of the 13 math self-efficacy items, I used SPSS to correlate students' self-reported math grades to the response items. By conducting this analysis, I sought to ensure that the scale provided an accurate sample of students' everyday math self-efficacy. The correlation between student grades and the 13 math self-efficacy items was .60.

Participants

Each participant chosen for the study met the following criteria: a) attended the spring 2013 semester of Game Design @ Mason; b) fully completed the Game Design @ Mason pre-survey (Appendix A); c) identified as African American/Black; and d) was middle school-aged. These criteria for inclusion ensured a minimum degree of similarity among participants. The rationale for each criterion follows.

First, it was necessary that students recruited to participate in the present study attended the spring semester of Game Design @ Mason. Additionally, it was critical that students were affiliated with the program as the math self-efficacy of all program participants was evaluated in an administered pre-survey which was an adaptation of the Morgan Jinks Math Self-Efficacy Scale (Jinks & Morgan, 1999).

Second, it was necessary that participants completed the scale as it was used to measure the math self-efficacy of students. These math self-efficacy ratings were then used to purposefully select students for interviews according to their math self-efficacy ratings. Third, as mentioned earlier, it was the purpose of this study to conduct culturally relevant research related to the topic of self-efficacy and its sources. Provided the limited number of qualitative studies examining the sources of math self-efficacy for students of color, I decided to focus my attention on African American students. As Game Design @ Mason had a history of recruiting a high percentage of African American students, the program provided an ideal context to examine the self-efficacy of its students.

Finally, it was important that participants were in middle school. As cited previously, researchers believe that it is during the middle school years that the development of self-efficacy becomes most apparent (Wigfield, Eccles & Pintrich, 1996). In light of this research, I choose to recruit this demographic.

Using these criteria, thirteen students were identified out of the 56 students who were enrolled in Game Design @ Mason. Of the thirteen students identified, seven students were recruited (Table 1). The other six students did not respond to the email request to participate in the study. A total of seven students were willing to be interviewed. Of the available students, 5 African American male middle school students, 1 African American female middle student, and 1 African American female high school student were recruited. A limited number of African American female students were available for recruitment. In order to increase female participation, the aforementioned 10^{th} grade female student was included in the sample population. After selecting students and re-reading Usher's (2009) study, I decided to follow up with parents to learn more about their occupations. This information was later used to better understand the sources of self-efficacy referenced by students during interviews.

Setting

Interviews with selected and agreeable students were conducted in March of 2013 with seven Game Design @ Mason students. Interviews took place during Game Design @ Mason instructional hours outside of the classroom. Participants were informed that I was interested in their perceptions of Game Design @ Mason, their school environment, and their opinions about themselves as math students.

Table 1.
Description of Study Participants

	Gender Age Grade	Self-Efficacy Mean Score[b]	Math Course	Math Grade	Mother's Occupation (M) Father's Occupation (F)
Students with Higher Math Self-Efficacy					
David	Male 11 6th Grade	3.00	Math 7	A+, A, A-	M: High School AP Chemistry Teacher F: Former College Professor/Senior Research Analyst
Stephanie	Female 14 10th Grade	2.54	Math 11	A+, A, A-	M: Human Resource Specialist F: Retired
Kyle	Male 12 7th Grade	2.54	Math 8	A+, A, A-	M: Budget Analyst F: Information Technology Coordinator
Student with Lower Math Self-Efficacy Ratings					
Luke	Male 10 5th Grade	2.38	Math 5	A+, A, A-	M: Budget Analyst F: Information Technology Coordinator
Steven	Male 10 4th Grade	2.31	Math 5	A+, A, A-	M: Human Resource Generalist F: Retired
Monica	Female 10 5th Grade	2.23	Math 6	A+, A, A-	*
Timothy	Male 12 7th Grade	2.00	Math 8	B+, B, B-	M: IT Specialist F: Patent Examiner

[a]Pseudonyms were assigned in an effort to preserve the ethnic and semantic origin of each participant's given name
[b] Mean score obtained by student's responses on a 4-point Likert-type scale
***Did not report parental occupation**

Table 2.
Percentages, measures of central tendency, and standard deviations of math self-efficacy items (N=7)

Item	% of 3	% of 2	% of 1	% of 0	Mean	SD	Median	Mode
1. I always try my best in math class.	42.86 (n=3)	57.14 (n=4)	0 (n=0)	0 (n=0)	2.43	.54	2.00	2
2. I enjoy taking math class.	28.57 (n=2)	42.86 (n=3)	14.29 (n=1)	14.29 (n=1)	1.86	1.07	2.00	2
3. I would like to learn more about math in college.	57.14 (n=4)	14.29 (n=1)	14.29 (n=1)	14.29 (n=1)	2.14	1.22	3.00	3
4. My teachers think I do NOT understand math very well.	14.29 (n=1)	0 (n=0)	0 (n=0)	85.71 (n=6)	.43	1.13	0.00	0
5. I am NOT good at math.	14.29 (n=1)	0 (n=0)	0 (n=0)	85.71 (n=6)	.43	1.13	0.00	0
6. I believe that what I learn in math class is	42.86 (n=3)	42.86 (n=3)	14.29 (n=1)	0 (n=0)	2.29	.76	2.00	2, 3
7. I get good grades in math.	57.14 (n=4)	42.86 (n=3)	0 (n=0)	0 (n=0)	2.57	.54	3.00	3
8. I am good at solving math problems.	71.43 (n=5)	28.57 (n=2)	0 (n=0)	0 (n=0)	2.71	.49	3.00	3
9. I do NOT like going to math class.	14.29 (n=1)	14.29 (n=1)	42.86 (n=3)	28.57 (n=2)	1.14	1.07	1.00	1
10. I usually give up when solving a math problem.	14.29 (n=1)	0 (n=0)	28.57 (n=1)	57.14 (n=4)	.71	1.11	0.00	0
11. I feel confused during math class.	0 (n=0)	0 (n=0)	71.43 (n=5)	28.57 (n=2)	.71	.49	1.00	1
12. When I am older, I want a job that does NOT use math.	0 (n=0)	14.29 (n=1)	71.43 (n=5)	14.29 (n=1)	1.00	.58	1.00	1
13. It is easy for me to pay attention in math class.	14.29 (n=1)	42.86 (n=3)	42.86 (n=3)	0 (n=0)	1.71	.76	2.00	1, 2

***Negative Items Bolded**

3= “Always like me”
2= “Usually like me”
1= “Sometimes like me”
0= “Never like me”

Data Sources

Three data sources were utilized in this study: the Game Design @ Mason pre-survey, interviews, and memos. I was granted access to the Game Design @ Mason pre-survey results. After ranking African American students according to their math self-efficacy ratings, I selected the students with the highest and lowest self-efficacy scores. Unfortunately, all students could not be reached. Consequentially, this limited the number of males and females within the sample population.

Using a semi-structured interview, participants were asked the same questions; however, I probed for deeper responses or explanations of responses, as clarification was needed. All interviews were audio-recorded with a digital recorder. There was no need to deceive participants in this study; so purposefully at the beginning of each interview I provided a brief overview for students of the types of questions they would be asked. Each interview took approximately fifteen minutes to complete.

The third source of data in this study included researcher memos. I wrote down thoughts following each interview to note student behavior or other forms of non-verbal communication during the course of the interview. Examples of information included in the memos were student demeanors, the willingness of students to answer questions, the openness of students during interviews, and notes to self about my behavior or tone of voice while posting questions. I reflected on these memos between student interviews in order to take note of emerging themes. Memos were also created throughout data analysis in order to capture information I perceived to be of importance as well as to clarify my thinking.

Interview Protocol in Detail

A semi-structured interview protocol adapted from Usher (2009) was used to gain information about the four sources of efficacy believed to strongly influence the math self-efficacy beliefs of students. These questions were written for broad interpretation allowing participants to freely choose their responses while allowing me to probe students in order to seek more detail, clarification and anecdotal evidence (Usher, 2009). The protocol consisted of 17 questions. The use of global questioning, incorporating general questions such as "Tell me about yourself as a math student" and "Tell me what interested you about Game Design @ Mason?" permitted descriptive and elaborate responses that reflected the complex development of self-efficacy beliefs.

Appendix B contains the semi-structured interview protocol used with students. Protocol questions were ordered categorically first inquiring about students' experiences within the Game Design @ Mason program followed by questions about their math ability and confidence within the context of their school and home environments. An interview checklist was utilized during each interview to ensure that every question within the protocol was addressed. In order to explicitly target the sources of math self-efficacy identified by students in each interview, I concluded with the question "What could make you feel more confident about yourself in math?" This approach was also directly modeled from Usher (2009).

