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Critically Reading a Middle School STEM Project through a Gender Lens

Stacia M Stribling, Sheri Berkeley, Leigh Ann Kurz, Amanda Colburn

George Mason University, USA

ABSTRACT
This study is situated within a larger research project that looked at the self-regulation cycle of middle school students who were taught to create their own serious educational games about science. The purpose of the current analysis was to use a gender lens to "critically read" a theme that emerged during the larger science, technology, engineering, and mathematics (STEM) project. Using a critical literacy framework enabled the researchers to better understand the structures that have complicated female participation in the science field, and specifically in the world of gaming as an access point into the science field. Taken together, findings showed a reluctance on the part of the students to engage in conversation related to sociopolitical issues. Specifically, students were reluctant to disrupt the commonplace stereotypes and assumptions that were woven into the alpha gaming platform developed by a gaming company for the larger study. Implications from these findings suggest that creating an inclusive environment in STEM is complex due to a host of messages, images, experiences, and barriers with which females (and males) must contend. Schools can provide the space to begin addressing these issues in order to move the field toward gender inclusivity. The current findings have similar implications for other populations that are under-represented in STEM fields, including persons with disabilities

KEYWORDS

STEM; secondary education; special education; gender

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Consider this old riddle: *A father and son are traveling home from soccer practice when they are in a terrible car accident. The father is killed instantly, and the boy is rushed to the hospital. It is determined that he needs surgery immediately, but upon seeing the boy the surgeon proclaims, "I cannot operate on him. He is my son!" Who is the surgeon?*

Even today this riddle manages to stump many. Research conducted with 197 Boston University Psychology students, and 103 children between the ages of 7 – 17 years old revealed that the majority of respondents are more likely to develop elaborate explanations - the boy had two fathers, the boy was adopted and the surgeon was his biological father, or the father was not really dead – rather than consider that the surgeon was the boy's mother (Wapman, 2014). While some have argued that the riddle uses linguistic priming to throw people off with the use of male characters and pronouns, there are numerous other research studies that illustrate gender bias is alive and well. For example, Moss-Racusin, Dovidio, Brescoll, Graham, and Handelsman (2012) conducted a randomized double-blind study where faculty from research-intensive universities were asked to rate applicants for a lab manager position. The application materials assigned to each participant were identical except for the name/gender. Results indicate that faculty participants (regardless of their gender) showed gender bias, rating the male applicants as more competent than the female applicants, suggesting a higher starting salary for the male applicants, and offering more mentoring opportunities to the male applicants.

For decades, critical theorists have brought gender and other biases to our attention, studied the root causes and the implications of these biases, and fought to work with communities to take action toward more equitable opportunities for all. Paulo Freire's (1970) work is a cornerstone of critical theory and provides a framework for understanding those oppressed by bias and inequities. Freire worked with the peasants of Brazil as they read their "world" and used literacy to change it. Perhaps the most challenging aspect of critical theory is for people to recognize their oppression; this is complicated by what Gramsci (1971) calls hegemony – the domination of one group over another with the partial consent of the dominated group. In other words, dominant ideologies are so powerful that the people who are oppressed by those ideologies buy into the beliefs and values that ultimately strip them of voice and power. The dominant ideology that boys are better at math and science or that men are surgeons and women are nurses has greatly impacted the expectations we have for different people and the ways in which people view themselves and make decisions about who they will become. Critical theory calls for the recognition and critique of this hegemony in ways that give voice to those from non-dominant groups and cultures and that provide equitable opportunities for all.

More recent influences on critical theory have included Giroux (1988) and McLaren (2003). McLaren (2003) advocates for educational practices that work to disrupt systems of oppression represented in practices such as racism, capitalism, sexism, linguicism, and classism. He and Lankshear (1993) state that "*critical* reflection is consciously guided by the intention to change understanding of the world and, in the same process, to change that very world we inhabit and are trying to understand" (p. 38). Giroux (1988) promotes this idea of changing the world through the process of coming to understand the world when he talks of applying Paulo Freire's work to schools and classrooms in the United States. He argues that school curricula and structures are not neutral, but rather are purposefully organized in ways that privilege the knowledge, beliefs, and values associated with dominant ideologies. It is only through what he terms "critical literacy" that students can address the unexamined assumptions that shape school experiences, which potentially impact the ways in which female students engage in male dominated disciplines such as science. Critical literacy requires reading the word (decoding/encoding words and make meaning of those words) and reading the world (decoding/encoding people, communities, and the visible and invisible messages embedded in texts and experiences) (Freire, 1970; Wink, 2005). Critical literacy is not "a piece of knowledge," but is rather "a culture of thinking" that engages one in observing her/his world in ways that consider issues of equity and access (Hadjioannou & Fu, 2007).

