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## Would female student teachers at primary teacher education colleges study mathematics were it optional?

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In this article we discuss findings from an investigation of whether female student teachers would choose to study mathematics if it were optional for primary teacher education in Malawi. A mixed methods research methodology was used to collect data through survey and focus group discussions (FGDs). Five hundred and twenty three female students from 6 public teacher education colleges completed a questionnaire, and 160 of them participated in FGDs. A descriptive statistical analysis was conducted on the quantitative data while a thematic analysis was conducted on the qualitative data. The findings show that 68% of female students would choose to study mathematics while 32% would not. This correlated with the students' mathematics scores at the end of their secondary school national examination. Those students with high score passes opted for mathematics and those with low score passes did not, suggesting that performance at secondary school influenced their confidence in studying mathematics. Female student teachers' reasons for choosing or not choosing mathematics were it optional are classified into 5 categories: the perceived usefulness of mathematics, inner motivation to study mathematics, the nature of the college mathematics content, how mathematics courses are taught at colleges, and gender stereotype in mathematics lessons. We discuss these in relation to the Malawian government's agenda of increasing participation of females in mathematics, science, technology, and engineering.

**Keywords:** female students; gender; Malawi; mathematics; primary teacher education

### Introduction

Science, technology, engineering and mathematics (STEM) play a critical role in the development of every country (Mandina, Mashingaidze & Mafuta, 2013; Norgbey, 2017). While STEM is of general interest world-wide, there is also a critical gender concern that women are under-represented in STEM – especially at graduate level (Mandina et al., 2013; Norgbey, 2017). The under-representation is clear in Africa where very few women study STEM courses and work in STEM-related fields (El Yacoubi, 2015). Despite the Millennium Goals recommending equity in education and the encouragement of African women to study mathematics and embrace scientific and technological careers, little progress has been made in closing the gender gap (El Yacoubi, 2015). Due to STEM interventions in recent years, there has been an increase in women working in the STEM field in the developed world but not in the developing world – especially in sub-Saharan Africa. However, comparisons in science and mathematics show that even in developed countries which have achieved gender balance in STEM, women prefer to study science courses over mathematics courses (Boaler & Sengupta-Irving, 2012).

While the gender gaps in mathematics are not significant in primary and secondary school education in most of the developed countries (Du Preez, 2018), most of the developing countries report gender gaps. For example, in South Africa, Naidoo and Kapofu (2020) observe low participation of females in mathematics in schools and in STEM-related careers. They explain that the lack of females in STEM careers is due to low numbers of female graduates in the STEM subjects at the tertiary level. In Malawi, gender gaps are observed in mathematics from as early as primary school level (Mbano & Nolan, 2017; Ministry of Education, Science and Technology [MoEST], 2014c). The performance of girls in primary mathematics national assessments is much lower compared to the performance of boys (MoEST, 2014c). The Malawian government bemoans this situation as it “implies fewer girls receive Primary School Leaving Certificates than boys and fewer girls are accepted to merit based, higher quality secondary schools” (MoEST, 2014c:46). Similarly, at international level, the Southern and Eastern African Consortium for Measuring Education Quality (SACMEQ) assessments for mathematics at Grade 6 level show that Malawi's performance is among the lowest of all the participating countries. Furthermore, boys perform significantly higher than girls in Malawi (Milner, Mulera & Chimuzu, 2011). By not performing well even as early as primary school mathematics, most girls do not pursue STEM courses and, therefore, are deprived of STEM-related careers.