Data Collection

Through email, I contacted the parents of the seven students recruited to arrange times for student interviews in conjunction with Game Design @ Mason Saturday sessions. Consent forms were explained and signed by both parents and students. An adapted version of Usher's (2009) interview protocol was used during student interviews. The rationale behind adapting Usher's protocol was to collect data from students such as factors that influenced their interest in Game Design and their preferences within the context of the Game Design @ Mason program. This data was not captured from student pre-surveys. It was also critical that this information was collected as it could relate to a student's understanding of his or her math self-efficacy within the context of the Game Design @ Mason program. Samples of questions used to adapt Usher's (2009) interview protocol include "Tell me what interested you about Game Design @ Mason" and "When you come to Game Design @ Mason, what makes you feel most comfortable?". After revisiting Usher's (2009) study, I decided that it would be beneficial to also collect the occupations of parents to better examine references to social persuasions or vicarious experiences by students during interviews. I collected this data through follow-up emails after completing student interviews. The occupations of Monica's parents were not reported, as she could not be reached for follow up.

Research Design

Grounded theory proved to be the most appropriate design for my study for the following reasons. First, the symbolic interactionist approach, fundamental to grounded theory, enabled me to research the meanings and perceptions individuals had of their self-efficacy based on the social reality of participants.

Second, grounded theory provided the opportunity to generate a theory specifically tailored to the social phenomenon that I would examine within the context of

Game Design @ Mason. Though Bandura's work served as the conceptual framework for my research, a grounded theory approach allowed me to also consider other explanations or sources of self-efficacy not included in Bandura's hypotheses should they arise.

Third, grounded theory permits the researcher to analyze data as it is collected. This process allowed me to make inferences about the data based on personal experience. Provided that my beliefs did not bias the data, I could reflect on my own experience as an African American who as a middle school student identified with low math self-efficacy. Drawing on these reflections as well as my understanding of the self-efficacy literature, I was able to code, analyze and interpret the data while testing the data to see if it would fit Usher's (2009) pre-existing conceptual framework for African American student's math self-efficacy.

Data Analysis

Grounded theory was the most appropriate conceptual framework for the present study as it allowed me to generate a broad theory descriptive of the dynamic development of math self-efficacy. As the aim of the present study was to examine sources that seem to influence the development of math self-efficacy among African American students, the grounded theory model directly related to my study's aim because data collection and data analysis are interrelated processes. Additionally, grounded theory permitted me to thoroughly capture the social phenomenon examined. The first data that was analyzed were the student pre-survey responses that were used to adapt Usher's interview protocol.

Coding

Upon completion, all interviews were transcribed and grouped according to how students ranked (e.g. high self-efficacy ratings or lower self-efficacy ratings). I listened to student interviews three-times, once immediately following the interview, once while preparing to transcribe the interview and once while actually transcribing. Notes that I jotted down while listening to interviews served as the basis for data analysis as each participant's response to queries slowly developed into an emergent pattern.

As a means to analytically break down the data as open coding requires (Corbin & Strauss, 1990), I first used a priori codes (Corbin & Strauss, 1990) to label all descriptions students provided about their perceptions of their math self-efficacy. These a priori codes were developed based on Bandura's conceptual definitions for each source self-efficacy. These sources of self-efficacy include mastery experiences (the result of actions cognitively appraised), vicarious experiences (a student's change in behavior based on the observation of another's actions), social persuasions (forms of verbal feedback or judgments) and affective states (strong emotional reactions to academic tasks or performances) (Bandura, 1997). Additionally, reoccurring forms of self-efficacy identified by students in previous research studies also contributed to the a priori code list (Table 3).Examples of a priori codes selected to describe mastery experiences include math achievements, learning accomplishments, and math learning experiences. Due to the limited number of students interviewed, track changes were used to label coded information.

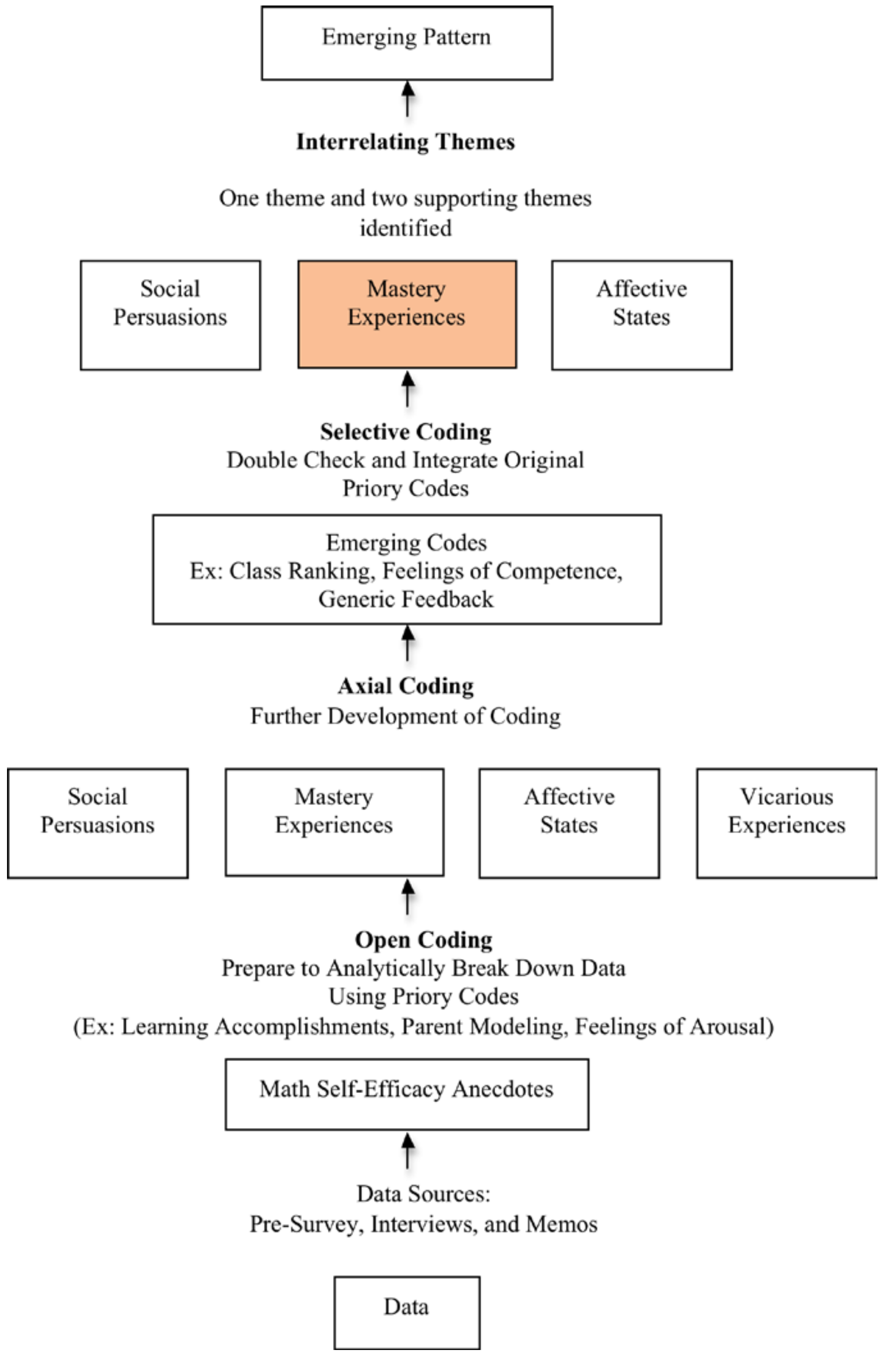
Secondly, after assigning a priori codes, I listened to all of the student interviews again to enhance the accuracy and internal-consistency of the codes assigned. At this time all irrelevant codes were removed. Irrelevant codes were defined as tangential codes not directly relating to sources of student's math self-efficacy. Examples of tangential codes included personal descriptions from students of their family lives including references to pets, non-academic related parent-child interactions, and non-academic related household routines.

Thirdly, axial coding was used to identify emerging subcategories from a priori codes (Corbin & Strauss, 1990). Examples of subcategories that emerged from a priori codes used to describe mastery experiences include class-ranking, performance on assessments, and advanced math instruction experiences. Fourthly, selective coding was used to double check coding categories to verify their relation to Bandura's conceptual definitions of the sources of self-efficacy. Categories were unified around one central category, mastery experiences, and its interactive relationship (though superordinate) to affective states and social persuasions. As a pattern emerged at this stage, I used constant comparative analysis between data sources to verify themes, properties and relationships between codes (Figure 1) (Corbin & Strauss, 1990; Merriam & Associates, 2002).