According to Janks (2000) critical literacy practices should be enacted in classroom settings and need to consider the intersection and interdependence of four main issues: domination, access, diversity, and design. Similarly Lewison, Flint, & Van Sluys' (2002) synthesis identified four dimensions of critical literacy: "1) disrupting the commonplace, 2) interrogating multiple viewpoints, 3) focusing on sociopolitical issues, and 4) taking action and promoting social justice" (p. 382). In addition, Luke and Freebody (1997) note "*critical literacy* has come to refer to such a wide range of educational philosophies and curriculum interventions," but contend that at the core, all of these philosophies and interventions are "committed to engaging with the possibilities that the technologies of writing and other modes of inscription offer for social change, cultural diversity, economic equity, and political enfranchisement" (p. 1). These critical literacy practices can spark conversations about stereotypes and inequities that directly impact students (e.g., Lalik & Oliver, 2007; Leland et al., 2005; Vasquez, 2004). While these researchers are referring to practices that classroom teachers can incorporate into their instruction, critical literacy can also be a valuable lens for educational researchers to use when interpreting data. That being said, the purpose of this study was to critically "read" a middle school science, technology, engineering, and mathematics (STEM) project through the lens of gender; in other words, giving voice to female students in the male-dominated science and gaming fields.

The Role of Gender in STEM

Over the last three decades, there has been an increase in the proportion of women in biology and chemistry, little to no growth in the proportion of women in physics, engineering, and math, and a marked decrease of women in computer science (Cheryan, Ziegler, Montoya, & Jiang, 2017). This issue of underrepresentation in

most STEM fields in the United States has been of growing interest for educators, psychologists, sociologists, and scientists for over 20 years, as they have attempted to encourage females to participate more in the sciences in school through various programs and projects (Blickenstaff, 2005). Research suggests that the gender gap in STEM is less about ability and more about individual and global perceptions (Tyler-Wood, Ellison, Lim, & Periathiruvadi, 2012). For example, Blickenstaff (2005) reviewed the literature to explore why females do not pursue or ultimately leave science careers and posited the following explanations:

- girls' lack of positive science experiences
- girls' poor attitudes toward science
- girls' possible feelings that science curriculum is irrelevant
- science pedagogy that favors males
- a global view that science favors men
- cultural pressure on females to conform to traditional gender roles.

These explanations are often rooted in more complex social phenomenon such as gender bias (e.g., Moss-Racusin et al., 2012; Williams, Phillips, & Hall, 2014), gender schemas (Bem, 1981), and stereotype threat (Spencer, Steele, & Quinn, 1999; Steele & Aronson, 1995). One can probably think of examples of females who do not fit within the above explanations – in other words, females who enjoy science and see its relevance, challenging traditional gender roles by working in the science field; however, these cases often stand out as exceptions. The reality is that, "although women fill close to half of all jobs in the U.S. economy, they hold less than 25 percent of STEM jobs" (Beede, Julian, Langdon, McKittrick, Kahn, & Doms, 2011, p. 1). The larger narrative that expects males to be more capable in the sciences trickles down to influence the ways in which teachers design curriculum and the expectations they set for certain students, which ultimately influences how females feel about the relevance of and their competence in science. Seron, Silbey, Cech, and Rubineau (2016) found, however, that curriculum design is not the only aspect of the field that potentially marginalizes females. In their longitudinal study of female engineering students, Seron et al. (2016) concluded that several rituals of professional socialization, including group projects and internships, "compromise[d] women's confidence and commitment to pursue a career in engineering" (p. 208). The females were often cast in supporting roles on projects and experienced gender stereotypical treatment in the workplace. These stereotypes and biases are internalized by both males and females adding peer group dynamics as another influence in females' success, or lack thereof, in STEM fields (Leaper, 2015).