One of the strategies that the Malawian government put in place to address this challenge was the recruitment of more female students into primary teacher education for the purpose of increasing numbers of female teachers in primary schools that could become role models for girls (MoEST, 2014a). However, it is generally known that very few students choose mathematics teaching as a speciality (Du Preez, 2018). Understanding student choices with respect to mathematics teaching as a career would assist in the retention of quality mathematics teachers and improving the quality of the teaching of mathematics (Du Preez, 2018). Malawian primary teacher education prepares teachers to teach all subjects in primary schools and as such all students study all courses offered at the teacher education colleges, including mathematics. Consequently, it is not known whether or not the student teachers are interested in studying mathematics and teaching mathematics

at school. We, therefore, sought to investigate whether female student teachers would choose to study mathematics were they given a choice, and the reasons behind their choices. Furthermore, as Mujtaba and Reiss (2016) point out, apart from research comparisons between boys and girls, very little research has focused on making comparisons between girls with high mathematics aspirations and girls with low aspirations. In the study reported on here we only focused on female student teachers' aspirations in mathematics. The research questions were the following:

1. Would female student teachers choose to study mathematics were it optional?
2. Would female student teachers' choice to study mathematics be related to their Malawi Schools Certificate of Education (MSCE) mathematics score?
3. What would female student teachers' reasons be for choosing or not choosing to study mathematics were it optional?

#### Literature Review

Boaler and Sengupta-Irving (2012) points out that the differences in mathematics performance between females and males is not a result of any innate gender-based difference but from social cultural, economic, and educational disparities. Norgbey (2017) observes that from a social cultural perspective, most parents do not encourage their daughters to study STEM courses as they think that their sons are better at STEM than their daughters. Thus, in childhood and adolescence, gender stereotypes about STEM results in girls' aspirations veering away from STEM fields to care-giving fields (Dasgupta & Stout, 2014; Norgbey, 2017). From an economic perspective, girls from high socio-economic status perform well in mathematics and have higher chances of choosing mathematics than those from low socio-economic status (Norgbey, 2017). However, El Yacoubi (2015) observes that despite poverty, the general education of girls in African countries is largely influenced by history, religion and culture. "These socio-cultural barriers are more pronounced when they come to scientific, technical and vocational education and, are unfortunately, tragic when they concern mathematics education" (El Yacoubi, 2015:135). From an educational disparity perspective, some teachers believe that only boys can perform well in mathematics. As such, they focus more on boys than girls during mathematics lessons (Tetteh, Wilmot & Ashong, 2018). Furthermore, there is lack of skilled and competent female teachers to act as role models to female students (Norgbey, 2017). These are critical issues in developing countries where the teacher is usually the most important factor that influences student performance (Tetteh et al., 2018).

In a literature review report from 50 articles that focus on women and STEM, Norgbey (2017) identified three interventions to reduce gender

disparity in STEM: advocacy, gender mainstreaming and affirmative action. Advocacy involves sensitising the society on benefits of involving women in STEM through dissemination of research findings and campaigning. Gender mainstreaming involves gender profiling at all stages of developing and implementing policies with gender inclusive policies. Affirmative action involves increasing the number of female STEM experts to act as role models and mentors to female students. In Malawi, several stakeholders, including the government, universities, the private sector and non-governmental organisations have, over time, developed and implemented a wide range of intervention policies, programmes and projects to increase girls' participation in STEM at all levels. Some of these include the 50:50 selection policy to secondary schools and tertiary education (MoEST, 2008) and the National Girls' Education Strategy that aims at strengthening and improving girls' access and participation in education at all levels (MoEST, 2014b). Despite these interventions, studies show that female students' access, success and retention in mathematics and science continue to be a challenge throughout secondary and tertiary education (Mbano & Nolan, 2017). This implies that the gender gap between women and men in STEM, which is the driving force of technology and economic empowerment, is still large in Malawi. El Yacoubi (2015) recommends that instead of just promoting equal access to educational opportunities in mathematics, interventions for women should also aim to achieve equity. She suggests that to achieve gender parity in mathematics, African countries should promote a positive image of African women in mathematics education and mathematics careers, encourage parents, teachers and all other actors in the school and societal environments to oppose gender stereotypes with regard to mathematics, make proper permanent assessment and relevant follow up in any undertaken initiative (El Yacoubi, 2015). Opposing gender stereotypes is indeed important as Spencer, Steele and Quinn (1999) found in their study in the United States of America that gender stereotype negatively affected performance of women in mathematics. Spencer et al. (1999) investigated the performance of women in mathematics through three studies. In the first study they sought to test claims by earlier studies that women performed the same as men in easier mathematics tasks but performed lower than men in more challenging tasks; this claim was confirmed by their study. In their second study they sought to explain the differences in the first study and tested the hypothesis that gender stereotypes affected women's performance in mathematics. Spencer et al. (1999) selected a sample of female and male university students all of whom were high performing in mathematics. The sample was