Table 3
Conceptual and Operational Definitions for Sources with Priory Codes

	A Priori Codes	**Theoretical Definition**	**Enacted Representation Examples**
Mastery Experiences	Math Achievements Learning Accomplishments Math Learning Experiences	Judgments of competence that are created or revised according to a student's interpretation and evaluation of a completed task (Usher & Pajares, 2006).	"I usually do" "I can" "I can't" "I did" "I learned" "When I was"
Vicarious Experiences	Parent Modeling Sibling Modeling Peer Modeling	Students' altering of their beliefs following a model's success or failure (Usher & Pajares, 2006).	"I saw my friend" "I saw my teacher" "Because he [or she]"
Social Persuasions	[Teacher, Parent, Peer] Feedback [Teacher, Parent, Peer] Judgments [Teacher, Parent, Peer] Appraisals	Dependence upon others to provide evaluative feedback, judgments and appraisals about academic performance (Usher & Pajares, 2006).	"He [or she] helped me" "He [or she] said" "My teacher said" "My mom said"
Affective States	Feelings of Arousal Feelings of Fatigue Personal Competence Beliefs	Students' interpretation of their physiological arousal as an indicator of personal competence (Usher & Pajares, 2006).	"I felt…"

Figure 1
Coding Processes Interrelating Themes



Credibility and Validity

The trustworthiness and credibility of the study (Strauss & Corbin, 1998) was ensured through multiple procedures and by verifying a high degree of intercoder reliability (Miles & Huberman, 1994). Though I coded all transcripts independently, it was necessary to verify the codes that were assigned were meaningful and logical. To accomplish this task a fellow graduate student within my concentration and familiar with social cognitive theory and self-efficacy was asked to review the matrices and tables I created during the open and axial coding process. Coding cross-checks were conducted by tallying the number of agreements and disagreements between my peer and me. To measure intercoder reliability, the ratio number of agreements was compared to the number of agreements plus disagreements (Miles & Huberman, 1994). The number of codes agreed on was 183 and the number of codes disagreed on was 9. With a ratio of 183 to 192, an intercoder reliability of 95% was found. To resolve disagreements in coding and better clarify inconsistencies in coding, Bandura's (1997) theoretical descriptions of sources of self-efficacy were used. By using an outside reviewer to judge the coding process to be of good science, I was able to contribute to the trustworthiness of themes and categories identified.

To enhance the validity of this study, constant comparisons between data sources were made. To ensure that conclusions about self-efficacy groups drawn from student interviews were accurate, I often referenced student pre-survey results and memos when assessing patterns and variations within the data. Once the accuracy of my conclusions was confirmed I began to look for purposeful action and interactions among participants to develop an emerging pattern. Hypotheses about these relationships were documented in memos and were redeveloped and refined until a verified pattern formed.

The internal validity of the present study was enhanced through use of constant comparative data analysis. By analyzing pre-survey self-efficacy question stems, student responses, student transcripts and memos, a detailed audit trail was created and maintained. This trail not only served as a means to enhance internal validity, but also provided a consistent means to compare my biases and predispositions during the collection and analysis of data. This process is described by Johnson (1997) as reflexivity and is a method used to enhance the objectivity of qualitative research (Johnson, 1997).

Finally, conclusions made during the course of data analysis were compared to self-efficacy research compiled in other content domains. These studies referenced will be discussed in the discussion chapter. By evaluating the degree to which the results of the present qualitative research could be generalized or transferred to other contexts enhanced the study's external validity.

4. RESULTS

In this section, I first provide the background information of the seven students interviewed to better contextualize my findings. To protect the confidentiality of students, pseudonyms have been used. Additionally, I report the sources of self-efficacy identified by students, the lack of differences between the high and lower self-efficacy groups in the sources of self-efficacy students identified, and the preferences of students with regards to the Game Design @ Mason program. I also report the sources of self-efficacy identified by gender and the willingness of students to share with peers their involvement with Game Design @ Mason.

Students With High Math Self-Efficacy Ratings

David.

David had been attracted to the Game Design @ Mason program because of his passion for video games and prior experience developing them. He described the autonomy during instructional sessions as an aspect about the program that he liked most. This characteristic, he shared, had been missing from the last game design program he had attended. When asked to describe himself as a math student, in confidence, he stated that he was a really good math student who in the fifth grade earned a perfect score on the math portion of the SOL.

Though he recognized his math abilities, he described himself as a procrastinator when it came to schoolwork. He also believed that his parents thought he was a really good math student who sometimes did not live up to his full potential. When describing his school environment, he shared that he surrounded himself with peers with similar math ability skills. Much like David, most of his fellow 6th grade peers were in Math 7. A few, he mentioned were in Math 6, however, he quickly added, that they too should be in Math 7, but instead chose to stay in Math 6 because of the easier course load.

David described his school as being “very open minded and tolerant.” David was quick to state that his school was not only racially diverse but also diverse with regards to students with disabilities. He stated, “There are a lot people with Asperger’s, and blind, and in wheel chairs.” School to David was a place to be free and to be himself.

Stephanie.

Stephanie shared that she had been attracted to the Game Design @ Mason program because of the hands-on experience the program offered. The biggest strength of the program, in her opinion, was the friendly atmosphere and the clear instructional sessions taught by mentors.

She perceived herself to be a strong math student and attributed her successes to her strong work ethic. In math class, she was recognized as one of the top ten students with the highest math grade in her advanced math class. In her words, “As a math student, I try to understand what is being taught and I try to put my best foot forward and work hard if I don’t understand it.” As an aspiring pediatrician, Stephanie expressed that in her mind, each math assignment and test she successfully completed, moved her towards going to college and benefiting her "later life."

When describing her school environment Stephanie stated, "My school has room for lots of different students. My school has lots of students with disabilities and we treat them the same just like we would treat everybody else. They are not different because they are in a wheel chair or because they can't learn the same."

Kyle.

The majority of Kyle's friends attended Game Design @ Mason. He liked the program and felt comfortable attending weekly sessions because of the program's social aspect. In general, his social circle, particularly at school, was very important to him. In his opinion, his ability to complete his homework on time and solve math problems that his classmates could not solve, demonstrated that he was a good math student. Despite, his high self-efficacy ratings on the Game Design @ Mason pre-survey, Kyle shared "I'm not the best student in my whole class. Um, there are most other kids that are in my class that are a lot better than me at math because I like learned most of my math concepts late." When describing his school environment, Kyle shared that it was a "really safe place for him."

Students With Lower Math Self-Efficacy Ratings

Luke.

It was very apparent that Luke had a passion for computers. During the interview, he seemed to enjoy pointing out the differences between using the Game Maker software and another platform named “scratch.” In fact, he shared that the computers used during the Game Design @ Mason weekly sessions made him feel most comfortable. Though he described himself as a good math student, based on his previous math test scores, he described feelings of anxiety he often experienced while taking tests. When asked what could improve his test taking confidence, he replied, “Encourage me.” Other than stating that his teachers and friends were nice, Luke did not describe his school environment in detail.

Steven.

Steven was passionate about videogames and shared with his mom that he wanted to be a professional “gamer.” When she expressed reservations about his career choice Steven decided that he would learn more about game design. He mentioned that some of his friends used to come to the program with him, however, had stopped attending. When describing himself as a math student, he shared that he was a hard worker and was not one to procrastinate. Though he described math as being sometimes hard and sometimes easy, he viewed himself as a capable student. In his words, “I would say that I am good at math and that I can do most of the problems that people give me”. Steven described his school environment as friendly with a lot of diversity.

Monica.

Monica enjoyed the autonomy that Game Design @ Mason allowed. She described feeling free to express herself through her game designs. She stated, “I can make what I feel inside and feel what I want to make and its perfect the way it is.” When describing her school environment, she stated that many of her friends were not in advanced math class and seemed to playfully tease her. She laughed as she recounted how they often called her “smarty pants.”

When recounting how she had been pulled out of two math classes to attend a more advanced math class, she shared how special she felt to have the ability to learn more. In her words, “I just feel grateful that I have that experience.” Monica would only describe her school environment as loud.

Timothy.

Timothy was a very quiet student who had a strong interest in computer programming. He described how his dad was very good at math and always carried papers with math equations on them. Timothy stated that his father told him if he wanted to be a computer programmer he had to be a good math student. Timothy shared how his father believed everything revolved around math. Despite, Timothy’s desire to be a good computer programmer, he shared that he did not live up to his full potential in math. He described himself as being able to understand concepts well, but not good at mastering equations. A self-professed procrastinator, he stated that he visited the teacher only when needing to turn in late homework. At school, he shared that he did not feel free to be himself because others would laugh at him. Timothy described his school environment as diverse.

Sources of Self-Efficacy Identified and Group Differences

Research Question 1: “What sources of math self-efficacy do African American students with interests in game design rely on most?”

