Prospectus Proposal [Direction 3, Revision 13]

Feb 2023 | Rashidul Bari

TSG: Addressing Student Stereotypes in the Classroom

Title: Developing a Website to Address Student Stereotypes of Muslim Female Mathematicians

Website: https://muslimwomenmathematicians.org

Need for the Study:

There is a stereotype that women are worse at math than men (Smith & Postmes, 2011). These stereotypes begin at an early age (Lake & Kelly, 2014) and are affirmed as students grow older (Bessoondyal, 1978). These stereotypes can hurt students' academic achievement and attitudes, which may result in career change (Tiedemann, 2000; McGlone & Pfiester, 2007). Stereotypes are especially damaging for "students with a 'double-jeopardy status' of belonging to two potentially disadvantaged groups at the same time: girls with a minority background," such as Muslim women (Müller & Lokhande, 2019; Inzlicht & Schmader, 2011). In particular, recent studies have shown a negative effect on academic performance due to female gender and Muslim minority group membership (Müller & Lokhande, 2019). To address these stereotypes, teachers use different methods to improve student attitude and achievement, such as (I) multicultural education, (II) student of the month initiatives, (III) positive affirmation, and (IV) mixed debate sessions (Bizahaloni, 1996; Smith & Postmes, 2011; Pretty, 2016). However, Adams (2008), Marx (2009), Oddone (2011), Bratter (2016), and others' studies raise issues about the effectiveness of the aforementioned stereotype reduction methods. There is a need for math teachers to implement a new strategy, which involves websites that address student stereotypes of Muslim female mathematicians (Eyyam & Yaratan, 2014). The four stereotype reduction methods as well as the use of websites will be discussed in the following paragraphs.

Multicultural education involves teaching culturally relevant lessons, incorporating aspects of a particular culture into math problems. According to Alameddine (2021), "educators can articulate the significance of different disciplines and how they are reflected in the works of Muslim figures. In science and math

subjects, teachers can discuss with students how Muslim [mathematicians] laid the foundations for numerous concepts and the significance of seeking knowledge from various perspectives" (Alameddine, 2021, p. 22). Multicultural education increases equity (Banks, 2004) by incorporating the culture of minority students into math lesson plans. As Alameddine (2021) states, "Through this framework, Muslim [female] students could make meaningful connections to the content of the academic curriculum while also acknowledging their backgrounds. Muslim students would gain a deeper appreciation of their learning environment that recognizes and fosters their voices. (Alameddine, 2021, p. 22). However, many researchers, such as Thomasenia Adams, have raised concerns regarding the shortcomings of multicultural math lessons: "teachers [who were asked to incorporate multicultural math into their classrooms] had many misconceptions and misunderstandings of people of various cultures" (Adams, 2008, p. 54). Furthermore, Adams remarks that many teachers "concluded that multicultural mathematics was made multicultural just by the mere mention of a group of people from some cultural group." (Adams, 2008, p. 54) Thus, multicultural math lessons are difficult to implement effectively because many teachers need professional development to overcome their own misunderstandings of other cultures (Bizahaloni, 1996; Adams, 2008).

The student of the month strategy is when a teacher or a department chooses a student role model to highlight for the day, week, or month. Marx et al. agree that "there is ample evidence from laboratory studies that stereotype-disconfirming role models can counter the effects of stereotype threat, and thereby improve the performance of stereotype-threatened students" (Marx, 2009, p.18). The student of the month is selected based on academic performance, character, behavior, and effort (McKinley High School, 2021). Marx et al.'s study shows that a student of the month intervention can improve student achievement and empower minority groups, including Muslim girls, by providing them with an exemplary peer to aspire to (Marx et al., 2009). Friedman (2009) found that student of the month initiatives are effective if the model student is considered competent and belongs to a negatively stereotyped group, such as Muslim girls. However, the selection of the student of the month is subjective

and depends on the judgement of the school administration, leaving room for human error (Marx et al., 2009). Furthermore, this initiative also fosters a culture of competition, not collaboration, and may hinder the creation of a community in the classroom (Marx et al., 2009).

With positive affirmation initiatives, teachers motivate students with compliments based on the students' positive characteristics. Thomas (2020) defines it as a process through which "individuals manage self-image threats by reflecting on important personal characteristics. Schmader and Beilock (2011) state that positive affirmation initiatives can impact student attitudes and achievement by leveraging students' positive qualities to create an inclusive classroom. Bratter et al. (2016) tested the efficacy of positive affirmation initiatives in a sample of 886 students across three high schools and uncovered a null finding. They concluded that there was no evidence that positive affirmation initiatives resulted in higher student achievement within the sample; hence, they raised doubts about the effectiveness of self-affirmation initiatives. In a recent study on the effectiveness of self-affirmation, Lokhande and Müller (2019) found that although Beilock's (2011) study showed the effectiveness of self-affirmation, it remained unclear whether self-affirmation initiatives work for students with "double-jeopardy status," such as Muslim women (Purdie-Vaughns & Eibach, 2008; Lokhande & Müller, 2019), because the evidence on the effects of self-affirmation interventions for such individuals is scarce (de Jong, Jellesma, Koomen, & de Jong et al. 2016; Woolf et al. 2009).

