

Mathematics Self-Efficacy Sources and Mathematics Engagement among Secondary School Students in Nyimbwa Sub-County, Luweero District

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ABSTRACT

Mathematics engagement occurs when the student engages in the activity that is directed towards doing mathematics, learning mathematics, completing mathematics tasks and participating in school mathematics. This study aimed at establishing the relationship between Mathematics Self-Efficacy Sources and engagement among secondary school students in Nyimbwa Sub-county in Luweero District, Uganda. It specifically intended to examine the relationship between mastery experience and mathematical engagement of students, determine the relationship between vicarious experience and mathematical engagement of students, establish the relationship between verbal persuasion and mathematical engagement of students and examine the relationship between physiological state and mathematical engagement of students. The study adopted a cross-sectional correlational research design. A sample of 240 respondents participated in the study. Data were collected from primary sources. Questionnaires and interview guides were used to collect data. Data were analyzed using descriptive statistics and Pearson correlation to determine the relationship between different variables. Findings revealed that mastery experience relates to mathematics engagement among secondary school students, vicarious experience relates negatively to mathematical engagement among secondary school students, verbal persuasion relates positively with mathematics engagement among secondary school students and that physiological state relate with mathematical engagement among secondary school students in Nyimbwa Sub-county in Luweero District. The study recommends that Government needs to educate and sensitize the mathematics teachers to cater for their students' wellbeing, carry out effective teaching to enable them have mastery experience in order to get engaged in mathematics and excel in their academics.

INTRODUCTION

Mathematics is the science and study of quality, structure, space and change of numbers and it is a compulsory subject to all students from primary one to senior four in Uganda. This is so because it provides foundational knowledge and skills for other subjects such as; sciences, art, social studies and even music (Kyungmee, 2008). Since being a compulsory subject, students are expected to engage with the subject and be confident when engaging with the subject.

Globally, the study of the concept of student engagement dates far back to the 17th century (UNICEF, 2020) and has since been concerned with emotional and behavioral withdrawal or disengagement from school, with behavioral engagement focusing on participation and emotional engagement focusing on identification (Fredricks et al., 2004). Both are fundamental in the Participation-Identification Model which entails visible indicators of students' participation in school activities (Finn's, 1989). Specifically, low behavioral Engagement leads to students not finishing school. Each dimension of student engagement has been measured using different variables (Eccles, 2016). Lawson (2013) conceptualized student engagement as a dynamic between their psychological dimensions and features of their learning environments.

Different studies on factors that have contributed to the students engagement in mathematics have been conducted for-example affective engagement which is defined as positive and negative emotional reactions to one's academic environment (e.g., teachers, classmates, school); and, cognitive engagement (Fredricks et al., 2004). Gender and age are doubtless relevant to any consideration of mathematics engagement (Rosander & Bäckström, 2012). With this in mind, the first set of engagement factors derives from a recent multidimensional motivation and engagement framework (Bobis et al., 2011; Liem & Martin, 2012; Martin, 2007, 2009) that suggests a number of cognitive and behavioral factors in the form of adaptive engagement for which cognitive involves; clearly thinking, paying attention and behavioural including; asking questions and class communication.

However, little is known about the influence of self-efficacy experiences on students' engagement in Mathematics. Self-efficacy is the pivot to success. Believing one's own strengths supports one even under undesirable situations and conditions (Ishfaq, 2011). Whether personally or at professional level, self-reliance matters a lot in achieving the aims set by an individual. Being successful requires consistent performance and this heavily depends upon how an individual deals with the situations or changes coming forth in his life. Self-efficacy means self-confidence, self-reliance, and trust in oneself. Self-efficacy is regarded as one's optimistic self-reliance. Bandura (1977) clarified self-efficacy as a sportsperson's trust that he has the required talent to generate a desired output.

Within the African region, student engagement was given emphasis in the 1990s and has an extensive research base (Fredricks, Blumenfeld, & Paris, 2004) and is shown to be a highly complex and multi-faceted construct. It is possibly as a result of this complexity that little has been done to formally define engagement (Finn & Voelkl, 1993) or to study engagement in terms of interventions in the school setting (Fredricks, Blumenfeld, & Paris, 2004; Finn & Voelkl, 1993). Researchers, psychologists and educators also differ in opinions of what constitutes engagement, how the construct can be measured and what factors combine to result in engagement. However, in this region, most research into engagement acknowledges three commonly identified dimensions: affective (sometimes labeled 'emotional') engagement, behavioral engagement and cognitive engagement which put emphasis on student's self-efficacy experiences.

