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Increasing Access of Female Students in Science Technology, Engineering and Mathematics (STEM), in the University of Malawi (UNIMA)

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ABSTRACT: In Malawi, in spite of a number of gender equity policies and initiatives that encourage females to pursue careers within the fields of science, technology, engineering, and mathematics (STEM), research indicates that they are under-represented in these fields. One initiative recommended to address the factors contributing to this under-representation is the development of a bridging programme for female students. A bridging programme (or, course) is generally defined as any course of study that addresses the gaps between students' existing knowledge and/or skills and the knowledge and/or skills required to successfully make the transition to a new course of study. In this paper, two bridging courses are compared for their lasting effects. The first one was carried out with Form Three (year 11) female students while the second bridging course was offered as a pre-entry course for female students admitted to University of Malawi (STEM) courses. The bridging courses had similar components of academic subjects, study skills, life skills, role models and excursions. The study found that both bridging courses had positive impacts on performance in STEM subjects but the most significant impact in both cases seems to be improvement in motivation and study skills. This paper presents a brief analysis of data collected (through interviews) with participants from both bridging courses and discusses these findings.

KEY WORDS: bridging course; STEM; implicit theory of intelligence; self efficacy; classroom climate; community of learners

INTRODUCTION

In Malawi, female students' access, success and retention in mathematics and science continue to be major areas of concern throughout secondary school and higher education. In recognising that education is a key factor in poverty reduction, the government of Malawi has given these issues a

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central role in its poverty alleviation strategy (GOM, 2013). As a result, access, equity, quality and relevance are the major issues addressed in educational policies of the government of Malawi (GOM, 2008). During the period of this study (2009-2012) increasing student enrolment, especially female students in science, mathematics, engineering and technology (STEM) at tertiary levels has been an area of focus for the Ministry of Education, as evidenced by the Policy and Investment Framework (PIF) of 2000 - 2012 (Ministry of Education Sports and Culture Malawi (MoESC), 2001). This policy stated, "Tertiary institutions will be required to increase the percentage of students enrolled in the natural sciences and technology field from 25% to 60% of the total full time student enrolment by 2012" **(**MoESC, 2001, p. 34**)**. In addition, the policy stated, "Tertiary institutions shall take appropriate measures with the aim of increasing the proportion of female students in non-traditional areas from 28% to 40% of female enrolment by 2012" **(**MoESC, 2001, p. 32).

In spite of this important policy, one of the major problems faced by the education system in Malawi is the gender disparity in access and achievement at all levels of education. This gender disparity, or gap, is most pronounced at tertiary levels in science-related programmes. For example, in the 2009 University of Malawi selection, 41% of the students selected into mathematics and science programmes were female. However, if those selected into nursing programmes (which are traditionally female careers) are excluded the female representation drops to 35%. One initiative recommended to address the factors contributing to this under-representation is the development of bridging programmes for female students.

A bridging programme is generally defined as any programme of study that addresses the gap between students' existing knowledge and/or skills and the knowledge and/or skills required to successfully make the transition to a new course of study. Bridging programmes generally offer a blend of content instruction, career guidance and a supportive environment that assists with negotiating the required transitions. Bridging programmes can range in structure from short, intensive courses to lengthier, more sustained communities of learning. This paper is based on a study that compares the outcomes of two bridging programmes. The first one was carried out with form three (year 11) female students while the second bridging course was offered as a pre-entry course for female students admitted to University of Malawi (STEM) courses.

RESEARCH QUESTIONS

The study asks the following two research questions:

- What was the impact of each bridging programme on access and retention of female students in tertiary STEM courses?
- What perceptions were held by the female students on the bridging programme?

REVIEW OF RELEVANT LITERATURE

The challenge of low participation and success of women in STEM has been studied extensively and from multiple perspectives. Barbercheck (2001), for example, proposes that there are two dominant models frequently used to explain why women are less likely than men to remain in STEM fields: the deficit model, which discusses formal and informal barriers affecting career choice, and the difference model, which states that there are fundamental differences in men's and women's goals and perspectives. Interventions designed to address the deficit model often use bridging programmes, whilst interventions designed to address the difference model generally focus more on changing the social norms of the STEM fields themselves by deconstructing "achievement scripts for women" (Barbercheck, 2001, p. 118). It should be noted that the bridging programmes discussed in this paper incorporated both models; that is, while the bridging programmes themselves might be considered an example of a deficit model intervention, the content of the bridging programmes attempted to deconstruct social norms. For example, as discussed in other research (see Levine, et al., 2015; Weber, 2011), the bridging programmes focused on deconstructing the social norm (stereotype) of males having a greater aptitude and ability for achieving success in STEM subjects by introducing successful female role models.