The mixed debate method involves small group discussions or debates on a certain prompt given by the teacher, with the goal of reducing stereotypes (Lewin, 1953; Haslam, 1997). Smith and Postmes (2011) conducted a mixed debate intervention on a group of 75 female students and divided them into small groups and asked, "Why is it true that men are (or are not) better than women at maths?" Subsequently, students took a math exam. The study found that "after affirming the stereotype, women's performance decreased. In contrast, when they challenged the stereotype, there was no difference between the performance of men and women on the maths test." (Smith & Postmes, 2011, p. 74) Vallée et al.'s (2020) investigation reveals that mixed-debate sessions in the classroom can potentially impact student

attitudes and achievement by reducing the effects of the stereotype that girls, including Muslim girls, perform worse than boys in mathematics. The use of the mixed-debate method can help facilitate class discussions about Muslim female mathematicians. However, these conversations are often dominated by only a handful of students because introverted students rarely engage in discussion (Vallée 2020).

Studies have raised issues about the effectiveness of the above methods, especially when applied to students with double-jeopardy status (Adams, 2008; Marx et al., 2009; Purdie-Vaughns & Eibach, 2008; Lokhande & Müller, 2019). There is a need for an approach that focuses on serving students with double-jeopardy status, in particular Muslim women. Websites can address student stereotypes of Muslim female mathematicians while simultaneously improving student attitudes and achievement (Eyyam & Yaratan, 2014).

Websites offer a sufficiently flexible, effective, and adaptable platform for teaching mathematics and its history (Light & Pierson, 2014). They offer a few advantages over the four stereotype reduction methods in terms of adaptability to different classroom models (James, 2002), differentiability (Mantle, 2001), and flexibility (Marks, Sibley, & Arbaugh, 2005). Websites have aspects that meet the needs of all types of learners, including auditory (videos), kinesthetic (virtual museum), visual (simulation), interpersonal (small group discussions), verbal (student presentations), logical (examples of mathematical contributions), and intrapersonal (illustrations). Virtual museums of Muslim women mathematicians and their contributions engage all seven types of intelligences proposed by Gardner (1992), including kinesthetic, because this involves students moving around physically to navigate a virtual space (McLellan, 1994). Websites incorporating learning narratives can address stereotypes, as recent studies show that using learning narratives of minority mathematicians can help "Muslim students make meaningful connections to the content of the academic curriculum while also acknowledging their backgrounds" (Alameddine, 2021, p.22). Unlike mixed-debate sessions, websites can accommodate all types of learning styles (James, 2002), including intrapersonal and interpersonal, and all students have an equal opportunity to contribute (Smith & Postmes, 2011). Most importantly, in the contemporary age,

websites have been shown to be readily adaptable to various classroom models, such as remote, hybrid, flipped, or traditional (Oddone, 2011).

Since studies have raised issues about the effectiveness of the above methods when applied to students with double-jeopardy status (Adams, 2008; Marx et al., 2009; Purdie-Vaughns & Eibach, 2008; Lokhande & Müller, 2019), there is a need for an approach that focuses on students with double-jeopardy status, especially Muslim girls (Eyyam & Yaratan, 2014). This approach comprises the use of websites, for the reasons outlined above.

Purpose:

The purpose of this study is to develop and evaluate a website aimed at reducing stereotypes about Muslim female mathematicians. The following research questions will be considered:

1. (RQ1) What does the literature say about stereotypes of Muslim female mathematicians?
2. (RQ2) What does the literature say about principles of pedagogically effective websites and historical narratives?
3. (RQ3) How is the website evaluated, and what changes will be needed?

Procedure:

Three approaches will be employed to address the research questions: 1) surveying historical books on Muslim female mathematicians and math educators for RQ1, 2) surveying books on web-based education and pedagogical technologies and books on historical narratives to derive the key principles for RQ2, and 3) inquiry-based statistical analyses for RQ3.

To address RQ1, the researcher will investigate the works of Natana J. DeLong-Bas, Celene Ibrahim, Leila Ahmed, and others to examine the literature on stereotypes of Muslim female mathematicians. In

addition, the researcher will conduct interviews with prominent Muslim female scholars of Islam, including Dr. Amina Wadud (professor emeritus of Islamic studies at Virginia Commonwealth University) and Dr. Asma Mustafa (research fellow on Muslims in Britain at the Oxford Centre for Islamic Studies). To collect data from the literature for RQ1, the researcher will utilize a life history approach (in which methods are used to understand the lives of historical figures) to understand the stereotypes against Muslim female mathematicians. The next research question addresses the principles for designing the website and writing the narratives.