The primary question that guided the study was “What sources of math self-efficacy do African American students with interests in game design rely upon most?” Interviews with students suggest that they primarily relied on mastery experiences to define their mathematic ability, while relying on affective states to further substantiate their competence beliefs. Social persuasions seemed to also inform the math self-efficacy of students, but to a very small extent. Most of the feedback students reported receiving were very generic. Social persuasions did not seem to powerfully influence mastery experiences. Overall, students consistently used similar forms of anecdotal evidence to define their perceptions of themselves as math students. The essential influences that fostered their development of how they defined their math ability included examples of class-ranking, judgments of ability based on past performances on assessments, and being “pulled out” of the classroom for advanced math coursework (Table 4). These influences reflected judgments students made about their competence in math based on their experiences completing previous math-related tasks.

Mastery Experience Subcategories and Anecdotes

When asked how students knew that they were good math students, more often than not they first referenced where they ranked in light of their peers (Table 5). Stephanie stated, “I am in the top ten of the highest grades in the class and we are in advanced algebra so everyone in the class is pretty good at math." Students also used award recognition to point out their ranking compared to peers. David mentioned that he received recognition for being the only boy in the fifth grade to earn a perfect score on the math portion of the SOL. Overall, the most common response students provided was much like the one Timothy gave, "I am in eighth grade math for seventh graders."

After probing students to further explain how they perceived themselves as math students, they often described situations with peers. These situations I coded as "performance on assessments." Students used these descriptions to compare their math performance on math tests, quizzes, and homework assignments with that of their classmates. In describing his interactions with friends before math class, Kyle stated "Some of them forget to do their homework and when they forget to do their homework they always ask me if [I] know how to do it. I tell them, if I can remember how to do it, then I'll help them." When it came time to review their homework in class, he shared that most of the time he was the student that was able to solve the math problems that others could not. Similarly, Luke referenced his routine experiences with homework and test checks. In his words, "We like pass tests around so other people can grade them so like we get a red pen out and check [mark] it if its right and we "x" [it out] if it's wrong. So most of my tests, I have a lot of checks."

Many students shared that they were pulled out of their regular class to attend an advanced math class or were provided opportunities to meet outside of class with other advanced math students. These examples were categorized as "advanced math instruction experiences." In describing how her peers knew she was a good math student, Monica stated, “Whoever is in advanced class, there are like probably me and five other students, we go to advanced class and then we come back.” David described another experience with advanced instruction. He shared, “I’m involved in another math group it’s a math 7 minority achievement group.”

These experiences and reflections revealed the dynamic processes of developing math self-efficacy. Students not only described similar forms of mastery experiences such where they evaluated their class ranking, they also recalled times they received awards.

Affective State Subcategories and Anecdotes

Participants used affective states as an additional form of evidence to more accurately describe their perceptions of themselves as math students (Table 6). It seemed that students relied primarily on mastery experiences as a general way to indicate that they were good math students. As further corroborating evidence, students described their usual emotional and psychological states when completing math tasks to illustrate their identity as math students. Stephanie, after identifying herself as one of the top ten students in her advanced math class, alluded to her psychological frame of mind when approaching math-related tasks. She stated, “I know that if I work hard I probably can do everything, well not everything, but probably get a clear understanding. So once I get that clear understanding, I feel pretty good.”

Monica, after identifying herself as a good math student based on her high performance on quizzes and placement in advanced math class, also described her psychological state when given math assignments. She shared, “Anytime [the teacher] hands out an assessment, or a test or anything like that I will be like, ‘I can do this! I can definitely do this!' and I just start writing and then I'm like 'Oh gosh' and then I just write it anyway and he is like 'Yes, A+.'"

Besides these descriptions, which I labeled as feelings of competence, some participants expressed different emotional and psychological states that I labeled as feelings of belonging, feelings of fatigue, and feelings of arousal. It seemed that Luke grappled with being a good math student who experienced bouts of anxiety during end of quarter tests. In a sheepish tone he described how he "kind of freaks outs" when attempting to complete what he described as very long and hard questions. When faced with challenging math problems, David, who also described himself as a good math student, stated that he battled fatigue.

Social Persuasion Subcategories and Anecdotes

The majority of participants did not provide descriptive social persuasion anecdotes (Table 7). In fact, the feedback that students described receiving from parents and teachers, though positive, was very generic. When describing her parent's perceptions of her math ability Stephanie stated, "My parents tell me that I do good in math." Similarly, David recounted the feedback on his math class his parents gave him "[My parents] tell me to do well in it. To get somewhere, to go to a very good college or something like that." When describing feedback from teachers Kyle shared, "[Teachers] just tell me that I am doing a really good job in math class."

When describing the feedback that he received from parents, Kyle shared that his parents often told him that he took too long on his homework. Kyle did not extrapolate on his homework behaviors and what might have prompted his parent's statements. The feedback that Monica received from her parents also seemed to be very general. In her descriptions she shared that her parents were very supportive and willing to help, often telling her "to do her best in math." Luke and Timothy too also stated that teachers and parents felt that they were good math students and encouraged them to always do their best in math. Of all the feedback reported, the feedback that Timothy received from his father was perhaps the most direct. In addition to telling him to try his best, he also stated to Timothy that the world revolved around math. Though a powerful statement, Timothy did not share how his father encouraged him to translate this worldview to academics other than by doing his best in math.

The overall the feedback students recounted was positive. However, no student described what doing his or her best looked like in terms of academic behavior. Nevertheless, it seems that these examples of feedback given to students, though generic, contributes in some way to their math self-efficacy.

Vicarious Experience Subcategories and Anecdotes

In reviewing student transcripts it quickly became apparent that students did not have role models to whom they looked to for support in math or other STEM disciplines (Table 8). When asked, "Do you think the people you admire would be good at math?" students replied "yes" then proceeded to list individuals unrelated to STEM. I categorized these descriptions as "lack of STEM models." Role models who were mentioned included celebrities, social media icons and historic figures. It became evident that students assumed that their role models would be good at math because they seemed intelligent or were successful. David and Michael's descriptions supported this observation. David shared, “The people that I admire…like a role model. Kayne West, I don’t know. I think that he would be pretty good at math.” Michael similarly assumed that his role model would be good at math. He said,

> “There is this guy on YouTube, for his job he just plays games and posts it on YouTube. He’s funny and he gets paid for the ads that end of being shown on his videos and lots of people watch him. But, he did take three years at chef school so I assume that he is good a measuring quantities.”

Some students did not provide the names of individuals who they admired. Stephanie simply stated that the people who she admired most were good at math because they were intelligent people. In her words, “ I usually admire intelligent people. So, many intelligent people have a good background in math or science. So they would have a clear understanding.” Similarly, Luke described the people that he admired most as creative individuals. Their creative abilities he surmised were indicative of their strong math ability. In light of the small and limited sample population recruited, it is hard to generalize my observations of the lack of STEM role models to all African American middle school students. However, I do conclude that students do not readily have STEM role models in whom they aspire to be like.

Research Question 2: How do sources of self-efficacy differ for students with high math self-efficacy ratings as compared to students with lower math self-efficacy ratings?

In comparing students with higher math self-efficacy ratings (David, Stephanie and Kyle) to students with lower self-efficacy ratings (Luke, Steven, Monica and Timothy) consistent differences could not be found, instead consistent patterns across groups were found. Regardless of group categorization, students expressed the important influence mastery-experiences had on their math self-efficacy. When defining their math self-efficacy, references were often made to how students ranked in class compared to peers, reflections on advanced math instruction experiences, and how students scored on math homework assignments, quizzes or tests. I coded these dialogues as class-ranking, differentiation examples and performance on assessments. Based on these responses, it became apparent that these examples of past performances (i.e. mastery experiences) primarily informed how students perceived their math ability (i.e. math self-efficacy). It can be inferred that the lack of differences between groups could be due to the narrow student demographic recruited. All students had a great deal more in common than they had different as the majority of students interviewed were in advanced math classes and shared a common interest in game design. Additionally, only seven students were interviewed thus limiting the probability of finding group differences.

Student Preferences

Research Question 3: "How do students with high self-efficacy ratings compare to students with lower self-efficacy ratings in their preferences for the Game Design @ Mason program?"

In answer to this question, distinctions between students with high self-efficacy ratings and lower self-efficacy ratings could not be made as consistent patterns within these two groups could not be found. Student's each provided their own individual responses when asked what they liked and disliked about the Game Design @ Mason program (Table 9). Overall, it seemed that students enjoyed a sense of autonomy within the classroom environment as well as when using the "Game Maker" software." When speaking of their dislikes, Monica described a challenging aspect of the program for her called “sprite.” I later learned that this term was used to describe a visual representation of all objects developed when designing a game. Steven similarly referenced his dislike for challenging parts of the software. Stephanie, Kyle and Luke felt that there was nothing to dislike about the program. In light of these responses, I sought to next examine the willingness of students to tell peers about their association with the Game Design @ Mason program

Peer Influence and Gender Differences

Research Question 4: “How do students with high self-efficacy ratings compare to students with lower self-efficacy ratings in their willingness to share with peers their association to the Game Design @ Mason program?”