Over the years, many researchers have focused on studying the barriers that prevent women from participating fully in STEM fields (Bamberger, 2014; Bottia, et al., 2015; Bystydzienski & Bird, 2006; Dweck, 2007; Wang & Degol, 2013; Wasburn & Miller, 2006), identifying key issues such as personal theories of ability and motivation, self-efficacy, pedagogy, classroom climate, gendered dynamics, and communities of learning. This paper will discuss each of these key issues in turn, in order to understand better the research in the field prior to discussing the study at hand.

Personal Theories of Ability and Motivation

Spelke and Grace (2007) used a framework that endeavoured to explain differences in achievement in STEM between men and women in terms of sex differences in motivation, sex differences in cognition, and discrimination. While an explicit discussion of discrimination is not a focus of this paper, the issue is briefly taken up in a later section on classroom climate. It has been reported that many STEM fields are still characterized as ‘masculine’ and thus can present an unwelcoming ‘chilly climate’ for female students (Bottia, et al., 2015). In terms of sex differences, Spelke and Grace concluded that differences in cognition based on sex was an unfounded factor and that a more critical factor was motivation.

Motivation is concerned with a desire to achieve and represents an inner drive, such as wishes or goals to act or behave in a certain manner. An important question to ask in relation to motivation is, “What are the psychological mechanisms that enable some students to thrive under challenge, while others of equal ability do not?” (Blackwell, Trzesniewski, & Dweck, 2007, p. 247). Dweck (1999) has developed a motivational model which suggests that core beliefs can set up different patterns of response to challenges and setbacks. One such belief is the implicit theory of intelligence. Two studies explored the role of implicit theories of intelligence in adolescents' mathematics achievement (Dweck, 1999, 2007). In these studies, the researcher found that having a belief that intelligence is malleable (incremental theory) predicted an upward trajectory in grades over the two years of junior high school, while a belief that intelligence is fixed (entity theory) predicted a flat trajectory. More details on Dweck’s findings follow.

Implicit theory of intelligence

According to Dweck (2007), there are two implicit theories of intelligence that describe how people view themselves as learners and how these beliefs shape their behaviours and motivations. The first is the entity theory of intelligence; learners holding this view will believe that intelligence and ability are fixed and stable—a gift which one either has or has not. The second theory of intelligence is incremental theory; learners holding this view will perceive intelligence and ability as malleable and emergent, something that can be developed through practice and dedication. Those learners with entity view of intelligence, many of whom are (according to Dweck) female, tend to be vulnerable to declining performance and lose the desire to carry on in that field if they encounter difficulty, whereas people with an incremental view of intelligence work hard, even when faced with difficulty (Dweck, 1999; 2007). It is posited that a person's theory of intelligence can be changed from entity to incremental through intervention and experience. For example, Dweck (2007) was able to achieve positive change in students' theory of intelligence by teaching them how the brain works, what kinds of physiological connections are being made during learning and how such repeated connections can increase intellectual ability. The students learnt that intellectual ability grows and develops over time; it is not fixed and static. From her study, Dweck (2007) was able to show how women are vulnerable and lose confidence when faced with obstacles and challenges in their learning, and ultimately when it comes to selecting and succeeding in STEM fields. She recommends not focusing on who has scientific abilities or who does not, but instead on how best to foster and develop such abilities.

Self-efficacy

Self-efficacy is another issue which is worthy of discussion when it comes to understanding an individual's response in a learning situation. Self-efficacy is generally defined as belief in one's own ability to complete a specific task and reach one's goals (Ormrod, 2006). Self-efficacy reflects how confident one is about performing specific tasks. A theory of self-efficacy predicts that individuals are more likely to engage in activities for which they have high self-efficacy and less likely to engage in those for which they do not (van der Bijl & Shortridge-Baggett, 2001). Fencl and Scheel (2006) reported on studies that showed that self-efficacy is one of the most useful predictors of success and persistence. In fact, Fencl and Scheel reported that self-efficacy was influenced by a number of personal experience factors, such as teacher and parent encouragement, successful grades, etc. Other research indicates that the role played by successful female scientists, serving as role models for female students, should not be undervalued (Bamberger, 2014; Weber, 2011). Such role models work to counteract misinformation or stereotypes associated with STEM careers (Wang & Degol, 2013) as well as provide opportunities for aspiring female STEM students to understand the day-to-day activities that are part of STEM-related careers (Levine, et al., 2015). Understanding more about STEM-related careers has been shown to shape the development of not only self-efficacy but also interest in STEM and long-term life goals (Wang & Degol, 2013).