The Sociopolitical World of Gaming

Given the larger social practices that prove to challenge gender inclusion, there are still aspects of pedagogy in the math and sciences that warrant further examination, including the use of gaming as a meaningfully engaging medium for learning (Mayer, 2014; Squire, 2011). While 97% of children engage in some form of gaming, Lenhart, Kahne, Middaugh, MacGill, Evans, and Vitak (2008) found that boys tend to play more often and for longer periods of time than girls. The question, therefore, is if this approach further privileges males or whether it can be

used as a powerful access point for females. Research into the efficacy of educational gaming reveals mixed results; some studies conclude that gaming has a significant impact on learning (e.g., Wouters, van Nimwegen, von Oostendorp, & van der Spek, 2013), while others claim that it does not necessarily deliver the benefits promised (e.g., Young et al., 2012). Klopfer, Osterweil, and Salen (2009) argue that the difference lies in the extent to which the game engages the learner, resulting in debate over the use of commercial versus educational video games. However, Kafai and Burke (2015) contend that the type of game is less important than the structure of the gaming experience, citing constructionist approaches where students design the games as most beneficial to learning and development.

Research on the intersection between gaming and gender began with a concern for the lack of females in the field (Cassell & Jenkins, 1998); however, much of the early research was couched within a marketing perspective and focused more on who was playing what. Jensen and de Castell (2010) suggest that this direction in research has served to create and reinforce stereotyping of what girls want, prefer, and like in terms of gaming opportunities, while ignoring "more nuanced accounts of *femininzed male play* or *masculinized female play*" (p. 63). In fact, Jenkins and Cassell (2008) found that females prefer games that are focused on exploration, are situated in real world settings, rely on social relationships to advance, and are centered on a story with relatable characters. Furthermore, De Jean, Upitis, Koch, and Young (1999) found, in a study of the Phoenix Quest math computer game, that girls had a strong preference for female game characters. Unfortunately, Douglas, Dragiewicz, Manzano, and McMullin (2002) discovered that in top selling video games, only 16 percent of the game characters were female. The lack of female characters coupled with their common portrayal as bystanders as opposed to active participants or as scantily-clad, unnaturally proportioned objects (Burgess, Stermer, & Burgess, 2007) raises many questions as to the growth made toward gender equality and the possible implications this has on young children including their ultimate participation in male-dominated fields.

Some research supports the argument that rather than marginalizing females, computer games have the power to engage them in learning (Gee & Hayes, 2010;2011). In their study of The Sims online game, Gee and Hayes (2010) discovered that the on-line platform provided a space for women to learn and grow as tinkerers, leaders, and programmers as they engaged in social engineering. They argue that this "soft modding" is a vital aspect of design alongside technical modding – a practice more common with male gamers. The Sims does offer what Gee and Hayes (2011) identify as the features of a nurturing affinity space; an affinity space being a community of practice (face-to-face or virtual) where the organization of the space and the organization of the people in the space interact in ways that are good for learning and growth. The features they identify include aspects such as a common endeavor centered around passion rather than around identity (e.g. race, class, gender, etc.), the ability to produce and not just consume, the transformation of content through interaction, and fluid understandings and respect for tacit and explicit knowledge, leadership roles, and feedback loops (Gee & Hayes, 2011). Of course, online affinity groups might tend toward these effective features because the identity of the gamer is not always (or does not have to be)

apparent. What might this mean for students sitting in a classroom and designing a game alongside peers? How does ones' gender influence engagement and production in a space that is not organized necessarily by passions and might not fit the definition of Gee and Hayes' nurturing affinity space?

The Current Investigation

This study is situated within a larger research project that took place in a suburban U.S. middle school with students who were 11-13 years old. The purpose of the larger project was to investigate the self-regulation cycle of students identified with learning disabilities as they engaged in science learning through the development of a serious educational game (SEG). The larger study used a multiple case study design (Yin, 2014) and included a total of 11 students who qualified for disability services under the Individuals with Disabilities Education Act (2003) for a specific learning disability in the area of reading, writing, and/or language according to school district eligibility criteria (i.e., participants displayed average to above average intelligence, but they underperformed academically compared to grade level peers). Of the 11 participants, there were four sixth-graders (three female, one male), four seventh-graders (two female, two male), and three eighth-graders (all female).

The larger study consisted of three phases. In Phase One, which lasted approximately three weeks, students were explicitly instructed in two science concepts pertaining to renewable energy sources (i.e., solar energy and wind energy) and were provided with interactive science binders to use as a reference throughout the study. In Phase Two, which lasted approximately five weeks, students were taught how to plan an SEG using storyboarding materials to map out the different events, scenes, characters, and questions for each event within their game. Qualitative self-regulation interviews started during Phase Two to capture the students' goal setting and reflection. In Phase Three, which lasted approximately five weeks, students moved to the computers to begin building their SEG. Students used self-evaluation to assess progress within the game and then were interviewed upon completion of their game. Each student designed and created their own individual game, though they engaged in discussions with each other throughout the process.