The question of “How do students with high self-efficacy ratings compare to students with lower self-efficacy rating in their willingness to share with peers their association to the Game Design @ Mason program?” also guided the study. To answer this question, during interviews, I asked students “Do your friends know that you are a part of Game Design @ Mason?” It was interesting to find that differences did not emerge between students with higher math self-efficacy ratings as opposed to students with lower math self-efficacy ratings. Additionally, differences between genders were not found. It is worth noting that with the exception of Steven and Timothy, David, Luke, and Kyle had not told their friends that they participated in a game design program. Though differences between genders were not found, it is worth noting that three of the five boys had not told their friends that they participated in a game design program. After probing further, students stated that there was either no specific reason why they had not told their friends about Game Design @ Mason or that they believed their friends would not be interested in knowing about the program. David offered some interesting insight, by noting that even his friends in Game Design @ Mason only discussed the program when attending the weekend sessions. He stated, “I don’t really tell them and they don’t really seem to be all that interested. All the friends in there [motioning to the game design session] don’t really talk about it until today like the meeting in class.” Luke and Kyle were very reserved when explaining why they had not told their peers. Kyle seemed to imply that he was going to eventually tell his friends at some point, yet did not state why he was waiting to tell them. He stated, “I haven’t told them about it yet…there is no reason, I don’t keep it secret from them. When asked if he intended to keep his attendance at Game Design @ Mason a secret, Luke responded with, “I just haven’t told them.”

Monica and Stephanie provided much richer descriptions and seemed more open to sharing with peers their involvement with the program. Stephanie stated, “I tell them what’s happening and what I do. Sometimes, I tell them and they want to join to. Some of them are planning on applying.” In speaking with Monica, she described conversations through text messages about Game Design @ Mason she shared with a “close friend.” Of interest, she did not tell other friends as they were not as close to her.

Research Question 5: “How do female students compare to male students in their descriptions of their sources of math self-efficacy?”

The final question that guided this study was “How do female students compare to male students in their descriptions of their sources of math self-efficacy?” No differences between male and female students were found in the sources of self-efficacy they identified as contributing to their math self-efficacy.

Table 4
Conceptual and Operational Definitions for Sources of Self-Efficacy With Emerging Codes

	A Priori Codes	**Theoretical Definition**	**Enacted Representation Examples**	**Emerging Codes**
Mastery Experiences	Math Achievements Learning Accomplishments Math Learning Experiences	Judgments of competence that are created or revised according to a student's interpretation and evaluation of a completed task (Usher & Pajares, 2006).	"I usually do" "I can" "I can't" "I did" "I learned" "When I was"	Class-Ranking Performance on Assessments Advanced Math Instruction Experiences
Vicarious Experiences	Parent Modeling Sibling Modeling Peer Modeling	Students' altering of their beliefs following a model's success or failure (Usher & Pajares, 2006).	"I saw my friend" "I saw my teacher" "Because he [or she]"	Lack of STEM models
Social Persuasions	[Teacher, Parent, Peer] Feedback [Teacher, Parent, Peer] Judgments [Teacher, Parent, Peer] Appraisals	Dependence upon others to provide evaluative feedback, judgments and appraisals about academic performance (Usher & Pajares, 2006).	"He [or she] helped me" "He [or she] said" "My teacher said" "My mom said"	Generic Feedback
Affective States	Feelings of Arousal Feelings of Fatigue Personal Competence Beliefs	Students' interpretation of their physiological arousal as an indicator of personal competence (Usher & Pajares, 2006).	"I felt…"	Feelings of Competence Feelings of Belonging Feelings of Arousal

Table 5
Significant Mastery Experience Quotes

Mastery Experiences	
Class Ranking	"Because I am in the top ten of the highest grades in the class and we are in advanced algebra so everyone in the class is pretty good at math." (Stephanie, pg. 3) "I think I got a math award well sorta got recognized like the person who runs the math elementary school cuz I was the highest SOL score out of all the boys in 5^{th} grade." (David, pg. 2)
Assessment of Ability	"Some of them forget to do their homework and when they don't, they forget to do their homework they always they ask me if they [I] know how to do it. I tell them, if I can remember how to do it and then I'll help them…so most of the time, somebody is always wrong. And um, when somebody is right, they always ask what they did differently in the math. And um, most of the time at that table, it's me who's right." (Kyle, p. 2-3) "Yes, because we like pass tests around so other people can grade them so like we get a red pen out and check if its right and we "x" it if it's wrong. So most of my tests, I have a lot of checks." (Luke, p. 2)
Award Recognitions	"I think I've gotten about three or two [awards]." (Steven, p. 2) "I got second place in this [regional] test." (Timothy, p. 2)
Differentiation	"Whoever is in advanced class there is like probably me and five other students and we go to advanced class and then when we come back." (Monica, p. 3) "I'm involved in another math group it's a math 7 minority achievement group. But, sometimes I don't understand it and then someone tells me to come in at lunch." (David, pg. 2)

Table 6.
Significant Affective State Quotes

Affective States	
Competence Beliefs	"Because like anytime he hands out an assessment, or a test or anything like that I will be like, 'I can do this! I can definitely do this!' and I just start writing and then I'm like 'Oh gosh' and then I just write it anyway and he is like 'Yes, A+'." (Monica, pg. 5-6). "Because, If there is something that I don't understand, I know that I am not perfect but I will work hard at it. I know that if I work hard and study hard then I can understand it." (Student 2, pg. 2)
Need for Belonging	"Um, because like I said because people pull me out of my classroom and make me feel special and they just tell me how great I am and how smart I am and it just feels good inside." (Monica, pg. 2)
Feelings of Arousal	"Because if it's an end of the quarter test, it's like very long with a lot of hard questions. So, when I get to those questions, I kind of freak out. And um, I just kind of freak out." (Luke, pg. 3) "I feel kind of annoyed if there are lots of questions." (Timothy, 4)
Feelings of Fatigue	"Sometimes math assignments are harder than what we are learning. So like I feel, I don't want to do this." (David, pg. 3)

Table 7.
Significant Social Persuasion Quotes

Social Persuasions	
Generic Feedback	"My parents tell me that I do good in math." (Stephanie, pg. 2) "[Teachers] just tell me that I am doing a really good job in math class." (Kyle, p. 3) "[They tell me] to do well in it. To get somewhere, to go to a very good college or something like that." (David, pg. 3) "Um, she would always use to tell us how to do specific things and she would never like not ever support us. So, if we had any questions on a math test she would help us remember how to do them." (Kyle, pg. 2)

Table 8.
Significant Vicarious Experience Quotes

Vicarious Experiences	
Lack of STEM Models	"Because the people that I admire, like a role model. Like Kayne West. Like I don't know. I think that he would be pretty good at math." (David, pg. 3) "There is this guy on YouTube, for his job he just plays games and posts it on YouTube. He's funny and he gets paid for the ads that end of being shown on his videos and lots of people watch him. But, he did take three years at chef school so I assume that he is good a measuring quantities." (Timothy, pg. 4)

Table 9.
Student Program Preferences

	Likes	**Dislikes**
Students with Higher Math Self-Efficacy Ratings		
David	"Um, designing the games and being able to choose what you want to do with it."	"Um sort of designing games also … the things we have to do like sometimes, I didn't understand it and sometimes the helper goes to help me when I raise my hand they don't understand it either."
Stephanie	"How friendly the teachers were, how friendly the people were, the teachers were really friendly and they explained things in a way that I could understand."	"No, I liked everything about the program."
Kyle	"Pretty sure just like making video games."	"No. I just like it."
Students with Lower Math Self-Efficacy Ratings		
Luke	"I like how [in Game Maker] you can make stuff move and make stuff move around you, move freely around you."	"Um, nothing."
Steven	"At first my friends would come but now they don't, it was fun because I get to create video games."	"The hard parts, when it gets challenging."
Monica	"That I can do the game that I want to do. And like they just say like you make this game, I can do whatever I want to do."	"Sprite was difficult for me. Game maker is probably is like easier, oh but sprite was really hard."
Timothy	"Just not a small amount of people there."	"Like there is this test thing last year where they would ask us to write a story with an object or something."

Emerging Patterns

In looking for relationships between sources of self-efficacy and students' perceptions of their math ability, I was able to develop an integrated framework (Corbin & Strauss, 1990) that seemed to shed more light on the development of math self-efficacy for students interviewed. I found that when students spoke about their perceptions of their math capability they readily cited mastery experience examples. This is consistent with the work of Pajares and Zeldin (2000) as well as Usher and Pajares (2006) who both found that African American students in their studies seemed to rely primarily on forms of mastery experience. I noticed that students then further described their math capabilities by describing affective states required to complete math-related tasks. Students who I grouped by high math self-efficacy ratings exhibited this pattern, as did students who were grouped by lower self-efficacy ratings. Therefore, this relationship developed into an emerging pattern (Corbin & Strauss, 1990) illustrated in Figure 2.