Pedagogy

Fencl and Scheel (2006) proposed that the use of active learning strategies such as discussion and cooperative learning reduced negative and/or stressful emotional responses to course work. Their study highlighted that one promising avenue for retention of female students in STEM subjects (physics in particular in their study) was a blend of both traditional and student-centered pedagogies. In a questionnaire administered to first-year university physics students (Fencl & Scheel, 2006), students cited poor teaching as their top concern and indicated a strong preference for a mixture of traditional (lecture) and student-centred pedagogies. That same study reported that "student-active pedagogies improve retention of both female and male students, helping to narrow the retention gap between them" (Fencl & Scheel, 2007, p. 287). It is worth noting that active learning does not dismiss the value and effectiveness of lectures. As Rissanen (2014) offers, "in many disciplines structured lectures form a solid basis for education, especially when teaching demanding and important concepts and phenomena to large study groups" (p. 3). However, if students are to be active learners, such lectures have to be well-designed, interesting, and engaging (Rissanen, 2014), and not form the primary means of conveying content to the learners.

Classroom Climate and Gendered Dynamics

The climate in a mathematics or science classroom can also constitute a barrier to women in STEM subjects. Bottia, et al. (2015) reported that, while there have been some improvements in the atmosphere in science and other STEM subject classrooms, studies show that "many STEM fields are still characterized by a 'chilly climate' that is unwelcoming to girls in high school and young women in college" (p. 16). Another study (Levine, et al., 2015) reports that the "gender gap is likely reinforced by the fact that high school science teachers spend significantly more time addressing the boys in the classroom" (p. 1639). Though there are more textbooks that feature both sexes and also more teachers who are aware of the gender divide, female students often feel outnumbered, intimidated, and isolated in their classes (Wasburn & Miller, 2006). Dingel (2006), who studied women's and men's experience in science classrooms through participant interviews, identified three possible existing gendered dynamics: the 'normal' scientist is considered male while females are seen as the exception, or 'other'; men (not women) are most often recognized as the authority and the one with competence as a scientist; women feel they have to do everything perfectly and understand every detail in order to 'make it' in science, thus placing unreasonably high expectations on themselves.

Community of Learners

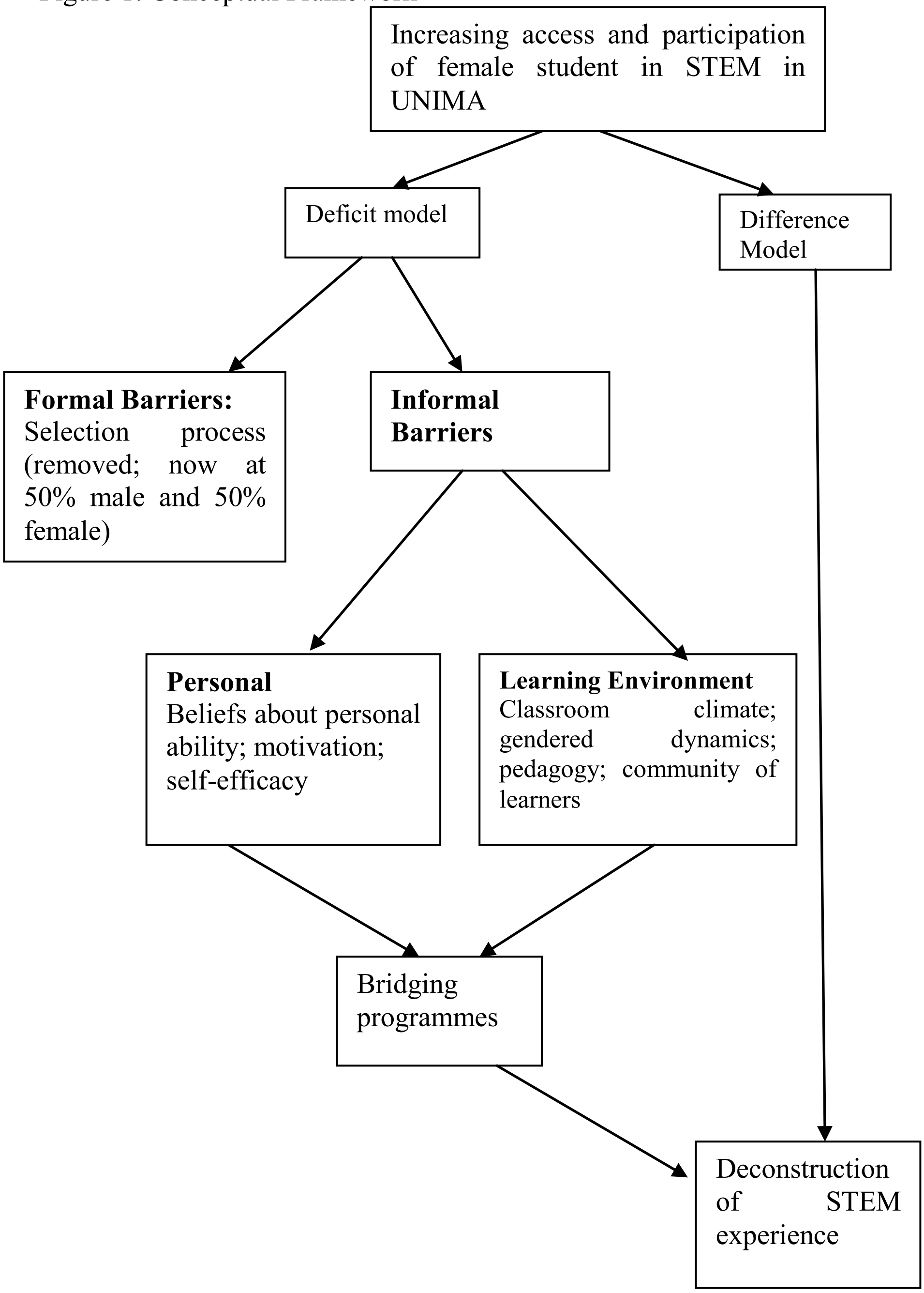
It should be noted that classroom climate is not only controlled by the presence/absence of males and the attention (or lack thereof) paid to female students by (both male and female) science teachers, but also by the lack of a supportive network or learning community for female students (Jackson, 2013). The concept of a *community of practice* (Lave & Wenger, 1991; Wenger, 1998) is important to enhancing participation in the classroom. In its most basic form, a *community of practice* (or simply, a community of learners) can be defined as a group of learners actively involved in learning from each other and sharing their beliefs and values. In learning communities, learners are interdependent, having joint responsibility, sharing resources and points of views. Participation in a community of practice is a process by which students can move toward greater participation and an enhanced sense of belonging (Herzig, 2007) in their mathematics and science courses and programs. Through communities of learning, women can study and complete assignments together, share information, and provide moral support to one another. In addition, such a "critical mass of women" (Herzig, 2007, p. 265) working together and supporting one another helps to sustain meaningful, positive, and caring relationships.