While many types of data were collected for the larger study, including qualitative self-regulation interviews and science learning measures, this particular investigation focused mainly on observations of and interviews with the students as well as student work samples. Student work sessions were video-taped and coded to capture interactions with the researchers/instructor and among students in the instructional group.

As members of a research team whose primary purpose was to investigate self-regulated learning in a project-based learning environment using SEGs with middle school students identified with learning disabilities, we were simultaneously interested in how this project might contribute to supporting female interest in STEM fields. Therefore, we decided to take the data we had collected on self-regulation and science learning to explore the question: How is gender enacted in a

middle school STEM project? While the project attracted many female participants, we were interested in digging deeper to better understand the structures and strategies that supported and/or inhibited the connections females might make to STEM fields. Using a critical literacy framework enabled the researchers to better understand the structures that have complicated female participation in the science field, and specifically in the world of gaming as an access point into the science field.

METHODS

Participants

There were three grades of students: sixth, seventh, and eighth. The sixth and eighth grades each had one class section participating, while the seventh grade had two class sections participating. As a result of requirement for inclusion in the project, each student had been identified as having a language based learning disability.

Sixth grade. The sixth-grade group included Cathy, Carson, Nancy, Evan, and Willa (pseudonyms); it was the largest and most social class, which engaged with the sociopolitical aspects of the game experience more frequently than the other three groups. This is perhaps due in part to the developmental stage of sixth grade students, and compounded by the fact that this was the largest and most diverse group in terms of gender and race/ethnicity. Two of the girls, Nancy and Willa, were African American, while the third girl, Cathy, was white. Carson was an Asian-American male, while Evan was a white male.

Seventh grade. Seventh grade had two groups participating in the project. The first seventh grade group included Maureen, Corbin, and Daniel; Maureen was a white female, Corbin was a white male, and Daniel was an African-American male. This group was quieter overall, and focused more singularly on the technical aspects of their game experience, as opposed to the sociopolitical underpinnings inherent to science, gaming, and technology. The second seventh grade group was unique in that it was an all-female group that included Rachel and Rebecca, both of whom were white. Both girls were rather quiet and reserved. They did not offer up critiques on their own, and were not always comfortable engaging in discussions about gender stereotypes.

Eighth grade. The single eighth grade group was also an all-female group that included Tina, who was African American, and Melanie and Michelle, who were both white. For the purposes of this analysis, however, the eighth grade group will not be included, as this group did not participate in the class session dealing with the game characters and gender due to scheduling conflicts.

Research team. Given the focus of our inquiry, we, as researchers, are also considered participants of sorts. We each brought our gendered selves to the development of the questions asked, the interpretation of the data collected, and the conclusions drawn from our collaborative analysis. The research team consisted of three faculty members, all of whom work in educational research at a university, and who were assisted by several graduate research assistants working

as data collectors. Two faculty researchers were white females and one was a white male. While all three researchers worked with the students throughout the different phases of the project, they each brought different interaction styles and pedagogical backgrounds to the work. As the primary investigator on the project, one of the female researchers has a background in special education and brought a behaviorist lens to the work. The other female researcher's background is in qualitative research with a critical lens. She engaged in the majority of the gender discussions with the students. The male researcher specializes in science education and the ways in which students construct science and gaming knowledge.

The SEG

As mentioned above, the larger study included three phases – science instruction on reusable energy sources, planning the development of an SEG, and building an SEG. The goal was for the students to use the knowledge they gained in Phase One regarding reusable energy to build a computer game that could teach peers who might later play the game and learn about these energy sources. Students, therefore, were not engaging in game play in order to gain new knowledge, but rather were engaging in "mini-game" design (Prensky, 2008) in order to demonstrate their knowledge through a unique medium and to gain new skills related to planning, organizing, and executing a game playing experience for others. In order for this to be a feasible task, a gaming company was hired to develop a gaming platform that the students could manipulate in order to develop a storyline that would lead players through a serious of tasks or missions through which they would learn information about renewable energy.