In the Ugandan schooling context, affective engagement can be considered the beliefs, attitudes and emotions as experienced by students. Aspects of affective engagement have been variously considered as anxiety, interest, and boredom (Connell & Wellborn, cited in Kong, Wong, & Lam, 2003); interest, achievement orientation, anxiety and frustration (Kong et al., 2003); identification with teaching staff or peers, and sense of belonging (Horn-Hasley, 2007). Behavioral engagement is identified by Fredricks, (2004) as one of the three ways of engagement together with emotional and cognitive engagements. According to (Bandura, 1986), self-efficacy plays an important role in determining behavior and feelings of confidence about a specific problem and is also crucial for an individual's capacity to solve that problem. Research has generally confirmed a relationship between mathematics self-efficacy and student performance, though different sizes of correlation were reported, often depending on the types of self-efficacy measures that were used (Multon, Brown, and Lent, 1991).

Despite all the efforts by the government of Uganda through the Ministry of Education in enhancing student engagement in mathematics in Nyimbwa Sub-county, learning mathematics has remained a complex process (Moenikia & Zahed-Babelan, 2010). Both cognitive and emotional factors are influential in achievement in mathematics and in retention (Singh et al., 2002). Therefore, how students learn mathematics is an issue as well learning the course content (Cano & Berbén, 2009; Goktepe-Yildiz & Ozdemir, 2018; Segers et al., 2008). Mathematics curricula were given prominence with this feature when emotional factors such as interest, attitudes and perception which influenced learning in particular were noticed (NCTM, 2014). In addition to those components, several socioeconomic factors, and factors such as the influence of families, peers, and schools which affect learning mathematics are also available. Research on engagement, attitudes and learning approaches- which are influential in achievement in mathematics have received interest in recent years due to the fact that it is difficult to change variables related to home and family (Cagiran & Soyuturk, 2021; Singh et al., 2002). Besides, the above-mentioned influences are greatly important for students in learning mathematical concepts (Liston & O'Donoghue, 2010). However, all the above create the contextual gap thus paving away for this study.

Problem Statement

Students' engagement in mathematics is of great importance in the teaching and learning of mathematics because: it raises the effectiveness of mathematics learning and teaching (Nayir, 2015), plays a mediatory role between attitudes towards mathematics and academic achievement as students with higher engagement can develop positive attitudes towards the subject which in turn will raise academic achievement in mathematics (Lijie et al., 2020, Nayir (2015). Also students with higher engagement in mathematics have higher chances of continuing offering the subject at the higher levels of education and engage in careers that require mathematics as an essential subject (Gopal et al. (2018). Because of the importance attached to engagement in mathematics by students and teachers as well, the government of Uganda through Ministry of Education and Sports and other educational stakeholders has put in place a number of strategies aimed at increasing student engagement in mathematics; among these is the revision of curriculum to reduce on the load, provision of adequate revision materials for mathematics, employment of qualified mathematics teachers across board, increase of salaries for science teachers and establishment of loan education schemes to students with mathematics and other science subjects.

Despite the aforementioned initiatives by the government of Uganda to increase secondary school students' engagement in mathematics, their engagement still remains low. If this issue of secondary school pupils' low engagement in mathematics is not resolved, it will have an impact on the government's strategy of vision 2040, which calls for transforming Uganda into a middle-income country through technological growth given that one of the main subjects credited with advancing technology is mathematics. Students in lower courses may have inaccurate opinions of mathematics due to inadequate participation, creating a negative precedent. In Luweero District, engagement of students in mathematics has been found to still be 'wanting' (SESEMAT, 2008) where it was reflected on the teachers' methodologies of teaching. Mathematical Engagement was found to be influenced by various factors yet in this specific study concentration will be put on how students' self beliefs can realize engagement (Birgen, 2004).

This study therefore sought to establish the relation between Mathematics Self-Efficacy Sources and mathematics engagement among secondary school students in Nyimbwa sub-county, Luweero District.