Conceptual Framework

Access and participation of female students in STEM subjects can be explained by two models: the deficit model, which discusses formal and informal barriers affecting career choice, and the difference model, which states that there are fundamental differences in men's and women's goals and perspectives. Informal barriers can be grouped as personal and environmental factors.

The personal factors attempt to explain the differences in beliefs about ability and self efficacy of females and males, while environmental factors refer to the interactions in the classroom. The deficit model prescribes intervention programmes which aim at the removal of the barriers, whilst the difference model requires deconstruction of STEM experiences. In the bridging courses reported here both models were used. Figure 1 summarizes the conceptual framework discussed in this paper.

Figure 1: Conceptual Framework



In a baseline study of factors affecting poor participation and achievement in STEM in Malawi and the corresponding interventions that might address these factors, Condie, Chambers, Kamwanja, and Chamdimba (2008) identified the following strategies/approaches as effective interventions:

- The use of context and societal relevance to interest and motivate female students
- Collaborative group working
- Discussion and sharing of ideas
- Active, 'hands on' science
- Problem-based approaches

METHODOLOGY

The study used a post hoc design in the form of a trace study with no comparison group. In general tracer studies enable researchers to assess the impact of an intervention programme and try to link it to specific elements of the programme (Schomburg, 2003). In this way effective and ineffective components may be identified. Tracer studies evaluate the relevance and quality of a programme. In this study the participants of each bridging course were traced after a period of time, and their achievements and perceptions of the bridging course were sought. The impact of each course (offered through 'camps') was assessed against its objectives.

The first bridging course camp (2009)

The first female bridging course camp camp took place at Bunda College, a campus of University of Malawi, from 27th July 2009 to 7th August 2009. This activity came as a second phase of Development Partnerships in Higher Education (DELPHE) project. The camp targetted secondary school girls who were not quite successful in their grades to make it to the univerisity but who were believed to be good enough to make it into science programmes at the university given some targetted exposure in science, mathematics and technology related careers, activities and teaching strategies. In other words, the goal was to intervene in average performing students of low socio-economic background, who normally may have not have a chance of being selected for STEM courses at university level (due to previously exisiting formal barriers associated with the deficit model).

In total, 36 girls were selected from 18 schools from across the country (2 girls per school), along with 18 science teachers from those same schools. This criterion of two students per school was important in order to ensure that at least each girl had someone from their own school with whom they would continue to interact with after the camp. Furthermore, a science teacher accompanied the two students in order to be exposed to the strategies used in the camp and hence continue assisting the female students after the camp was completed. Over the two-week period, the bridging course offered sessions to both students and teachers in the areas of bioengineering, biology, physical science, mathematics, life skills and gender responsive pedagogy, role modelling, career guidance, and educational excursions (to historical and scientific sites of interest).