divided in two groups and each given a challenging mathematics test. One group was told that the test has shown gender differences in performance while the other group was told that the test has not shown gender differences in performance. The findings exposed that in the group that was told that the test showed gender difference, the women performed significantly lower than the men. In the other group that was told that the test showed no gender differences, the women performed the same as the men with no significant difference. In their third study, Spencer et al. (1999) repeated the second study with a less selected sample and found similar results, therefore, concluded that the gender stereotype threat affected females' performance in mathematics.

In our review of the literature, we found a gap on studies that followed up on how female students experienced mathematics in teacher education. In addition, we also found a gap in the literature on studies that assessed or followed up on the Malawian government's initiative of increasing enrolment of female student teachers to provide skilled and competent role models for primary school girls.

#### *Primary teacher education in Malawi*

The current Initial Primary Teacher Education (IPTE) programme in Malawi was introduced in 2006, and is offered by all primary teacher education colleges. There are eight public teacher colleges spread across the country. The IPTE programme initially consisted of 1 year of full time face-to-face courses at the colleges followed by 1 year of teaching practice in primary schools. In 2016, the curriculum was reviewed and the structure changed to two terms of college-based courses, followed by two terms of teaching practice, then a final two terms of college-based courses (MoEST, 2014c). Entry qualification into the programme is the MSCE with passes in mathematics and science. MSCE is a qualification after passing a national examination at the end of secondary school education. The requirement of a pass in mathematics and science was a raise from previous requirements of any MSCE, and this was done to improve the quality of primary school teachers. Unfortunately, this has led to low female student enrolment at colleges compared to male students' enrolments because many female applicants did not meet the higher requirement of a pass in mathematics at MSCE. The total enrolment for 2019 at the six public colleges that participated in the study was 771 (39%) females and 1,220 (61%) males. Two issues arose from the low female student enrolment at colleges. Firstly, it contradicted the stated goals of the National Girls' Education Strategy (MoEST, 2014b) of increasing girls' participation, achievement and retention in schools by producing more female teachers who

would become role models to girls in primary schools. Secondly, it might have reduced female participation and performance in mathematics courses where females might have felt intimidated because they were outnumbered by male peers (Dasgupta & Stout, 2014). In light of this, it was necessary to investigate the views of female student teachers in colleges regarding the study of mathematics.

#### *Theoretical underpinning*

Our theoretical underpinning was drawn from Spencer et al. (1999) that the gender stereotype threat affected performance of women in mathematics. As discussed in the literature review section, female students in Malawi and other African contexts face gender stereotype in mathematics where often less is expected of them than of male students. Females experience this gender stereotype at home, in their communities and at school. Spencer et al. (1999) argue that such gender stereotypes lower females' self-expectations and consequently affect their participation and performance in mathematics.

#### **Methodology**

We employed a mixed method approach where both quantitative and qualitative data were collected to enable us to gain an overall picture as well as in-depth insights of students' choices and their reasons (Cohen, Manion & Morrison, 2007). Mixed methods is defined as "research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches and methods in a single study or program of inquiry" (Tashakkori & Creswell, 2007:4). We combined quantitative and qualitative methods in this study with an aim of gaining deeper and common understanding of the girls' choices and experiences through triangulating data from multiple methods (Mertens, 2010). The quantitative methodology included administering a survey questionnaire to the female student teachers. The main aim of conducting the survey was to collect quantifiable data which would enable us to produce statistical information on choices that the female student teachers would make were mathematics optional and the reasons for their choices. The qualitative methodology involved conducting FGDs with some of the female student teachers who completed the questionnaire in order to gain in-depth insights into why female student teachers would make such choices.