The major categories that seemed to impact the affective states of students included their feelings of competence, feelings of belonging, and feelings of arousal. All three of these factors emerged from the data during axial coding. Many students reported feeling that they possessed the skills necessary to do well on math assignments. In the words of Monica,

> "Anytime [the teacher] hands out an assessment, or a test or anything like that I will be like, 'I can do this! I can definitely do this! And I just start writing and then I'm like 'Oh gosh' and then I just write anyway and he like 'Yes, A+'."

David and Stephanie shared similar sentiments when speaking about taking math tests. David stated, “ Every time before a test or the day before a test or like an important class before the period starts I feel really *really* (emphasis added) confident that I am going to get all of them right and if not then one or two wrong.” Stephanie too approached taking tests confidently, perceiving them as opportunities to boost her overall course grade.

In addition to expressing their feelings of competence, students also described the desire to feel like they belonged. The anecdotes that students described were all related to school experiences. In describing his school environment, Kyle shared that “it’s a safer place for me.” Timothy did not share in that same security as he stated he didn’t feel that he could truly be himself at school because “people would laugh.” Monica described that teachers in her math class made her feel special by often telling her she was smart. Though illustrated differently, these examples reflect the desire of students to feel that they belong.

Finally, students also expressed feelings of arousal when completing math assignments, in the words of Luke, “If it’s an end of the quarter test, it’s like very long with a lot of hard questions. So, when I get those questions, I kind of freak out.” Though not sharing in Luke’s anxiety, Monica expressed feeling annoyed when given what she defined as “a lot” of questions. These feelings described in addition to the aforementioned mastery experience examples seem to be foundational to the math self-efficacy development of students interviewed.

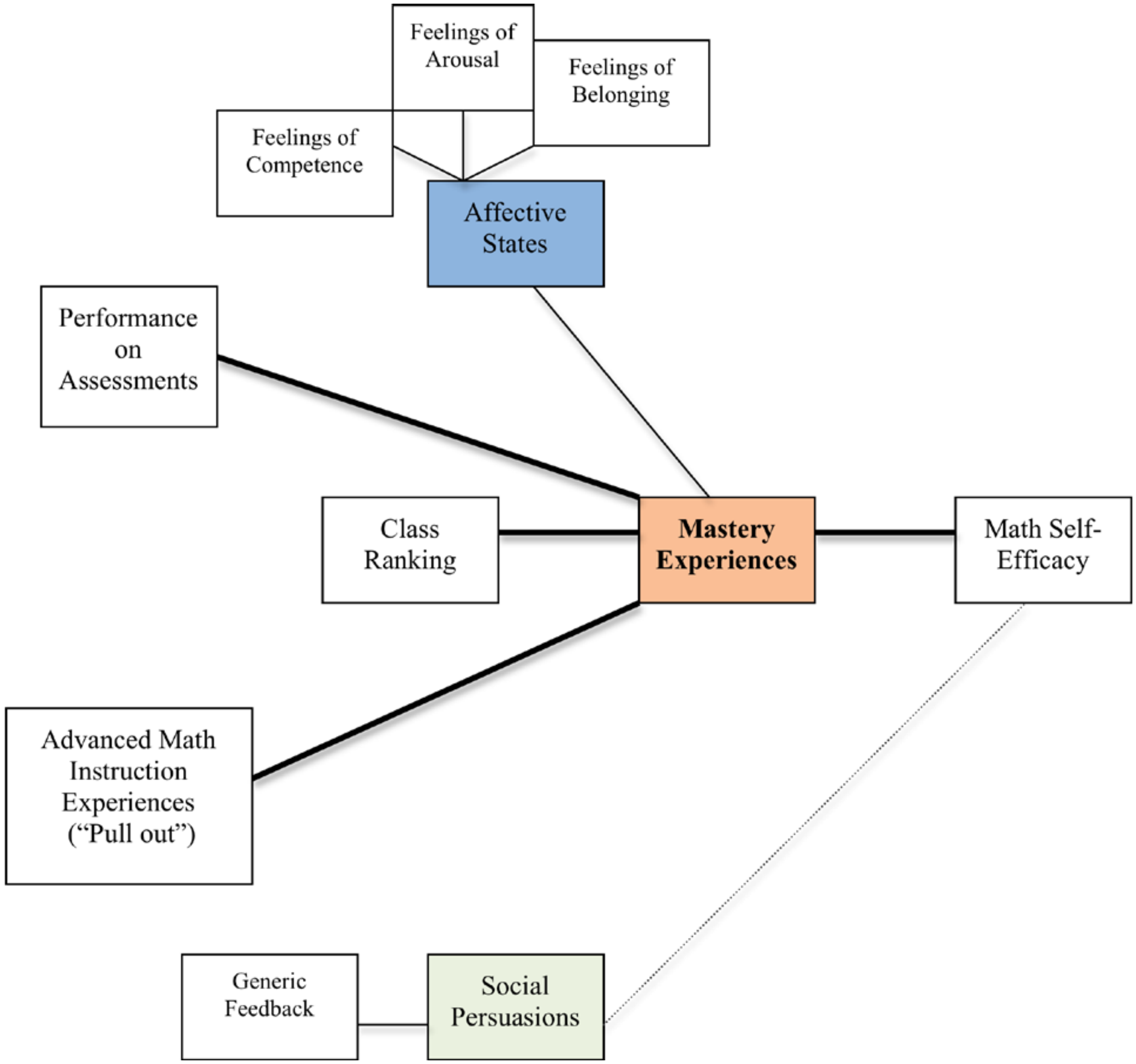
For students, social persuasion seemed to play a very minor role in their descriptions of math self-efficacy. Though students often mentioned that their peers were generally also good at math, students did not describe receiving forms of verbal feedback from peers. When asked, “What do the majority of your friends say about those who do well in math?” David replied, “Um, nothing because they are the ones who do well in math.” Though this response was telling of David’s peer group, it did not satisfy Bandura’s definition of social persuasion or vicarious experience.

In general, the feedback that students described receiving though positive seemed to be very generic. Even with probes, the anecdotal evidence students offered seemed weak. In the words of Kyle, “[Teachers] just tell me that I am doing a really good job in math class.” Similarly Steven said, “[My parents] like tell me that you should always try your best.” I have recognized social persuasions as having some degree of impact, though it would seem small, on the development of student’s math self-efficacy.

The influential role that mastery experiences have on math self-efficacy has been well supported by past research (Britner & Pajares, 2006; Lent, Brown, Gover, & Nijjer; Usher & Pajares, 2006; Usher, 2009; Zeldin & Pajares, 2000; Zeldin, Britner & Pajares, 2007). Where my findings differ in light of past research is the influence that vicarious experiences, social persuasions, and affective states have in support of mastery experiences. Usher and Pajares (2006) found that forms of social persuasions seemed to be the secondary source of self-efficacy that African American students relied upon. In short, their research suggests that mastery experiences and social persuasions are most predictive of academic achievement for African American students. Interestingly, Caucasian students were found to rely primarily on forms of mastery experience followed secondly by their affective states. These both informed the math self-efficacy of students as found in the present study. Usher (2009) found that vicarious experiences and affective states were key in how students defined their math ability. In light of the different supportive roles that social persuasions, vicarious experiences, and affective states seem to have in conjunction to mastery experiences, Usher (2009) concludes that different research findings are to be expected due to methodological limitations between differing studies, contextual factors, and study demographics.

Additionally, it is important to recall that Klassen (2004) found that African American students seemed more attuned to messages that they received from others rather their past performances. In my interviews with students, descriptions of messages they received from peers, parents, and teachers were not of primary focus and when included, descriptions of feedback proved to be very generic. It is possible that since these students were already at the top of their class, they were not as attuned to forms of social persuasion as other average or low performing math students used in Klassen's (2004) and Usher and Pajares' (2006) studies.

Figure 2
Emerging Pattern Diagram



Summary of Findings

The study's research questions included (a) What sources of math self-efficacy do African American students with interests in game design rely upon most? (b) How do sources of self-efficacy differ for students with high math self-efficacy ratings as compared to students with lower math self-efficacy ratings? (c) How do students with high math self-efficacy ratings compare to students with lower math self-efficacy ratings in their preferences for the Game Design @ Mason program? (d) How do students with high math self-efficacy ratings compare to students with lower math self-efficacy ratings in their willingness to share with peers their association to the Game Design @ Mason program? (e) How do female students compare to male students in their descriptions of their sources of math self-efficacy?