There were four categories of facilitators: 1) university lecturers who facilitated activities in biology, mathematics, physical science and bioengineering, assisted by two practising secondary teachers from local secondary schools; 2) an expert on Gender Responsive Pedagogy, 3) female STEM-related role models, and 4) student mentors (third year female students enrolled in STEM programmes). All sessions were offered to both the female students and the teachers, but in different formats. The students' sessions involved learning in groups while the teachers' sessions were designed to assist teachers to share their teaching skills and techniques. In biology, mathematics and physical science, the focus was on topics that students and teachers had identified as challenging in a baseline survey (administered during the first year of the study to gather data on the various challenges girls face when learning sciences) and also while at the STEM camp. An expert on gender responsive pedagogy was invited to the camp to educate instructors (and students) on issues related to possible discrimination, the classroom chilly climate, etc. that may have helped shape the girls' images of themselves as STEM learners. The role models comprised a reknowned female academic scientist and a female medical doctor, both of whom came to talk with the female students about how they came to select and embark on successful careers, including a discussion of what was involved in their work. The student mentors invited to participate in the camp were three female science students in Civil Engineering, Agricultural Sciences and Education Sciences. In addition, there were field visits to science establishments, including the Wildlife Orphan Rehabilitation Sanctuary, a Dairy, and a Veterinary Laboratory; such visits provided exposure to 'real-life' STEM-related careers for the girls. During the evenings of the camp, the female students worked on homework, learned life skills through presentations and prepared for a talent show—all of which student mentors played a central role.

The second bridging course camp (2010)

The second feamle bridging course camp took place at Chancellor College, a campus of University of Malawi, from 6th July to 17th July 2010. This bridging course was developed and implemented for female students who were already selected into University of Malawi STEM courses but had low grades in mathematics and science coming out of high school. There were 12 girls selected to Chancellor College B.Sc. and B.Ed. (science) programmes and 14 Students of the Polytechnic selected for B.Sc. (Technical Education). The overarching goal of this second bridging course was to improve girls' participation and success in STEM courses and, ultimately, in their programmes of study at university. Similar to the first bridging programme, the second one aimed at addressing the individual, cultural, and structural factors that currently work to limit female students' access and motivation to choose careers in STEM related fields. It did so by strengthening necessary skills and processes in mathematics and science before beginning university and while engaged in first semester university courses. It was hoped that the female students could participate in, and contribute to, the community of learners that was formed among the bridging course participants, offering each other support, encouragement and a sense of belonging throughout the first-year (and beyond) in university. Furthermore, the course addressed issues of self-efficacy and confidence in mathematics and science through a better understanding of self and others as learners. It sought to develop in the girls necessary dispositions for critical thinking, problem solving approaches in learning, and effective skills for gathering and evaluating information. Additionally, an effort was made in this camp to provide opportunities for the girls to work toward a deep understanding of mathematics and science concepts, and the pedagogical strategies that foster such deep understanding. The female students experienced a variety of teaching and learning approaches such as individual research, interactive and group learning, whole classroom instruction, one-on-one tutorials, project-based learning, guest speakers, and field trips. There were activities to enhance study skills, time management, dealing with stress, career development, diversity, and general skills in personal and social development. Role models— including a Commissioner of the National Statistics Office, District Public Health Officer, and a lecturer in Technical Education— were drawn on to introduce the female students to future educational and professional opportunities available in the science, mathematics and technology (STEM) fields.

This second bridging course camp consisted of seven modules, offered concurrently throughout the week-long programme. The titles of the modules are listed below but for the purposes of keeping this paper brief and focused on participants' perceptions of the camp, specific details of each module are not provided here.

- Study skills
- Critical thinking and problem solving
- Upgrading and skill enhancement for particular concepts/processes in science and mathematics
- Student-centered pedagogical approaches to learning mathematics and science concepts
- Exploring science, technology, and mathematics (STM) in society
- Engaging in real-life mathematics and science investigations
- Understanding and addressing attitudes and beliefs about self as a mathematics and science learner

Data collection

The first bridging course camp

For the first bridging course camp, data was gathered three years after the camp in order to assess its post-secondary impact and to gain some understanding of the perceptions that the female students had of the camp. It specifically addressed the following questions:

1. How did the female students who attended the bridging course perform in the Malawi School Certificate of Education (MSCE) examinations?
2. How many of these female students were selected to University?
3. How many chose to pursue science-related careers?
4. What were their perceptions of the camp?