When the gaming company completed the platform on which students were to build their science games, there were a total of 10 male characters, three female characters, and three androgynous characters (see Table 1). However, this was only after the game platform developers were prompted by the female researchers to create female characters as the first version of the gaming platform did not contain any female characters at all. When the female characters were finally added, they were in short supply and were given the following character names: "Archer Girl," "Teacher Tess," and "Girlie Girl." This is in stark contrast to the many available male characters who were identified in the game as ninjas, police officers, and explorers, just to name a few. Some characters were technically androgynous, such as the "Astronaut" and "Robot"; however, these characters clearly appeared to be the stock male character, just with the face covered by the character's gear. When approached, the game designers, all male, seemed surprised that there would be an issue with the characters they created.

Table 1
Pictorial Representation of Characters by Gender

Genre	Male		Female	Androgynous
Student				
Professional				
Fantasy*				

**Even though the faces of two of the characters were covered, they were classified as male because students perceived them to be male.*

Data Sources and Analysis

Audio-recorded interviews and video-recorded class discussions were reviewed in conjunction with student work and the researchers' field notes. We used Lewison, Leland, and Harste's (2008) critical literacy framework to analyze the interactions between instructors and students, students and students, and students and content. As researchers, we took a "critical stance" by "consciously engaging," "entertaining alternate ways of being," "taking responsibility to inquire," and "being reflexive" as we viewed the data through the lens of gender (Lewison et al., 2008, p. 13). This critical stance allowed us to explore tensions, to examine the relationships between literacy and power, and to reflect on the ways in which aspects of the project helped maintain and/or challenge the status quo. We looked specifically for evidence within the project of critical social practices: (a) disrupting the commonplace, (b) considering multiple perspectives, (c) focusing on sociopolitical issues, and (d) taking action (Lewison, Flint, & Van Sluys, 2002; Lewison et al., 2008).

Two student research assistants reviewed the observational notes and videos to identify episodes related to gender issues for further transcription and analysis. The assistants looked not only for specific conversations where gender emerged as an explicit topic, but also for more subtle interactions where gender roles were either reinforced or challenged. Data analysis focused only on these specific episodes; they were presented to the larger research team who analyzed them through the lens of critical literacy. The study of classroom discourse through analysis of specific classroom episodes is a well-established approach in the field of critical literacy (see for example Fisher, 2008; Souto-Manning, 2009; Van Sluys, Lewison, & Flint, 2006). There were six significant episodes that were identified through this process. Three of them were the conversations the sixth-grade and two seventh-grade groups had with the researcher about the gaming platform. The other three were the conversations that each of those groups had with the gaming company regarding critiques and suggestions for the gaming platform. Rich conversations among the researchers regarding the extent to which each episode represented the use of critical social practices brought multiple perspectives rooted in our own identities (e.g., male/female, professor/student, critical theory/gender theory, special education theory/general education, social science/natural science) to the reading of the data and strengthened the analysis.

RESULTS

The analysis showed that while gender was not an explicit focus of the original study, there was much to learn from viewing the data through a gender lens. The episodes identified where gender was a specific focus of conversations among students and between students and researchers included elements of examining assumptions and questioning the status quo, but mostly reinforcing the status quo. The strongest themes that emerged were related to the overt examination of the character options in the gaming platform and included the avoidance of sociopolitical issues and the reinforcing of gender stereotypes.

Avoidance of the Sociopolitical

Data analysis revealed that most students seemed unaware of female stereotypes and appeared to resist focusing on sociopolitical issues. There were multiple opportunities for the students to provide feedback to the gaming company. On one particular day in April, the issue of female characters in the game emerged with the sixth and seventh grade groups. While one of the researchers facilitated the conversation and noted some concern on the part of the students with the female character choices, the students in the sixth grade group appeared to divert the conversation away from sociopolitical issues (see Table 2).

Table 2

Depiction of Primary Discussion Points by Grade Level

Gender by Grade	Discussion of Game Characters	Key Terms
Sixth Grade Female: 3 Male: 2	The female students acknowledged lack of female characters, but request a stereotypical "princess" in addition to more attractive female characters when asked. One male student, Evan, found no issue with the available characters, while Carson suggested that female characters might be included since they might "be lost" and need help in the game, further reinforcing archetypal female characteristics within an adventure setting.	• Stereotypical female characterization • Male hegemony
Seventh Grade (1) Female: 1 Male: 2	Male and female students were interested in the alignment of characters to available scenery and storylines, but not interested in engaging in the sociopolitical discussion of gendered characters. Daniel even assumed there must have been a female farmer character since there was a farm setting available, highlighting this group's apparent lack of awareness or concern with gendered characters.	• Character alignment • Game scenery • Storylines
Seventh Grade (2) Female: 2 Male: 0	The two girls present that day engaged with the researcher in discussing the concept of a "Girlie Girl," and defined her as stereotypically female. They did not raise any other concerns related to the game and its characters. Instead, Rachel and Rebecca maintain a tone of levity in their discussion and prefer to divert the conversation away from sociopolitical issues.	• Girlie Girl • Tomboy • Dominant ideologies