Overall findings of the study indicate that:

What sources of math self-efficacy do African American students with interests in game design rely upon most?

a. Students interviewed relied primarily on mastery experiences to define their perceptions of their math ability but also relied on descriptions of affective states to explain their perceptions of their math ability. Students also reported social persuasions however; its influence on their math self-efficacy was limited due to the generic feedback students received. Vicarious experiences described by students also illustrated that they lacked STEM role models.

How do sources of self-efficacy differ for students with high math self-efficacy ratings as compared to students with lower math self-efficacy ratings?

b. Sources of self-efficacy identified by students did not differ between groups.

How do students with high math self-efficacy ratings compare to students with lower math self-efficacy ratings in their preferences for the Game Design @ Mason program?

c. No consistent differences were reported between groups with regards to student preferences for Game Design @ Mason. Students each had their own unique "likes" and "dislikes" about the program.

How do students with high math self-efficacy ratings compare to students with lower math self-efficacy ratings in their willingness to share with peers their association to the Game Design @ Mason program?

d. No differences were found between groups in their willingness to share with peers their association to the Game Design @ Mason program.

How do female students compare to male students in their descriptions of their sources of math self-efficacy?

e. No gender differences were found in the sources of self-efficacy identified by female and male students.

5. DISCUSSION

The primary purpose of this study was to examine the sources of math self-efficacy identified by African American students with interest in game design. Specifically, it was my aim to compare students with high math self-efficacy ratings to students with lower math self-efficacy ratings. I also sought to consider possible gender differences when analyzing the responses of students. In this section, I discuss the results of the present study, the implications of the study, and consider future areas of research.

Connecting Findings to Past Research

Game design has been identified as a unique way to garner the interests of students of color in STEM (Clark, 2005). Yet, in order to maintain the interest of students of color in STEM, students must perceive themselves as capable of completing STEM-related tasks, they must expect successful outcomes of STEM-related tasks, and they must perceive STEM-related tasks as valuable (Eccles, Adler, & Meece, 1983). In short, sources of self-efficacy inform the feedback loop that either positively or negatively encourages the persistence of students of color in STEM. Results from the present study indicate that students rely primarily on mastery experiences and affective states (and in a small way social persuasions) to not only gauge their math ability but also according to Eccles' et al. (1983) research, to also sustain their interest in math. Students with higher math self-efficacy ratings demonstrated both interest and ability to complete math related tasks whereas individuals with lower math self-efficacy ratings demonstrated lower interest levels paired with math ability. The distinction between math interest and math ability is important, as both constructs are key to the persistence of students of color in STEM.

Though the influence of one's interest level and ability influenced math self-efficacy ratings, the influence of participant's age on math self-efficacy ratings of participants must also be considered. Declines in efficacy are particularly noticeable in the middle school years (Eccles, Midgley & Adler, 1984; Usher, 2009). With this in mind, it should come as no surprise that participants in the lower math self-efficacy grouping represent entering or soon to be entering middle school students. It also seems that racial identity may have informed the math self-efficacy of students. The descriptions of racially and intellectually diverse school environments by participants where respect and academic achievement for all students within the classroom are prized suggests that students interviewed understand and embrace Oyersman's et al. tripartite model of racial identity.

The primary constructs of interest to the present study, sources of self-efficacy, critically influence the math self-efficacy of African American students (Bandura, 1997; Usher & Pajares, 2006; Usher, 2009). In this study, mastery experiences, affective states, and social persuasions were identified as sources that informed the math self-efficacy of participants. Yet, these sources of self-efficacy alone did not influence math self-efficacy. Attention therefore must also be paid to other attributing factors such as interest, ability, age, and racial identity though not the primary focus of the study. Effort to understand the total development of math self-efficacy for African American students can only result in positive educational outcomes for students. With this in mind, the implications of the present study will now be considered.

Implications

In order to close the STEM achievement gap between African Americans and Caucasians, the results of self-efficacy research akin to the present study must be translated in ways that lay individuals understand its practical application. This is particularly important for individuals responsible for imparting learning to students. In light of the present research, practical implications can be found with regard to teacher instructional training, teacher-student interactions, and federally funded STEM intervention programs.

To engage and encourage African American students towards STEM disciplines, intentional measures by teachers must be made. Research suggests that teachers who modify their instructional strategies to consider the sources of self-efficacy for their students increase the self-efficacy of their students (Siegle & McCoach, 2007). Additionally, teachers can modify their instructional strategies with minimal training to enhance the self-efficacy of students using all four sources of self-efficacy. Five instructional strategies have been identified as means to increase the self-efficacy of students within the classroom, all of which can be directly applied to math. These instructional strategies include: 1) reviewing lesson accomplishments from the previous day with students, 2) asking students to record each day something new they have learned or succeeded in, 3) encouraging poor performing students to attribute their failure to lack of effort, 4) placing student's attention on their academic growth, and 5) using student models to illustrate the common struggles that students like them face when mastering classroom material (Siegle & McCoach, 2007). Teachers when trained to use sources of self-efficacy to inform instructional strategy become better equipped to enhance the academic performance of students.

In addition to informing instructional strategies, sources of self-efficacy can also be used to inform teacher-student interactions. Margolis and McCabe (2006) offer teachers strategies on what to do and say to strengthen struggling learner's self-efficacy and to encourage students with high self-efficacy towards metacogntive thinking. These strategies are again informed by sources of self-efficacy with particular emphasis on mastery experiences, vicarious experiences, and social persuasions as these sources can be easily used by teachers as a means to positively engage students. Margolis and McCabe (2006) suggest that teachers use forms of mastery experiences and vicarious experiences to guide teacher-student interactions. By planning moderately challenging tasks, using peer models, sharing with students learning strategies, capitalizing on student choice, interest, and reinforcing effort, teacher-student interactions powerfully and positively impact student self-efficacy. Such strategies have the capacity to empower and propel African American students towards academic success in STEM.

Finally, sources of self-efficacy when incorporated into the framework of federally funded STEM intervention programs have the potential to powerfully influence the persistence of African Americans in STEM. Lewis (2003) wrote that STEM intervention programs often have questionable scholarly bases, as they often rely on anecdotal evidence rather than theory-driven research as rationale for intervention strategies. By using self-efficacy research to inform STEM intervention strategies, African American students become academically equipped and psychologically empowered to persist towards and later enter the STEM workforce (Hernandez, 2013).

Limitations

A primary limitation of this investigation was the limited sample size. This was largely due to the fact Game Design sessions served as leisure activity for students and was not mandated. Consequently, the population of available students to recruit was limited. With a small sample population, generalizations to a larger student population could not be made, thus posing another limitation. An unequal number of males and females were also recruited which also limited the possibility of finding gender differences.

Despite being unable to recruit all 13 students, the overall aim of the study was not compromised as all students interviewed were African American, successfully completed the pre-survey and could be categorized according to the high or low self-efficacy criterion.Students who were recruited made up a rather homogenous population as they all were top students in their class, possessed similar interests in game design, and resided in the same demographic region and had more similar levels of self-efficacy than widely different levels; there were no students with low or very low self-efficacy. Another major limitation was the homogeneity of the math self-efficacy ratings reported by students. These details limited the ability to find differences across the groups and the generalizability of the present study.

Member checks were not used to validate data collected in the study, as some students were difficult to contact. As all students could not be contacted for follow up interviews, only one interview was conducted with each student. Therefore, researcher interpretations could not be verified.

Conclusions and Future Prospects

The findings of the present study suggest that more research regarding sources of self-efficacy is needed to further understand the dynamic development of math self-efficacy among African American students. Due to the narrow demographic of students recruited, generalizations to the larger African American middle school student population could not be made. However, these findings do raise more questions for future areas of research. It is unclear why for this demographic, social persuasions did not more inform the math self-efficacy of students . Perhaps more notably, it is unclear the role that vicarious experience plays in the development of math self-efficacy for African American students. More research specifically, it needed with regards to the types of mentors and role models African American students with STEM related interests seek and recruit. Particularly, it would be important to research the influence that social media has on the type of role models that African American students idealize and how this might influence their interests in STEM. Additionally, research that examines sources of self-efficacy for above performing students, specifically comparing the sources of math self-efficacy of students of color to Caucasian students is needed. Such research will indicate whether previously identified differences between sources are a factor due to race, task performance or environment. Finally, consideration of classroom environments on the self-efficacy of African American students is also needed. In light of Oyersman and Bybee’s (2001) research, environments where African American students are the majority as compared to the minority seem likely to influence the math self-efficacy levels and perhaps even the sources of math self-efficacy for students differently. In summary, further research within the domain of self-efficacy and STEM for students of color is needed and would no doubt better inform theory-driven STEM interventions.

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APPENDIX A

Game Design @ Mason Through Mentoring And Collaboration Student Survey

Thank you for participating in *Game Design @ Mason*! In order for us to do a good job planning *Game Design @ Mason*, we'd like to hear what you think. Please answer each of the following questions so we can make *Game Design @ Mason* the best it can be.