LITERATURE REVIEW

A thorough review of both theoretical and empirical literature was done in the process of conducting this study. Identifying the gaps that this study aimed to fill was the main focus of the literature review. The study was guided by Social Cognitive Theory by Bandura (1994). The theory was used basing on various attributes embedded therein to guide this study. Social Cognitive theory deals with "can I" questions; it is a drive preceding the above-mentioned explanations. Self-efficacy beliefs influence learners' cognitive, behavioral and affective beliefs towards mathematics.

The theory states that people make judgments of their capabilities to organize and execute actions required to attain designated types of performances. Self-efficacy is not concerned with skills one has but with the judgments of what one can do with whatever skills one possesses. Self-efficacy, then, is an individual's belief that he or she can perform a particular task or behavior. It is a person's beliefs about own abilities to control her/his level of performance and events that influence his/her life. Students with strong self-efficacy are harder workers, engage more frequently, have greater persistence in tasks and persevere in face of difficulties more often than students with low self-efficacy (Bandura, 1977).

Bandura (1992) states that self-efficacy beliefs produce feelings, thoughts, motivations and behaviors through four processes: the cognitive process, the motivational process, the affective process, and the selection process. These were used to underpin data from students' practices and beliefs. Cognitively, did students think they could accomplish tasks? Research has shown that cognitive performance is enhanced by possessing self-efficacy beliefs (Bouffard & Bouchard, 1990). Cognitive performance is influenced by three factors: how people understand ability, one's ability versus ability of others, and performance feedback. Students view ability either as acquirable skills or as inherent amount. It has been found that students who believe they can acquire skills and build their abilities have a high sense of personal efficacy and those that believe they are

born with only certain amount of ability have very low efficacy (Wood & Bandura, 1989). Through this assertion, this study seeks to explore how students perceive the relationship between their self-efficacy beliefs or abilities and engagement in the mathematics classroom.

Students also perceive their own ability based on the performance of others (Bandura & Jourden, 1991). Students' efficacy beliefs were weakened when they saw others scoring higher and performing better; however, their personal efficacy was strengthened when they realized they were progressively gaining. Performance feedback can also affect feelings of efficacy. Efficacy is enhanced when feedback is positive and is centered around what is achieved versus negative attention (Jourden, 1992).

The second process is motivation which is enhanced and sustained by clear and challenging goals (Bandura & Cervone, 1986). Students remain engaged if the work that they are completing is within or just beyond their abilities. Motivation is enhanced by self-efficacy beliefs (Bandura, 1994). Self-efficacy beliefs determine the goals students set for themselves, the persistence of students to complete tasks, and the student's ability to overcome a sense of failure and continue to persevere, even though disappointment.

The third process is affective process, which is emotional center of self-efficacy. Did the student feel that she could handle the emotional consequences of first contemplating and then attempting a task? Perceived coping self-efficacy and thought control efficacy can work together to help students reduce their levels of stress and withdrawal behaviors (Ozer & Bandura, 1990). Last, is selection or choice related processes that are shaped by beliefs of personal efficacy. The types of activities students choose to participate in, the environments students place themselves in, even the career options they choose to investigate are influenced by self-efficacy (Bandura, 1994).

The theory shows that there are four sources of self-efficacy (Bandura, 1994). It develops from mastery experiences; this is an experience that has been met with either success or failure. While experiences of success foster healthy personal efficacy, experiences of failure only weaken a student's sense of personal efficacy. The second source of efficacy beliefs is through vicarious experiences (Bandura, 1994). It has been found that if students see others, especially students who deem to be their equals, succeeding, then they will feel they are able to accomplish similar tasks. However, if students see another student put forth a large amount of effort and fail, they will not feel they are capable to same task.

Not only does being successful and seeing others succeed build efficacy! Verbal persuasion is the third source of self-efficacy. This is aided by building efficacy beliefs (Bandura, 1994). Students can be persuaded that they have the abilities to accomplish a task. Achievement is improved through verbal encouragement (Schunk, 1985). It is not an easy endeavor, especially if persuasion is followed quickly by an experience of failure.