Below is an excerpt from a conversation with this sixth grade group of two boys who had been on the gaming platform and three girls who were still in the planning stage:

> **Nancy:** Well, I was wondering if there are girl characters yet?
> **Researcher:** Are there girl characters? Did you guys find any?
> **Group:** Yeah…
> **Researcher:** What did you think of them?
> **Carson:** They're okay.
> *(Laughter.)*
> **Researcher:** They're okay? Say more about that, Carson. Do you remember what they were?
> **Carson:** Not really. (*Shakes his head "no."*)
> **Evan:** I think that I found some castle walls, and I think they should have some already built kingdoms and stuff.
> *(Muttering under Evan's comment.)*
> **Nancy:** Girls are better than boys.
> **Cathy:** They need a princess.
> **Researcher:** They need a princess?
> **Nancy:** If there's going to be a castle, there's gotta be a princess…or a dragon.
> *(Chatter about characters.)*
> **Researcher:** Do you guys remember how many girl characters there were?
> **Cathy:** Three.
> *(The group continues to discuss the girl character choices.)*
> **Evan:** There's either a glitch in my computer or a glitch in the game like where you place certain stuff down and you can't delete it up again. You have to start all over again.

There are several aspects of this conversation that are intriguing. For one, whenever the conversation moves in the direction of discussing the girl characters, Evan interrupts with comments or observations unrelated to the issue of gender – wanting already built kingdoms and struggling with his inability to delete objects from the game. We are not suggesting that Evan was necessarily doing this on purpose; however, it is interesting the power he had to divert the conversation. It is also interesting that the girls were requesting a stereotypical female character, a princess, while seemingly ignoring the "Archer Girl" as a possible companion character to the other medieval-themed, male characters that were already available. While we did not discuss in depth their conceptions of the proposed princess character, on the surface, it stood in stark contrast to the existing male characters that were doctors, police officers, ninjas, and explorers.

The researcher later brought the conversation back to the issue of female characters, asking the students what a "Girlie Girl" was. Students responded with the following descriptions: "*make-up*," "*very feminine*," "*dresses,*" and "*pink*." Nancy indicated that she would not use that character because her game took place on a farm; she wanted to use a farm girl, even though no such character existed in the gaming platform. Evan commented that he "*put her in the game but deleted*

her." Carson offered a possible role she could play in the game: "*Maybe the girl probably needs help to find something. So you could have her out there to do questions*." When asked if there might be boys that need help, Cathy diverted the conversation by asking about the robot character. A discussion ensued about the "gender neutral" characters in the game – bears, robots, aliens – though it is not clear if any of the students actually attributed a gender to any of these characters.

The seventh grade groups were even more reluctant to engage in a discussion about the female characters. In the first seventh grade group, the class that preferred to focus on the technical aspects of their game project, the conversation was quite short and quickly shifted into a discussion of the functionality of the game:

> **Researcher:** Did you see any girl characters?
> **Corbin:** That wouldn't be bad.
> **Researcher:** An archer girl.
> **Daniel:** A farmer girl?
> **Maureen:** Could make a girl clerk and a boy clerk.
> **Researcher:** How many girl characters were there? Do you remember?
> **Daniel:** Three. There were three.
> **Researcher:** Do you remember (what they were)?
> *(Students cannot remember the girl characters. Daniel guesses farmer.)*
> **Research:** No, there wasn't a farmer girl. There was an archer. Do you remember an archer?
> **Daniel:** Nope *(Others shake heads, "no.")*
> **Researcher:** One was a girlie-girl. What does that mean?
> **Corbin:** I have no idea! *(Emphatic.)*
> **Maureen:** I dunno…could they add an electrician or something? Like if Daniel was saying that the power goes out [in the game]?

Given the conversation that emerged earlier with the sixth grade group, the researcher tries hard to engage this seventh grade group in a similar discussion. She inquires about the girl characters, asking about the number of characters and the type of characters. While Daniel remembers that there were only three girl characters, the group struggles to remember what they were. Because so much of the scenery available in the game platform included farming, there was an assumption that there was a farmer girl. The researcher probes specifically about the character girlie-girl; Corbin is emphatic in his response that he has no idea what this is. At this point, the only girl in the group, Maureen, chimes in. She does not take up the critique of the existing characters, but rather requests the addition of a character that would better technical fit for the possible storylines – an electrician. It is not clear if she views this character as being male or female, only that she sees it as a narrative fit.