What is your phone number?

____

What is your email address?

____

What is the entire name of your school?

How old were you on September 1, 2012?

____

What grade are you in?

- o 3rd Grade
- o 4th Grade
- o 5th Grade
- o 6th Grade
- o 7th Grade
- o 8th Grade
- o 9th Grade
- o 10th Grade

- 11th Grade
- 12th Grade

What is your gender?

- **Female**
- **Male**

Which best describes you?

- African American/Black
- African/Afro-Caribbean
- Latino/Latina/Hispanic
- Caucasian
- Asian/Pacific Islander
- Native American
- Biracial or Multiracial
- Other (please specify)

Was at least one of your parents born outside the United States?

- Yes
- No

What is the primary language spoken in your home?

____

How did you find out about the Game Design @ Mason program?

- I was part of game design at McKinley or Bethesda
- Science teacher at my school
- Math teacher at my school
- Technology/computer teacher at my school
- Guidance counselor at my school
- Flyer for Paul Robeson Saturday Academy
- Friend
- Parent/Guardian
- Other (please specify)

In your home, is there at least one working?

	Yes	No
Desktop computer	o	o
Laptop or notebook computer	o	o
Computer tablet such as an iPad	o	o
MP3 player such as an iPod	o	o
Digital camera	o	o
Smart phone or cell phone	o	o
External hard drive NOT flash drive	o	o
Video game system	o	o

In your home, is there MORE than one working?

	Yes	No
Desktop computer	o	o
Laptop or notebook computer	o	o
Computer tablet such as an iPad	o	o
MP3 player such as an iPod	o	o
Digital camera	o	o
Smart phone or cell phone	o	o
External hard drive NOT flash drive	o	o
Video game system	o	o

Is there high speed Internet access in your home?

- o Yes
- o No

How many hours do you spend playing video games or computer games each day?

- o hour
- o 1-2 hours
- o 2-3 hours
- o 3-4 hours
- o 4 hours or more

In the past six months have you

	Daily	Frequently	Occasionally	Never
Sent a text message	o	o	o	o
Communicated with people by email	o	o	o	o
Used Twitter to READ tweets	o	o	o	o
Used Facebook to POST messages or photos	o	o	o	o
Used Facebook to READ messages or photos	o	o	o	o
Used LinkedIN	o	o	o	o
Logged on to Ning Site	o	o	o	o
Logged on to an EdModo Site	o	o	o	o
Created a blog	o	o	o	o
Took pictures with a cell phone or smart phone	o	o	o	o
Created a website	o	o	o	o
Used a flip cam	o	o	o	o

Downloaded an app to a cell phone or computer tablet	o	o	o	o
Been part of a Skype call	o	o	o	o
Used computer programming software such as Scratch or Game Maker	o	o	o	o
Used the Internet for homework or class assignment	o	o	o	o

Morgan –Jinks Student Self-Efficacy Scale (Adapted)

The following best describes how you feel about math:

	Always like me	Usually like me	Sometimes like me	Never like me
I always try my best in math class.	o	o	o	o
I enjoy taking math class.	o	o	o	o
I would like to learn more about math in college.	o	o	o	o
My teachers think I do NOT understand math very well.	o	o	o	o
I am NOT good at math.	o	o	o	o
I believe that what I learn in math class is	o	o	o	o

useful in the real world.				
I get good grades in math.	o	o	o	o
I am good at solving math problems.	o	o	o	o
I do NOT like going to math class.	o	o	o	o
I usually give up when solving a math problem.	o	o	o	o
I feel confused during math class.	o	o	o	o
When I am older, I want a job that does NOT use math.	o	o	o	o
It is easy for me to pay attention in math class.	o	o	o	o

Morgan –Jinks Student Self-Efficacy Scale (Adapted)

The following best describes how you feel about science:

	Always like me	Usually like me	Sometimes like me	Never like me
I understand mostly everything in science class.	o	o	o	o
I believe that what I learn in science classes is useful in the real world.	o	o	o	o

It is easy for met to answer questions in science class.	o	o	o	o
I wish I did NOT have to take science classes in school.	o	o	o	o
My teachers would say that I am good at science.	o	o	o	o
I think that learning about science is fun.	o	o	o	o
I do NOT get good grades in science.	o	o	o	o
I do NOT like going to science class.	o	o	o	o
I enjoy learning about a new theory in science class.	o	o	o	o
I feel confused during science class.	o	o	o	o
I would like to go to college to learn more about science.	o	o	o	o
I enjoy taking science classes.	o	o	o	o
It is difficult for me to pay attention in science class.	o	o	o	o
I always try my best in science class.	o	o	o	o

Morgan –Jinks Student Self-Efficacy Scale (Adapted)

The following best describes how you feel about computers and technology:

	Always like me	Usually like me	Sometimes like me	Never like me
I enjoy computer games and/or video games.	o	o	o	o
I can explain how to use a computer to someone who needs help.	o	o	o	o
I would like to learn more about technology in college.	o	o	o	o
I think you need to know how to use technology to get a good job.	o	o	o	o
I do NOT do well when I have to use a computer for a class assignment.	o	o	o	o
Technology is difficult for me to learn and use.	o	o	o	o
I wish I knew more about computers and technology.	o	o	o	o
I feel nervous when I have to use a computer.	o	o	o	o

I do NOT think learning technology is useful.	o	o	o	o
I wish we used computers more in my classes at school.	o	o	o	o
I know a lot about technology and using a computer.	o	o	o	o
I am good at playing video games.	o	o	o	o
I have experience with robotics.	o	o	o	o

How much of the job possibilities listed interest you?

	It interests me a lot	It is a possibility	It interests me just a little	It does not interest me	I do not know what this job is
Architect	o	o	o	o	o
Biologist	o	o	o	o	o
Chemist	o	o	o	o	o
Computer Programmer	o	o	o	o	o
Engineer	o	o	o	o	o
Environmental Scientist	o	o	o	o	o
Game Designer	o	o	o	o	o
Mathematician	o	o	o	o	o
Medical Professional (ex. doctor, nurse)	o	o	o	o	o
Physicist	o	o	o	o	o
Software	o	o	o	o	o

Developer					
Technology Specialist	o	o	o	o	o
Web Developer	o	o	o	o	o

If the jobs you are interested in were not listed, please write them here.

____

In math class I usually earn

- o A+, A, A-
- o B+, B, B-
- o C+, C, C-
- o D+, D
- o F

In science class I usually earn

- o A+, A, A-
- o B+, B, B-
- o C+, C, C-
- o D+, D
- o F

- o **My overall GPA is approximately**

- o A+, A, A-
- o B+, B, B-
- o C+, C, C-
- o D+, D
- o F

What do you hope to learn from participating in this program?

____

What is your name?

____

APPENDIX B

Student Interview Protocol

<u>Game Design @ Mason</u>

1. Tell me what interested you about Game Design @ Mason?
2. When you come to Game Design @ Mason, what makes you feel most comfortable? (Why or Why not?)
   a. What parts of the program do you like most? (Why or Why not?)
   b. What parts of the program do you like least? (Why or Why not?)

<u>School environment</u>

3. What do you and your friends do when you get together?
4. Do your friends know that you are a part of Game Design @ Mason? (Why or Why not?)
5. Describe how most of your friends do in math.
6. What do your friends say about math?
   a. What do they say about those that do well?
   b. How do you think your friends would describe you in math?
7. Do you feel free to be yourself in school? (Why or Why not?)
8. What is your school environment like? (Why or Why not?)

<u>Mathematics experiences and self-efficacy</u>

9. Tell me about yourself as a math student.
   a. What sort of work habits do you have in math?
   b. Have you ever been recognized for your ability in math?
   c. If you were asked to rate your ability in math on a scale of 1 (lowest) to 10 (highest), where would you be? Why?
   d. Do your friends know that you are good at math? (Why or Why not?)
   e. Do your classmates know that you are good at math? (Why or Why not?)

10. What do you like to do related to math outside of school?
11. What sorts of things do your teachers tell you about your performance in math?
12. Describe the best teacher you’ve had in math. What made her (or him) so good?

13. Under what conditions do you perform well in math? Under what conditions do you perform less well? Why?

Mathematics and others

14. What do members of your family do that involves math?

    a. What do your parents tell you about math?
    b. What would your parents tell your teachers about you as a math student?

15. Do you think the people you admire would be good at math? Why?

Affective and physiological response to mathematics

16. I want to ask you to think about how math makes you feel. You probably haven't been asked to think about that before. When you are given a math test, how does that make you feel? How do you feel when you are given a math assignment?

Sources of self-efficacy in mathematics

17. Earlier you rated your math ability on a scale of 1 to 10. How would you rate your *confidence?* Why? What could make you feel more confident about yourself in math?