The fourth source of efficacy beliefs is the physiological states of the students. Is the student expectant in his / her moods? Students' moods, physical conditions, and stresses are indicators for efficacy beliefs (Bandura, 1994). Basing on this source, one can easily ask if the teachers provide a classroom environment that was stress-free. Did students feel that teachers affect their engagement in the mathematics classroom by setting the "mood?"

Mastery Experiences as Source Mathematics Self-efficacy and Mathematical Engagement

Mastery experiences are experiences of previous success and failure in specific tasks that shape an individual's beliefs that he/she can perform similar task (Bandura, 1977). In the context of mathematics, mastery experiences involve firsthand encounter with successful or failure in mathematical problem-solving and task completion. When students successfully overcome mathematical challenges and achieve desired outcome, they develop a belief in their capabilities to perform similar tasks in future. Allowing students to develop a sense of accomplishment and mastery over mathematical concepts and skills is essential in fostering positive self-perception and building a solid foundation for mathematical engagement among secondary school students.

The importance of mastery experiences in mathematical engagement is further supported by the National Council of Teachers of Mathematics (NCTM, 2000) which emphasizes the need to provide students with

opportunities to engage in problem-solving and reasoning tasks that allow them to experience success and build confidence in their mathematical abilities. By providing students with appropriately challenging tasks, support and feedback, mathematics teachers can foster mastery experiences that promote mathematical engagement and long-term success.

Silver et al. (2020) show that mastery experience derives from the phrase “*seeing is believing*” to underscore the importance of providing people tangible evidence of success. When people actually see for themselves and cope effectively with difficult situations, their sense of mastery is likely to be heightened. Such experiences serve most successful when goals and strategies are specific with clear identification. In a study by Rosli et al. (2019), it is indicated that concrete, specific and proximal (short-range) goals provide greater incentive, motivation and evidence of efficacy to science subjects than goals that are abstract, vague and set in the distant future. Specific goals allow students to identify specific behaviors needs for successful achievement and to know when they have to succeed. For example, the most effective interventions for phobias and fears involve “*guided mastery*”—in vivo experience with the feared object or situation during therapy sessions, or between sessions as “*homework*” assignments. Recent technological advances allow the use of “*virtual reality*” experiences in treating phobias and fears. In cognitive treatments of depression, learners are given structured guidance in arranging success experiences that will counteract low-self-efficacy expectancies (De Talancé, 2016).

Chen and Usher (2013) investigated the four hypothesized sources of self-efficacy from a different perspective. They hypothesized that students tend to differ in how they rely on self-efficacy source information. Some students regard mastery experiences as more important than the other three sources, while others may rely on those sources of efficacy information more equitably. By utilizing Latent Profile Analysis, they examined latent patterns, or profiles, of the relations among efficacy-relevant experiences and beliefs reported by 1,225 middle and high school students. The results revealed that there are four types of profiles. Although the four efficacy sources Bandura hypothesized revealed to have different weights in the four types of profiles, results support past findings indicating that mastery experiences are a powerful source of self-efficacy.

Vicarious Experiences as Source of Mathematics Self-Efficacy and Mathematics Engagement

Learning can be experienced when learners view the performances of others, ie; what types of actions effective or non-effective for their own enactment of a task (Mc Cown et al., 1996). According to social cognitive theory (Schunk, 2000), vicarious experiences can accelerate learning over what would be possible if students perform every behavior in order to learn. This is especially true when trying to learn complex skills such as riding a bike, swinging a golf club, or using computers in the classroom. By observing experts, teachers, and other models, learners may get a head start toward their own mastery of difficult tasks. Self-efficacy beliefs are influenced by observations of behavior of others such as through a learner interacting with a fellow learner or with the teachers, watching videos and the consequences of those behaviors. Educationists use this information to form expectancies about behavior and consequences, depending on extent to which learners believe that they have similar experiences with the persons under observation (Fung et al., 2018). To Bandura (1997), vicarious experiences generally have weaker effects on self-efficacy expectancy than to performance experiences.

According to Conger and Keane (1981), vicarious learning and imagination can be used to teach new skills and enhance self-efficacy for skills. For example, modeling films and videotapes have been used successfully to encourage socially withdrawn children to interact with other children. The child viewing the film sees the model child, someone much like himself or herself, experience success and comes to believe that he or she too can do the same thing. In vivo, modeling has been used successfully in the treatment of phobic individuals. This research has shown that changes in self-efficacy beliefs for approach behaviors mediate adaptive behavioral changes (Williams 1995).