#### **Sample and Data Collection**

The study targeted all female student teachers enrolled in six of the eight public primary teacher colleges in Malawi. The six colleges were purposefully selected according to availability of

female mathematics lecturers who were previously involved in professional development workshops funded by the project which also funded this study. All 771 female student teachers at the six colleges were given questionnaires containing semi-structured questions. As participation was voluntary, a total of 523 students completed and returned the questionnaires, representing a 67.8% response rate. The data were collected at a time when the students had covered about half of the curriculum. The questionnaire contained both closed and open-ended questions. The rationale behind the use of open-ended questions was to give the student teachers freedom to answer the questions in their own words and to avoid limiting their views (Cohen et al., 2007; Mertens, 2010). The questionnaire comprised of five questions, but here we only focus on the first two questions. Question 1 was closed-ended and it required the students to circle their mathematics score at MSCE. Question 2a was closed-ended and it required of student teachers to tick yes or no regarding whether or not they would choose to study mathematics at the college were it optional. Question 2b was open-ended and it required student teachers to explain why they would choose or not choose mathematics were it optional. After completing the questionnaire, some of the student teachers were selected to participate in FGDs on a voluntary basis. The open-ended questions on the questionnaire were used as a guide during the FGDs. In total, 20 FGDs of 40 to 60 minutes duration were conducted. Each group had eight female students who were grouped according to their choices of whether or not they would choose mathematics, and each college had the same number of groups for each choice.

Collection of both types of data was done by female lecturers who taught mathematics at the colleges to enable the female student teachers to feel at ease as the lecturers might have already established rapport and a sense of security with them (Cohen et al., 2007).

#### Data Analysis

Responses to the questionnaire were coded using numerical codes. The closed questions were easy to code because they were already categorised. Coding of the open-ended questions was done by reading through the responses to identify common

themes. The common themes that were identified were grouped into categories and assigned numerical codes (Pallant, 2010). We captured the questionnaire data using the numerical codes in the statistical package for the social sciences (SPSS) where we recorded the codes of responses for each respondent as a separate entry. Statistical analysis was conducted and simple descriptive statistics such as frequencies, percentages and cross-tabulations were obtained (Pallant, 2010). For the qualitative data from FGDs, thematic analysis was done using a priori themes that were generated from the quantitative data analysis (Cohen et al., 2007; Mertens, 2010).

#### Results and Discussions

In the following section, we present and discuss the results from the quantitative and qualitative data analysis. We first present the quantitative results and compare them with the qualitative results and the literature. We begin by presenting the results for research question 1 which was about whether female student teachers would choose to study mathematics were it optional.

**Table 1** Choices that female student teachers would make were mathematics optional

Choice	Frequency	%
Yes, would choose mathematics	356	68
No, would not choose mathematics	167	32
Total	523	100

The results in Table 1 show that of the 523 female student teachers, 356 students (68%) would choose to study mathematics while 167 students (32%) would not choose to study mathematics if they were given an option. It is encouraging that more than two-thirds of the students would choose to study mathematics. However, about a third would not, which means that the number of female student teachers who would take mathematics at college would decrease. These results support Boaler and Sengupta-Irvin's (2012) observation that the participation of females in mathematics usually falls as soon as mathematics becomes optional and worsens at higher levels. To determine the students' choices at each college, simple cross-tabulations were run between choices and college of which the results are presented in Table 2.