Reinforcing of Gender Stereotype

In the following class session, when the sixth graders met with the men from the gaming company, the researcher prompted the students to share their thoughts about the characters. Here is what they said:

Cathy: We need more girl characters!
Nancy: And make them better looking than the boys.
(Another researcher asks them to be specific about the girl characters they want.)
Cathy: A cowgirl.
(Carson brings up matching scenery with character possibilities.)
Evan: I didn't have a problem with the characters….the girl characters look a little bit more bright than the boy characters.
(Game rep. says this is true, asks if they want them all the same style or with variety.)
Nancy: I like variety.
Evan: Some of the characters' faces look kind of slanted. I don't know if that's a glitch or…just how they look?
(Game rep. describes this as "stylized" characters.)
(Carson raises hand and asks about adding old people to his game.)

While the conversation began with a call for more girl characters, there was no specific feedback regarding what was problematic about the existing girl characters. Nancy's request to make them better looking than the boys does more to reinforce gender stereotypes rather than to critique the choices they were given so far. Society's expectation that females be attractive, above all else, is echoed in Nancy's comment and is not challenged by anyone in the group. When asked about specific characters they would like to see, Cathy's comment about a cowgirl quickly moves the group to expand on their observation that the characters do not fit the scenery they have available to them in the gaming platform. Interestingly, but not necessarily surprising, Evan shares his satisfaction with the characters. However, he then critiques the fact that the girl characters look a "*bit more bright*" than the boy characters. It's not clear whether he is referring to the colors they are wearing (lighter shades vs. darker shades) or to skin tone (many of the male characters have their heads covered with masks, sunglasses, hats, etc.). Either way, the gaming representatives do not ask for clarification and instead launched into comments about the different character styles used in the gaming industry. Evan's final comment more clearly raises issues of race with "*slanted*" faces. He chalks this up to a "*glitch*" in the system, and the issue of stereotypes is once again side-stepped.

The seventh grade group, which was composed of all girls, was equally reluctant to engage in a conversation about the girl characters, and when probed articulated clear gender stereotypes:

Researcher: Were you guys asking for girls, too?
(Rachel shakes her head "yes.")
Researcher: What is a girlie-girl?
Rebecca: Just…girlie! I dunno!
Researcher: What does it mean to be girlie?
Rebecca: I don't know how to explain it. They're just girlie.
Researcher: They're like…

Rebecca: They're not really tomboy-ish, they're like into fashion or hair or something like that.
Researcher: Is there an equivalent though, for boys? A boy-y-boy?
Rebecca: No, that's just boy.
Researcher: Does that make sense to you guys?
(Rachel shakes head "no" and Rebecca shrugs her shoulders.)
Researcher: What do you guys think of this? What do you notice about these characters? *(Showing and listing characters aloud, states the three girl characters last.)*
Rebecca: They all have big heads *(laughter)*…and tiny bodies.
Rachel: They look like there are a lot of elves…

Rebecca appears to have a sense of what a "girlie-girl" is, but struggles to articulate this. It is not clear if she doesn't have the words to describe a "girlie-girl" or if she just expects the researcher to already know this as a fellow female. When she does finally describe this character, she states what it is not – "tomboy-ish." She positions this character in opposition to a "boy" and highlights stereotypical female behaviors such as concern with fashion and hair. Neither girl seems bothered by the fact that there is no equivalent term for boys. As Rebecca states, "No, that's just boy." Her response illustrates the power of dominant and non-dominant identities. It is also striking in this example that the researcher uses the term "guys" when referring to the two seventh grade girls, as in, "Does this make sense to you guys?" and "What do you guys think of this?" Upon reflection, it can be challenging to ask young girls to critique gender stereotypes using language that strips them of their own gender identities. The researcher's language is certainly worthy of critique as well.

DISCUSSION

Taken together, all of these episodes indicate reluctance on the part of the students to engage in discussions about sociopolitical issues and to disrupt the commonplace stereotypes and assumptions that were woven into the gaming platform. There are many possible reasons for this reluctance:

(a) the students had developed a limited relationship with the researchers and did not feel comfortable expressing their thoughts,
(b) the students were not used to reading the world and critiquing it through a gender lens,
(c) the students had bought into the dominant ideologies and did not feel the need to critique.