Vicarious experiences in other words involve observing other people successfully completing a task (Lei et al., 2018). Whereby when one has positive role models in life (especially those who display a healthy level of self-

efficacy) - one is more likely to absorb at least a few of those positive beliefs about the self. Social role models including older sibling, older friends, camp-counselors, parents, aunts and uncles, grandparents, teachers, coaches, and employers have an important influence towards self-efficacy among the observer persons or the learners. In addition, in interpreting the results of their actions, it is realized that students build their efficacy beliefs through the vicarious experience of observing others (Schnitzler et al., 2020).

Vicarious experiences have been used to increase students' self-efficacy, or confidence, for performing tasks similar to those performed by observed models (Bandura, 1986; Ertmer et al. 2003). It comprises of personal beliefs about one's capability to perform at specified levels and, as such, is considered to be the "key factor of human agency." While not as strong of a source of efficacy information as personal mastery experiences, vicarious experiences often offer a more feasible method for enhancing pre-service teachers' self-efficacy for technology integration, especially given the lack of resources and logistical difficulties involved in providing students with relevant mastery learning opportunities (Ertmer et al., 2003).

Ertmer et al. (2003) had remarked that vicarious experiences increase students' self-efficacy or confidence to perform tasks similar to what had been performed by an observed model. In a study conducted by Albion and Gibson (2000), it was found that vicarious learning could not be strong as mastery experience in relating to self-efficacy among students. But, vicarious experiences offer a more feasible method for enhancing pre-service teachers' self-efficacy for technology integration, especially given the lack of resources and logistical difficulties involved in providing students with relevant mastery learning opportunities. The study also established that technology also offers effective means for delivering vicarious experiences. In a study that explored the effectiveness of electronic models for increasing pre-service teachers' self-efficacy for technology integration, Ertmer et al. (2003) showed a significant increase in students' judgments of confidence after viewing successful models in a hypermedia environment. Similarly, Albion and Gibson (2000) got same results after observing realistic examples of technology integration in an interactive multimedia environment in which pre-service teachers showed significant increase in self-efficacy for technology integration. Driscoll et al. (2003) demonstrated benefits of observing dialogue-like discourse (as opposed to monologue-like discourse) that were modeled by a virtual tutor in a computer-supported environment. That is, overhearing dialogues containing deep questions helped learners recall information and thus, increased their learning outcomes.

Vicarious learning has also been portrayed through meaningful group discussions. According to Koschmann et al. (1996), meaningful group discussions lead to cognitive benefits by engaging students in deep reflections on their ideas. By exchanging ideas and considering others' perspectives, learners are prompted to reflect on their existing ideas as well as to integrate new ideas from friends into their existing knowledge. The cognitive processes involve asking questions, providing explanations or response to questions, and elaborating on one's ideas to provide these explanations, which had been said (Cohen, 1994). Slavin (1996) had pointed that as long that experience had taken place, then vicarious learning is within the learners. Cochran-Smith and Lytle (1999) described how teachers' engagement in collaborative dialogue can enable learners to acquire knowledge and co-create new understandings that are adaptive. Albion and Gibson (2000) emphasized the importance of teaching using collaboration in multimedia-based, problem-solving environments, stating that the efficacy of problem-based learning stems from discussions among group members who desire to use examples from others so that they could learn.

Verbal Persuasion experiences as source of Mathematics Self-efficacy and Mathematics Engagement

The third factor for self-efficacy is called social persuasion. When people are persuaded verbally that they can achieve or master skills for certain tasks, they are more likely to do those tasks. Having others' verbal support attainment or mastery of a task goes a long way in supporting a person's belief in himself or herself. This implies that Self-efficacy beliefs are influenced by our observations of the behavior of others and the consequences of those behaviors. Educationists use this information to form expectancies about our own behavior and its consequences, depending on the extent to which they believe that they are similar to the person under observation.

Efficacy beliefs are influenced by what others say to us about what they believe we can or cannot do. The potency of verbal persuasion as a source of self-efficacy expectancies is influenced by such factors as the expertness, trustworthiness and attractiveness of the source, as suggested by decades of research on verbal persuasion and attitude change (Eagly & Chaiken, 1993). Verbal persuasion is a less potent source of enduring change in self-efficacy expectancy than performance experiences and vicarious experiences.