**Table 2** Female student teachers' choices at each college

College	Yes, would choose mathematics		No, would not choose mathematics		Total
	Number	%	Number	%	
1	58	81	14	19	72
2	65	47	72	53	137
3	48	67	24	33	72
4	30	79	8	21	38
5	54	65	29	35	83
6	101	83	20	17	121
Total	356	68	167	32	523

As can be seen from Table 2, except for College 2, at least 65% of the respondents from the other five colleges indicating that they would choose mathematics. In three of these up to 80% would choose mathematics, which is very encouraging. In College 2 only 47% would choose mathematics which means that more than half of them would not. We discuss this concern in more detail when considering the reasons behind the choices. To determine whether the female student teachers' choice to study mathematics was related to their MSCE mathematics score, in one of the items in the questionnaire the respondents were required to circle the score that they had achieved. The MSCE scores ranged from 1 to 9 where 1 to 2 was pass with distinction, 3 to 6 pass with credit, 7 to 8 bare pass, and 9 was fail. Table 3 presents the results of cross-tabulation between the students' MSCE score and whether or not they would choose to study mathematics.

**Table 3** Cross-tabulation of MSCE score and choice of mathematics

MSCE grade	Yes, would choose mathematics		No, would not choose mathematics		Total
	Number	%	Number	%	
Pass with distinction	18	100	0	0	18
Pass with credit	261	85	47	15	308
Bare pass	77	39	120	61	197
Total	356	68	167	32	523

The results presented in Table 3 suggest that there was a relation between the students' MSCE mathematics scores and their choices. All students who passed with distinction would choose mathematics were it optional. For the students who passed with credit in mathematics, 85% would choose mathematics while of those who barely passed, only 39% would choose mathematics were it optional. This suggests that the better the score, the higher the chance that the student would choose to study mathematics were it optional. This makes sense because a good performance in a subject can

be motivation for further study in the subject. It appears that the effect of the gender stereotype threat (Spencer et al., 1999) is lowered when the score is high and is enhanced when the score is low. This is probably because the high score improves the females' self-expectation while the low score enforces their low self-expectation.

Looking at these findings, the entry requirement of at least a pass in mathematics is justifiable because we expect that students that failed mathematics at MSCE would not be motivated to study mathematics at college. Furthermore, it seems that a bare pass in mathematics was not good enough, but pass with credit was. It might be reasonable, therefore, to raise the requirement of entry into primary teacher education to a minimum of pass with credit in mathematics although that would further limit the number of female applicants who would qualify. Other forms of interventions that include addressing the gender stereotype would be required at secondary school to improve performance of female students in mathematics.

**Reasons for Students' Choices**

We were interested in the reasons why female student teachers would choose or not choose to study mathematics. Tables 4 and 5 show reasons for choosing and reasons for not choosing mathematics respectively. The sum of the percentages exceeds 100 because some of the students provided more than one reason.

**Table 4** Reasons for choosing mathematics were it optional

Category of reason	Number	%
Mathematics enhances critical thinking	109	31
Enjoy mathematics/find mathematics interesting/passion for mathematics	102	29
Mathematics is used in other subjects	74	21
Able to understand mathematics/Do well in mathematics	42	12
For future career	27	8
To be role models	13	4
Teachers teach well	6	2
To motivate learners in schools	3	1

**Table 5** Reasons for not choosing mathematics were it optional

Category of reason	Number	%
Mathematics is difficult	128	77
Do not like mathematics	25	15
Mathematics is time consuming	13	8
Do not get good grades in mathematics	11	7
Lecturers do not explain well	3	2