Several instruments were used to address these questions. Firstly, MSCE results for 33 of the 36 students were analysed to find out the impact of the bridging course on their performance. Secondly, 21 of the 36 students were traced and asked what they were doing now to see what their post secondary situation was like. Thirdly, 12 of the 36 students were interviewed individually and in three focus groups to understand their perceptions of the camp and its impact on their lives. And finally, 6 individual female students were asked to describe the most significant impact (or resulting personal change) of the bridging course camp using the 'most significant change stories' (MSC) technique. This technique was developed by Davies (Dart & Davies, 2003) as a monitoring and evaluation tool for interventions. It is based on a qualitative participatory approach and presents a shift from quantitative evaluations and instead focuses on the human impact of the intervention. The advantage of MSC techniques is that they highlight the impacts of the intervention that have the most significant effects on the lives of the participants. However, it is limited in that only few stories are heard and discussed.

The second bridging course camp

For the second bridging course camp, data was gathered to determine the impact of the bridging course on students in their first year in University. The following questions were specifically addressed:

1. How did the female students who attended the bridging course perform in the college examinations?

2. What were their perceptions of the camp?

The end-of-first-year results for 24 of the 26 bridging course participants were obtained. Furthermore, 11 participants completed a questionnaire asking them to self-report on the impact of the bridging course [§]. However, only seven questionnaires were used in analysis since the others were incomplete.

Data analysis

The quantitative data were summarised using descriptive statistics. The qualitative data from the interviews, focus group discussions and the questionnaires were analysed by tabulating the responses question by question. Whilst this is economical in summarising and presenting data it has three weaknesses: the integrity and wholeness of each individual is lost; data is decontextualised and, since its framework and areas of interest are already decided, the analysis may be unresponsive to additional relevant factors that may emerge in the data (Cohen, et al, 2007). However, it was used on basis of the guiding principle in qualitative research that data analysis should have fitness of purpose (Cohen, et al, 2007). Since in this case the aim of the study was find out participants' perception of the bridging course and its impact on their lives (and questions were asked for these specifically), it was seen fit to tabulate responses by question.

[§] You will notice that evaluation of the first bridging course was after 3years and evaluation of the second course was only after one year. This was a result of change of management in the project. Project officers moved on after the first course and it took time for the new officers to come unto the project.

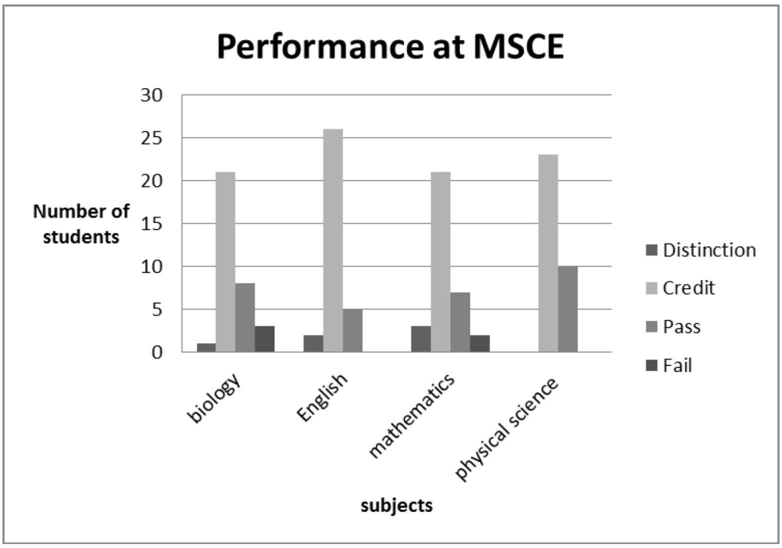
FINDINGS

The first bridging course camp (2009)

Performance in Malawi School Certificate of Education (MSCE) Examinations

Figure 2 provides a graphical display of the students' performance in biology, English, mathematics and physical science. The modal performance of the female students who attended the camp was credit (60-69%). There was 100% pass rate in English and Physical science and there was 97% and 98 % pass rate in biology and mathematics respectively. These results were better than the national average which for that year the pass rates were 51% for mathematics, 32% for biology and 54% physical science

Figure 2: Performance at MSCE

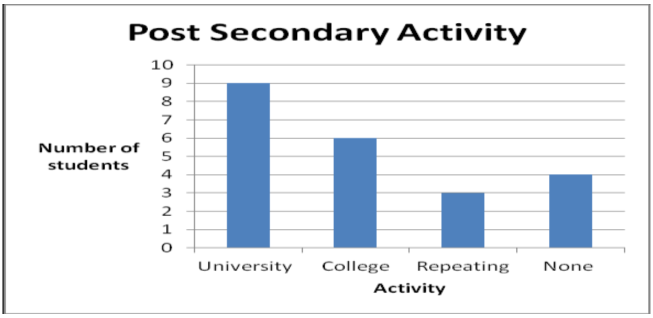


Key Fail is below 40%, pass is 40-59%, credit is 60-69% and distinction is 70% and above.