In a qualitative study, Van Zee and Minstrell (1997) indicated that students' thinking was enhanced during peer interactions in terms of talking to each other and their teachers, problem representation, explanation, justification, monitoring and evaluation. Van Zee and Minstrell (1997) suggested that when teachers engage in reflective answering of their background, they encourage their students to clarify their meanings in life. Students also got examples to emulate despite various challenges during teaching – learning.

Physiological state as Source Mathematics Self-efficacy and Mathematical Engagement

Physiological state is the condition or state of the body or bodily functions that involves the physical condition and the physiological state. Physiological state is so vital for successful adaptation to environment as well as learning. The emotional, physical and psychological well-being of a person can influence how they feel about their personal abilities in a particular situation. Bandura (1982) stated that if a learner or an individual struggles with depression or anxiety, he or she might find it harder to have a healthy level of well-being. This statement raised a question from different scholars whether it is impossible to build self-efficacy while suffering from some struggles? Of course not, but boosting self-efficacy is a much easier task when one feels healthy and well.

Physiological and emotional states influence self-efficacy and engagement while learning as it is associated to poor performance or perceived failure with aversive physiological arousal and success with pleasant feeling states. According to Bandura (1997), when a person becomes aware of unpleasant physiological arousal, he / she is more likely to doubt competence than another one with physiological state. Likewise, comfortable physiological sensations are likely to lead to feelings of confident in ability and situation at hand. Physiological is an indicator of self-efficacy expectancy, and extend beyond autonomic arousal. In activities involving strength and stamina, such as exercise and athletic performances, perceive efficacy is influenced by experiences as fatigue and pain.

Physiological state furthermore is said to be a construct of: anxiety, stress, fatigue and mood. Thus, students learn to interpret their physiological arousal as an indicator of personal competence by evaluating their own performances under differing conditions. Strong emotional reactions to school-related tasks can provide cues to expected success or failure and yet high anxiety can undermine self-efficacy and any form of engagement. Therefore, students who experience a feeling of dread when going to a particular class or towards mathematical engagement each day are more likely to interpret their apprehension as evidence of lack of skill in that area. In general, increasing students' physical and emotional well-being and reducing negative emotional states strengthen self-efficacy and mathematics engagement (Delfino, 2019). Perhaps the greatest limitation of research that has been conducted on the sources of self-efficacy and engagement has been the manner in which sources have been operationalized and assessed.

Skilling et al. (2016) stated that teacher physiological practices must be intentional towards student engagement. The intentions of teachers must be integrated into instructional strategies that are flamed to play a large role in student engagement whilst learning. Such strategies must be pro-active and active, involve students working in groups and discussions, employ problem-based learning as the teacher facilitates, and ask students to explain their thinking. In a survey of Kindergarten to Grade 12, Smith and Star (2007) found that instruction that involved manipulative, hands-on activities, real-world problems, and student groups had positive impacts on engagement across all grade levels studied.

There are a number of studies that have correlated attitudes as a physiological fact variable and mathematics engagement; as well as achievements. However, few correlations have been supported as right while researchers oppose the importance or efficacy to such correlations. According to Vandecadelaere et al. (2012), attitude towards mathematics is significant and a crucial aspect that need to be studied. The questions remain

how to measure attitude physiologically towards mathematics engagement. Attitude as a physiological state needs other variables to be measured, apart from the common known of positive, negative and indifferent attitude. This is because schools are constructed on policy which compels students / learners into a certain defined situation (Edigar, 2012).

METHODOLOGY

This study employed mixed methods approach where by both quantitative and qualitative data were collected. Cross-sectional design and correlational research design were adopted to determine the relationship between sources of mathematics self-efficacy and mathematics engagement among students in secondary schools in Nyimbwa sub-county. The study targeted a population of 408 S.2 students and 10 teachers in the six (6) secondary schools in Nyimbwa Sub-county. The sample size of the study was 240.