To address RQ2, the researcher will survey books on web-based education and pedagogical technologies to explore the principles with which the website will be designed so that it is pedagogically effective in teaching students the history of Muslim female mathematicians and math educators. To collect data from the literature and synthesize the data on principles of website design, the researcher will explore Ben Brignell's design principles collection (Brignell, 2017), which consists of 1448 design principles and 195 examples based on the works of 167 web designers. To synthesize the literature data on the principles of historical narratives, the researcher will explore the work of prominent historians and academicians, such as Dr. Michael J. Gill, Dr. David James Gill, and Dr. Thomas J. Roulet. These principles were first coined during the turn of the millennium when e-learning and historical courses became more prominent on the internet. The advent of history programs, such as the Big History Project, has created multiple frameworks for designing pedagogically effective websites. The researcher will examine these frameworks to design a website that teaches students the history of Muslim female mathematicians. Key principles for the design of a pedagogically effective website and key principles for the structure of the historical narratives on Muslim female mathematicians will be gathered. The second part of RQ2 focuses on narratives, which offer several advantages. First, narratives will be interdisciplinary and holistic and offer a multidimensional perspective of a Muslim female mathematician's identity. Second, adopting an autoethnographic view enables the reader to engage in the best of both phenomenological and ethnographic understanding by offering a microscopic and macroscopic outlook of a Muslim female

mathematician's life. Third, . The website will feature narratives of key Muslim female mathematicians from medieval and contemporary times to examine a variety of characters who have made significant contributions to mathematics or mathematics education. The researcher will present the findings in the form of key principles of pedagogically effective websites and key principles of effective historical narratives.

To address RQ3, the researcher will use statistical analysis to measure how students evaluate the website, and student feedback will be incorporated into the site. To this end, the study will involve three stages: (1) a diagnostic stage, (2) an intervention stage, and (3) a retrospective analysis. To collect data from the diagnostic and retrospective stages for RQ3, the researcher will conduct a phenomenological study consisting of the three stages outlined above. The researcher will present the findings using statistical analyses to identify common themes and interpret data. In response to these findings, the researcher will appropriately modify the website as per the suggestions of students. Hence, the goal of the diagnostic stage is to serve as a baseline for comparison against the retrospective to see if the website intervention made a difference in student responses. The diagnostic survey questions will be developed according to three criteria outlined by Fink (2002): purpose, objectiveness, and response type.

The purpose of the first question is to identify student motivation for studying math, which is aligned with RQ3. Originally, the question was worded as "Why do you like to learn math?" However, to satisfy the objective criteria for the survey question, the researcher removed any loaded or biased words such as "like," which would create response bias and influence students to choose an answer that would present themselves to the instructor in a favorable light. The response type for the first question is closed-ended multiple choice, because Züll (2016) demonstrated that closed-ended questions are preferable to open-ended questions in the case of limited responses, thus making statistical analyses easier.

The purpose of the second question is to see if Muslim female mathematicians are part of students' favorite mathematicians. Originally, the question was worded as "List your three favorite minority

mathematicians." However, the researcher realized this would create response bias by influencing students to give the desired answer (i.e., Muslim female mathematicians), which is why "minority" was removed. The second question has an open-ended short answer response type because the researcher cannot include all possible answers as multiple choice.

The purpose of the third question is to understand why students chose the role models they did. As explained above, role models have the power to motivate students to work harder, so it is important to understand which role models students are most inspired by. Originally, the question was worded as "Why did you choose those minority mathematicians?" In an effort to make the question as unbiased as possible, the word "minority" was removed to prevent any potential response bias. The third question has an open-ended short-answer response type, because as Züll (2016) explains, questions with a wide range of possible answers are best developed with short-answer response types, as the instructor cannot anticipate all possible responses. The following three questions will be included in the diagnostic:

1. Why learn math?
2. List your three favorite mathematicians.
3. Why did you choose those mathematicians?

The next stage will be the intervention. After the diagnostic, students will be provided with the website, which will be designed according to the principles of website design in RQ2. Periodic surveys will ask students for feedback to improve the website. Finally, the study will conclude with a retrospective analysis to measure the change in students' attitudes arising from using the website. The retrospective study will consist of the same survey questions as the diagnostic study. For this final stage of the study, a questionnaire will be distributed to the students. The questionnaire will include all three diagnostic questions and one additional question: What do you like about the website and what can be improved?

This final question is intended to gauge students' attitudes towards the website and inquire about their experiences using the site to evaluate the effectiveness of the intervention.

The study sample will consist of approximately 400 secondary school students in the United States. The sampling frame will consist of attendance records from Skedula, Google Classroom, Zoom, Department of Education, and TeachHub. Most participants will be between the ages of 14 and 18, and the sample will consist of individuals of various races and genders.

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