Post Secondary Activity

Of the 21 bridging course participants traced, 9 had been selected to university, 6 had gone to other colleges, 4 were not in school nor college and 2 repeated in order to improve performance. Of these, one improved and was selected to university, whilst the other one did not improve. Figure 3 summarizes the post-secondary activities of the participants.

Figure 3: Postsecondary Activity



Students' perception of the bridging camp

The students were interviewed to find out their perceptions of the bridging camp they had attended. Table 1 presents the five most common responses and five least common responses; 10/12 female students interviewed could still recall that the objectives of the course were to encourage them to work hard in school, especially in science subjects, and to aim at studying science courses in University or College. Whilst most of the students could remember the subjects tackled at the camp, a few mentioned very specific events such as dealing with difficult topics and personal hygiene.

Table 1: Five most common responses and five least common responses to the question: What was the Camp about?

What was the camp about?

What the camp was about	n = 12
Encourage girls do science	10
Mathematics	8
Study skills	8
Biology	6
Physical science	5
Topics not done at school	1
Difficult topics	1
Importance of schooling	1
Not to fear boys' performance	1
grooming	1

A quote from Jessie (all names are pseudonyms) illustrates how the camp encouraged girls to study science:

> They encouraged us female students to work hard in school. It was about science subjects only, since female students fail in these, so that we do better. Most female students had dropped science subjects, were encouraged to take them because they are useful. They said that for someone waiting to join University of Malawi, she needs science subjects. Female students think science is boys, but encouraged us that all can take the subjects.

Students' perception of the impacts of the bridging camp

Table 2 presents the five most common and five least common perceptions of the impact of the camp. All students interviewed reported that they now work hard in mathematics and science and appreciate the importance of group work. Other frequently mentioned impacts of the camp were related to study skills, career guidance and encouragement from role models. On the other hand, some of the least frequently mentioned impacts included improvement in self esteem, attitude to postpone marriage, ability to seek help, not thinking science is for boys only and improved status in eyes of peers having attended the camp.

Table 2: The top five common responses and five least common responses to the question: What was the impact of the Camp?

What is the impact of Camp?

Impact of the camp	Number of students (n =12)
Work hard	12
Group work	9
Life skills	8
Career guidance	8
Encouraged by Role models	5
Self esteem	2
Postpone marriage	2
Can seek help	1
Science is for boys only	1
Improved status	1

Patricia's response illustrates her change in study habits:

> Before the camp I just read like a novel but got nothing. This time I still remember the activities we did on how to study. In order to pass, you need time to study, choose specific topic at a time to study in order to understand it. You should be able to check understanding using review questions. You should develop a timetable and programme the topics. We were encouraged to write a summary and if you do that it means you understand. If you study unplanned work, it's a waste of time. You need to focus during study. You should forget everything and concentrate on the study. Each should study according to their needs, not just follow their friends. You should choose good environment to study.

Most significant stories

Six Students were asked to share their most significant change as a result of the bridging course. The interviewer summarised it in writing and then the interviewee was asked to read the story and make any changes that she thought necessary. Table 3 presents the issues highlighted in those most significant stories.

Table 3: Issues in most significant stories

Significant stories	Number of students (n =6)
Work hard	6
Aim high	5
Postpone marriage	3
Motivated by role models	3
Study skills	2
Importance of school	2
Fees	2

The most common significant changes mentioned by the students were encouragement to work hard, which was put into practice; aim high in education and postpone marriage. They were also motivated by role models. Omega had this to say:

> Before the camp I did not like school and did not work hard. I could do well in class without effort. I was worried about my future because of problem of fees, as I felt my father could not afford to pay for college fees. When I went to camp I learnt that at college you do not need to pay fees. Secondly I also learnt that you could apply to other organizations for assistance if need be. There was a facilitator from X Secondary School who encouraged me in this. I stopped being careless and started to work hard at school. I wanted to go to college and also be a role model to my siblings, none of whom had gone to college.

How did you share your experience after the camp?

Five of the girls interviewed stated that the teacher helped them present their findings at school assembly and in class, and to form study groups, which met regularly to mainly solve mathematics problems. The others mentioned informal sharing of career guides and the lessons learnt.

The second camp

Performance at the end of First year in College

Table 4 below presents the end-of-first-year results of bridging course participants at Chancellor College (Zomba) and The Polytechnic (Blantyre) compared with the results of the rest of the students.

Table 4: End year results of Bridging course participants and their counterparts

College	Pass rate % Bridging course	Other girls
Chancellor College (B.Ed. Science)	81 (n =11)	62 (n = 29)
The Polytechnic (B.Sc. Technical Education)	100 (n=13)	75 (n= 30)

The pass rate of female students who participated in the bridging course was higher than that of the other students who did not take the bridging course. This suggests that the bridging programme had positive and lasting impact on the participants.