The fact that the students were even more reluctant to share these conversations with the gaming company could be attributed to the fact that the representatives were all male.

From the very beginning, the researchers were concerned that female characters were notably absent from the platform. Even then, the characters that were created did not represent the range of possibilities evident in the male character choices and, in fact, were wrought with gender stereotypes. Our experiences are consistent with the challenges that other researchers have identified for females related to game design. Just as the fish is the last one to discover water, the industry

struggles to recognize the sociopolitical waters in which it swims. The tentacles of STEM fields stretch not only into gaming, but also into education, job recruitment, science labs, and more. In order for the STEM fields to become more gender inclusive, it is necessary to acknowledge the sociopolitical underpinnings of the messages sent that marginalize females.

It was evident in the data that hegemony was influential, particularly in the game development, and that the majority of students did not necessarily take issue with the female stereotypes presented to them. Furthermore, students were not necessarily comfortable engaging in dialogue regarding the disparity between male and female characters in the science game. This critique, however, is critical if we hope to truly engage in ways to make STEM a more inclusive field.

Implications for Classroom Practice

It was not until after the fact that we, as researchers looking into the self-regulation cycle of students with learning disabilities, thought to go back through the data to view it through the lens of gender. We were inspired to do so because we recognized the challenges we faced with the gaming company in order to create a platform to which the students could relate and connect. In the midst of studying self-regulation, we found ourselves donning our "teacher hats" to engage the students in discussions around the game characters – essentially inviting them to engage in sociopolitical issues. Capitalizing on these "teachable moments" is perhaps the most important lesson to be learned from our reflective study. Changing the field just might necessarily depend on educating our students to be critical consumers and challengers of stereotypes.

Acknowledging sociopolitical issues necessarily leads to challenging stereotypes. This is particularly important in classrooms where teachers have the opportunity to set the stage for STEM learning by asking questions such as: What knowledge is privileged in my classroom? Who is benefiting from my instruction? Whose voice am I hearing? Whose voice is silent/silenced? How can I include the voices, knowledge and experiences of all of my students? Teaching, therefore, becomes more than just developing strategies for instruction; it becomes a process of critically questioning the teaching and learning cycle while building effective relationships with students that are grounded in real experiences and needs. Teachers can use this reflection process to identify the underlying messages inherent in instructional practices and to re-envision a curriculum that encourages critique. The fundamental goal is "to promote a more genuinely equitable society – a society that more closely resembles the promise of democratic rhetoric, equal opportunity to all" (Hinchey, 2004, p. 14). Ultimately, this critical reflective process (Brookfield, 1995) is an essential element of a critical literacy framework.

We contend that critical literacy is a vital part of all educational experiences, but especially STEM projects. Creating a critical literacy milieu (Stribling, 2014) could encourage students to disrupt the commonplace, consider multiple perspectives, focus on sociopolitical issues, and most importantly, take action in ways that promote a more inclusive environment related to STEM learning opportunities. Within this critical literacy milieu, teachers must also consider the cognitive skills

they are nurturing for all, but particularly for their female students. As Watermeyer and Stevenson (2010) found in the Discover! clubs, an out of school program in the UK for girls focused on STEM, it is important to "…empower the female learner as an autonomous, flexible and critically reflexive student. Fundamentally however, such learning is not about the accumulation of 'fact' but the ability to negotiate argumentation and deliberation" (p. 40). In other words, teach the people, not just the content.

It is important to note that gender is only one aspect of identity through which a person might experience oppression. While females are underrepresented in the STEM fields, so too are other minority groups including, but not limited to, African-Americans, Latinos/Latinas, and people with disabilities (National Academy of Sciences, 2007; President's Council of Advisors on Science and Technology 2010; Stern & Woods, 2002). It is often the intersectionality of these identities that complicate people's experiences (Crenshaw, 1991; McCall, 2005). It is challenging to isolate discussions on issues of gender, as this is merely one aspect of identity through which one might experience oppression. Often conversations that expose gender inequality incorporate issues of race, class, sexual identity, etc., which add additional layers to personal experiences and societal assumptions. While this paper focused specifically on gender issues in an educational gaming platform and in the subsequent student game design, we recognize that a critical literacy approach would necessarily provide an opportunity to critique multiple aspects of identity that are marginalized in the STEM field. While we have come a long way, there remains a long road ahead. We are hopeful that there are ways to make that journey more powerful and transformational for all.

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