As is clear from Table 4, there are several reasons why students would choose mathematics if given an option. The three most common reasons in descending order of frequency were that mathematics enhanced critical thinking, mathematics was enjoyable and interesting, and that mathematics was useful in other subjects. It is very encouraging that almost a third of the female student teachers said that they enjoyed mathematics and found it interesting. It is also encouraging that they regarded mathematics as enhancing critical thinking and that it was useful in other subjects. Recognising the importance of learning mathematics motivated them despite the gender stereotype they faced. The next common reason was that they understood mathematics and did well in mathematics. This supports our finding that the better the score at MSCE the higher the chance of choosing mathematics if optional, and further supporting our conjecture that getting high scores reduces the effect of the gender stereotype threat. The remainder of the reasons were less common and each given by less than 10% of the students who indicated that they would choose mathematics were it optional. These reasons were: they needed mathematics for future careers, they would like to be role models, their lecturers taught mathematics well, and they wanted to motivate learners in schools. The inspiration to become role models and wanting to motivate learners in schools are intriguing reasons because that is what the national girls education strategy (MoEST, 2014b) is aimed at. However, the percentage of respondents who mentioned this was low indicating that there was still more work that needed to be done to promote female teachers becoming role models for girls in schools. The reason for choosing mathematics due to its relevance for their future careers is encouraging as is an interest in mathematics and mathematics-related careers. However, this indicates some desire to leave the teaching profession thus reducing the already low number of female teachers.

When all the reasons are analysed, we see that the largest number of reasons was about the usefulness of mathematics. According to Mujtaba and Reiss (2016), when students find mathematics enjoyable or interesting, they regard mathematics as having intrinsic value; those who find mathematics as a tool for succeeding in other fields regard mathematics as having an extrinsic value. The findings are similar to those from a study by Mujtaba and Reiss (2016) who found that students'

participation in mathematics beyond the compulsory level was largely determined by extrinsic motivation. This is an important finding because it informs us that student teachers could be motivated by the extrinsic values of mathematics.

The findings as shown in Table 5 reveal that the main reason why most of the students would not choose mathematics was that they found it difficult. This was by far the most common reason and given by more than three quarters of the student teachers. This supports Mandina et al. (2013) we found that perceived difficulty of mathematics, a lack of self-confidence and anxiety were limiting factors for female students' participation in mathematics. These were likely to be caused by the gender stereotype that female students faced. The rest of the reasons were given by smaller proportions of student teachers. These were that they did not like mathematics, mathematics was time consuming, they did not get good grades in mathematics and that their lecturers did not teach mathematics well. This is similar to the findings of Naidoo and Kapofu (2020) in South Africa where female secondary school students reported that they "experienced mathematics as difficult, confusing and stressful, that mathematics was time-consuming" (p. 8). The fact that some students would not choose mathematics because they did not get good grades appears to further confirm that scores in mathematics at MSCE would influence the students' choices in further studies. Comparing the reasons for not choosing mathematics to the reasons for choosing mathematics, we note that four of the five reasons for not choosing mathematics were about the students and how they perceived themselves in studying mathematics; they found it difficult, they did not achieve good grades, they did not like it and they found it time consuming. These were all related to their self-perception, which appeared to further confirm our assertion that low scores enhanced the effect of the gender stereotype threat and consequently lowered their self-confidence in mathematics. We also noted that these reasons were all intrinsic factors, unlike the reasons for choosing mathematics, which were mostly extrinsic factors. This further supports the earlier findings that students' motivation to study mathematics was mostly extrinsic (Mujtaba & Reiss, 2016).

Comparing the reasons across the six colleges, there were more similarities than differences. For example, respondents from all colleges mentioned that "mathematics is difficult" as the main reason

for not choosing mathematics. Regarding reasons for choosing mathematics, respondents from all colleges mentioned that mathematics enhanced critical thinking and that they liked mathematics. Respondents from five colleges mentioned “to be a role model” and the respondents from the remaining college who did not mention “to be a role model”, were the only respondents who mentioned “to motivate the learners.” This is encouraging because it implies that in the six colleges there were some female student teachers who would like to motivate girls in schools to have interest in mathematics, which is in accordance with MoEST (2014b). It is, however, problematic that there was only a small proportion of female student teachers who would choose mathematics to become role models and to motivate girls, because it would then limit the progress on addressing the issue of girls’ low participation in mathematics using MoEST (2014b) strategic intervention of producing more female teachers. Nevertheless, it is not only the responsibility of female teachers to motivate girls to study mathematics. It is the responsibility of both female and male teachers, parents and the entire community – especially in ending gender stereotyping of mathematics.