Students' perception of the Bridging Course Camp

What was the mathematics, science and technology camp was about?
Table 5 below presents the perception of 7 students from Chancellor College who filled in the questionnaire

Table 5: responses to the question: What was the Camp about?

	N=7
encouraging girls to pursue with science courses	5
study skills	5
reasoning	5
group work	4
prepared us for the university life	3
strengthen our self confidence	3

In general, the participants said the Camp was to encourage pursuing science education (5/7) and to prepare for university life (3/7). Most of them also mentioned study and reasoning skills (5/7) and group work (4/7). Some felt it was to strengthen their self confidence (3/7). A Quote from Sera illustrates this:

> The camp was about encouraging female students and young women to take part in science subjects, boosting female students' confidence, preparing female students to get ready for science courses

As the responses suggest, the participants still had a fairly accurate perception of the aims of the bridging course.

Students' perception of the Knowledge and Skills acquires through the Bridging Course Camp

What knowledge and skills did you acquire through this camp?

Table 6 present responses to the question: What knowledge and skills did you acquire through this camp?

Table 6: responses to the question: What knowledge and skills did you acquire through this camp?

	N = 7
group work	6
study skills	5
reasoning	4
preparation skills	2
confidence	2
time	2
questions	2
communication	2
balance time	2
knowledge in science	1

The common skills were small group discussion (6/7), study skills (5/7) and reasoning skills (4/7). Other skills mentioned by 2 of 7 participants in each case were preparation, gaining confidence, time, asking questions, communication, and balancing time for study. A Quote from Sera illustrates this: "I gained Study skills; how to manage time; how to attempt questions (Science and reasoning questions); how to become a balanced girl."

Group work, study skills and reasoning skills were commonly perceived to have been gained from the bridging course. It is interesting to note that none of the girls mention subject knowledge.

How the knowledge and skills acquired through the camp were used

Table 7 presents responses to the question: What knowledge and skills acquired through the camp have you used in your studies? In your life?

Table 7: Common to the question: What knowledge and skills acquired through the camp have you used in your studies? In your life?

	N = 7
reasoning skills	5
study skills	5
confidence	3
time management	2
questions	1
group work	2
communication	1
discipline	1

Most participants mentioned reasoning and study skills (5/7). Some mentioned gain in confidence (3/7). Other responses included time management, asking question, small group work, communication and discipline. Beauty's response illustrates this:

> I have used a lot of skills in my studies and some of them are as follows:
> I know how to manage my time
> I ask questions if I have not understood
> I know how to study effectively
> I am confident to face new challenges
> I am a focused girl.

Sharing the Bridging Camp Experience with Others?

It turns out that sharing of experience was mostly informally done by talking to individuals and friends about the camp and what it was all about.

DISCUSSION

The findings from the first camp show that female students performed well in the MSCE examinations, especially in science subjects, and chose STEM careers. Similarly, results for participants of the second camp at Chancellor College and The Polytechnic showed that the pass rate of camp participants was higher than that of other students. Furthermore, talking to the female students from both camps it would seem that their attitude toward studying and their own self image changed for the better. For those who attended the first camp, the lasting impact of the camp was that they were motivated to work hard, through setting realistic goals spurred by role models and motivational talks and activities. These female students and first camp participants felt that the life skills sessions helped to build their self-efficacy, esteem and confidence, enabling them to work hard in subjects they had once thought to be too difficult for them. The study skills sessions assisted them in using metacognitive strategies, such that they could better plan their studies and monitor their understanding. In seeing the value of cooperative work, they formed study groups in their schools, which assisted them to study effectively. On the other hand, the university participants seem to have valued reasoning and study skills, and the psychological sessions aimed to build their confidence more than the subjects. In general, it would seem that the female students had an overall positive image of the bridging course camp and they felt it helped them settle in college life easily. They were motivated to study mathematics and science subjects and had developed self-confidence, even though there was not much mention of what they had learnt in individual subjects. It seemed that the value of the bridging course was to build confidence and develop reasoning and study skills.

FINAL THOUGHTS

Considering both camps, it would seem that the components of the bridging courses that have lasting impression on the female students were as follows: the use of group work, life skills (which stress goal setting and developing self-esteem), study skills, career guidance and the use of role models. It is thus recommended that schools and colleges should consider assisting female students in developing confidence, reasoning and study skills through regular bridging courses in order to increase their access, success and retention in STEM. In general, there is a lack of knowledge on how students are guided to choose their careers and this would be interesting to study in connection with girls in STEM. It would also be interesting to explore how students actually study in secondary schools and then to devise interventions to improve their studies.

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