#### Findings from Focus Group Discussion

During the FGDs, the student teachers elaborated on the reasons that they indicated in the questionnaires. The issues that they raised are summarised in five categories: the perceived usefulness of mathematics, inner motivation to study mathematics, the nature of college mathematics content, how mathematics courses were taught at the colleges, and gender stereotype in mathematics lessons. Extract 1 is an example of an explanation by students who indicated that they would choose mathematics, which we categorise as perceived usefulness of mathematics and inner motivation for further studies in mathematics.

*We like mathematics and we would like to continue learning mathematics because for some of us, teaching is not our main career, we want to do other things like business and accounting in the future, others in this group want to go to Polytechnic or Chancellor College to do science or engineering, [Information and Communications Technology] ICT, or continue studying mathematics. (College 4)*

#### **Extract 1** Indication of student’s perceived usefulness of mathematics

Extract 1 shows that there were several aspects to the students’ perceived usefulness of mathematics. Some students would choose

mathematics because it was a pre-requisite for the courses that they would like to do in future. This agrees with Mujtaba and Reiss (2016) who found that high aspiring girls did realise the material value that mathematics offered. The student teachers’ explanations also showed that they realised that sufficient knowledge of mathematics equipped them to fit well into various scientific and technological fields. The fact that some students would choose mathematics because they were interested in learning higher mathematics implies that these students had intrinsic motivation for mathematics and would persist even if it became difficult (Mujtaba & Reiss, 2016). However, it is slightly worrisome that some of the reasons for choosing mathematics at teacher education level were not to remain in the teaching profession. This implies that some of these student teachers did not have intrinsic motivation for teaching as a career. Du Preez (2018) suggests that it is necessary for teacher education to ensure that they choose students with intrinsic motivation and perceive teaching of mathematics as a lifelong career to improve the quality of the teaching of mathematics.

Some students explained that they would choose mathematics because their lecturers taught mathematics very well.

*Some of our mathematics lecturers deliver mathematics lessons in a way that helps all of us to follow and understand the concepts. They use different teaching and learning methods and resources to help us to have tangible experience with mathematics. For example ... (working) in groups helps us to understand mathematics better.*

#### **Extract 2** Indication of student’s rationale for choosing to learn mathematics

Extract 2 shows that these female student teachers were satisfied with the teaching strategies that some of the lecturers used as they enabled them to understand mathematics. The teaching strategies highlighted by the female student teachers support Mandina et al. (2013) and Norgbey (2017) who explain that girls prefer co-operative teaching strategies like group discussions and that the use of more collaborative teaching approaches increased girls’ attitudes, interest, enjoyment and confidence in mathematics. Regarding the nature of the mathematics courses offered at the colleges, the student teachers explained that they generally learned strategies of how to teach different primary school mathematics topics; as such they would choose mathematics because the courses were not difficult for them. Extract 3 illustrates how this point was emphasised.

*Here at college does not concern deep solving of hard mathematics problems like we used in the secondary school. Here we mainly learn the procedures for teaching the primary mathematics content and we only solve primary school mathematics which is very easy for us. (College 5)*

**Extract 3** Indication that mathematics learnt at college was not difficult

Extract 3 shows that the student teachers would choose mathematics because it was not as challenging as secondary school mathematics. This suggests that if college mathematics was more challenging, then the student teachers would not choose it. Thus confirming that the girls' perceived confidence and difficulty of mathematics was a main determinant of girls' choices in mathematics at tertiary level (Mandina et al., 2013). This supports Spencer et al. (1999) that female students did as well as males when the mathematics was not challenging, suggesting that the effect of the gender stereotype threat was low when faced with easier mathematics and high when the mathematics was more challenging.

Interestingly, while some student teachers found the mathematics course at the colleges easy, other student teachers found it difficult. These student teachers explained that they would not choose mathematics because college mathematics was a difficult course.

*The college mathematics is very difficult and the way lecturers explain some concepts is not good, they do not help us to understand the concepts ... they don't explain properly and we don't understand (College 1).*

**Extract 4** Indication that mathematics learnt at college was difficult

Extract 4 shows that some student teachers viewed the college mathematics courses as difficult and they blamed their lecturers for not explaining the mathematics clearly. This might imply that the student teachers' inability to understand resulted from the lecturers' inability to explain the mathematical concepts. A lack of thorough understanding of some mathematical concepts by some of the female student teachers implied that they might complete their college mathematics courses without good understanding of some primary school mathematics content, which would impact negatively on their teaching of mathematics in schools. As Du Preez (2018:1) argues, "the quality of the mathematics education in schools depends on the quality of the teachers."

It was also revealed that the female student teachers faced gender stereotyping in the

mathematics lessons where male lecturers made negative comments about females and mathematics as indicated in Extracts 5 and 6.

*Some lecturers make us have bad feelings for mathematics because when we do not understand and we try to ask questions, they laugh, when we fail to answer a question they also laugh. They usually tell us that mathematics lessons are difficult, so they always make us have negative attitude towards mathematics. (College 2)*

**Extracts 5** Indication of behaviour of some male mathematics teachers

*Some lecturers do not make mathematics interesting and they make negative comments that girls cannot do better in mathematics. So instead of helping us to understand mathematics, they mock us that we are unable to understand (College 4).*

**Extracts 6** Indication of behaviour of some male mathematics teachers

Extracts 5 and 6 from College 2 and College 4 reveal that the reason some students would not choose mathematics at college was not necessarily the level of difficulty of the mathematics courses but the way it was taught and due to gender stereotyped comments made by the lecturers. It is worrying that lecturers of student teachers have these attitudes and display them without regard of the impact that their behaviour have on female student teachers and how such behaviour was encouraging gender stereotype attitudes in student teachers, which may be carried over to their teaching in schools. This confirms that female students were discouraged from studying mathematics because they were often ridiculed when they made mistakes, asked questions, or were unable to answer the teacher's questions (Tetteh et al., 2018). The stereotype threat in mathematics among female students resulted in decreased performance on assessments, hence resulting in low participation of female students in advanced mathematics (Boaler & Sengupta-Irvin, 2012). As Norgbey (2017) argues, gender stereotypes and academic cultures which are positive towards males but hostile to females in secondary and tertiary education contributed highly to the low numbers of women in STEM.

## Conclusion

In this study we investigated the choices that female student teachers would make were mathematics optional at primary teacher education colleges and the reasons behind those choices. The results show that the participation of female

students in mathematics would be about 30% lower and that most of the students who barely passed mathematics at MSCE would not choose mathematics were it optional. In general, the reasons that the female student teachers gave for choosing mathematics were mostly extrinsic factors such as the perceived material usefulness of mathematics. The reasons for not choosing mathematics were mostly intrinsic factors such as low self-confidence regarding mathematics. The low self-confidence was largely caused by the gender stereotype threat that female students faced, even from their lecturers.

These findings confirm that the girls' low participation in higher education mathematics was mainly a result of social and educational disparities rather than innate disparities. We, therefore, suggest interventions that would result in changes in the culture at teacher colleges – especially the attitudes of mathematics lecturers – to improve female students' self-confidence and their active and positive engagement in mathematics. Most importantly, it is necessary to change lecturers' attitudes and behaviour that perpetuate stereotyping female students as not capable in mathematics. The teacher colleges must be safe environments for female student teachers to study mathematics without experiencing the gender stereotype threat. As El Yacoubi (2015) cautions, promoting equal access alone will not achieve equity in mathematics education in Africa. Malawi and other African countries need to also promote a positive image of females in mathematics education and strongly oppose gender stereotypes.

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### Authors' Contributions

LM collected all the data and conducted the qualitative analysis, she wrote the literature review, methodology, results and the first draft of the article. MK conducted the quantitative analysis, wrote most of the discussion and she revised drafts of the article.

### Notes

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