This study employed both stratified random sampling and purposive sampling techniques say the classes of senior two students and teachers since it was a well representative of the population in the selection of the sample. Concerning qualitative data, interviews were conducted to determine the consistency of results collected by quantitative means with senior two mathematics teachers of each secondary school to participate in the study together with focus group discussion with some selected learners of the class. For teachers, purposive sampling was used. An interview guide was also used to determine the consistence of the quantitative data collected. This involved personal interviews with the S.2 mathematics teachers and focus group discussion with the selected S.2 learners.

Quantitative data obtained from questionnaires were analyzed by descriptive and inferential statistics utilizing the Statistics Package for Social Sciences (SPSS V.21) while Qualitative Data Analysis including in depth interviews was done by identifying themes, categories and patterns emerging from the information collected. The data was analyzed to ascertain the accuracy, credibility, consistency, and usefulness of the information as recommended by Cohen, Manion, & Morrison (2017). The study observed the following ethical measures: Ethical clearance,

Informed Consent and Voluntary Participation and Confidentiality, Privacy and anonymity including adhering to APA Manual 7th edition to avoid plagiarism.

RESULTS AND DISCUSSION

This study sought to investigate the relationship between sources of mathematics self-efficacy and mathematics engagement of students in secondary schools in Nyimbwa sub-county, Luweero District. To gather information on this theme data was collected quantitatively and qualitatively from various respondents. Quantitatively, 240 questionnaires were administered to senior two students in the six secondary schools in Nyimbwa sub-county, Luweero District and interviews from ten s.2 mathematics teachers for the selected schools were held. 129 questionnaires were returned fully completed; this represents a response rate of 53.8%. According to Amin (2004) in a survey, a response rate of over more than half should yield valid findings hence the response rate in this study was deemed appropriate to yield valid findings.

Background Characteristics

This section presents the background characteristics of the S.2 learners who participated in this study. These included gender, age, type of school, PLE score, level of education of father, level of education of mother and career prospect. The response is presented in Table 4.1;

Table 4.1: Descriptive Statistics on the Background Characteristics (N=129)

Variables	Values	Frequency	Percent (%)
Gender	Male	77	56.0
	Female	52	44.0
Age	10-15	42	35.0
	16-20	87	65.0

Type of school	Mixed	92	63.9
	Single	37	36.1
PLE score	4-12	72	45.0
	13-23	43	31.0
	24-29	13	15.0
	30-34	01	9.0

Source: Primary data, 2022

Findings in the study showed that students rated themselves highly in the following aspects of mathematics engagement:.

Relationship between Mastery Experience as Source of Mathematics self-efficacy and Mathematics Engagement

Table 4.3: Descriptive Statistics of Students' Rating on Items Related to Mastery Experience as a Source of Mathematics Self-Efficacy

Statements	Response (N = 129)							Overall rating
	Never	Rarely	Sometimes	Often	Always	Mean	SD	
Score excellent marks on math test	0 (0%)	0 (0%)	79 (61.2%)	21 (16.3%)	29 (22.5%)	3.61	0.832	Often
I have always been successful with mathematics	0 (0%)	25 (19.4%)	0 (0%)	104 (80.6%)	0 (0%)	3.61	0.794	Often
Even when I study very hard, I do poorly in mathematics	104 (80.6%)	25 (19.4%)	0 (0%)	0 (0%)	0 (0%)	1.19	0.397	Never
I got good marks in math on my last report card	0 (0%)	0 (0%)	55 (42.6%)	29 (22.5%)	45 (34.9%)	3.92	0.88	Often
I do well on math homework	0 (0%)	0 (0%)	46 (35.7%)	0 (0%)	83 (64.3%)	4.29	0.962	Often
I do well on even the most difficult math home work	0 (0%)	54 (41.9%)	0 (0%)	75 (58.1%)	0 (0%)	3.58	0.495	Often

Source: Primary data, 2022

Overall, the results indicate that students in this study have a positive view of their mastery experiences in mathematics. However, there is some variations in the students' responses with some students reporting higher levels of mastery experiences than others. This can be observed from the higher values of standard deviations.

Qualitative results are in agreement with quantitative results whereby one of the Teachers mentioned that;

“In my mathematics class, students with mastery skills in the subject are more engaged than those without mastery experience” (Field Data, 2022). The researcher thought that students that lack mastery experience generally don't like to be engaged in mathematics.

Furthermore, another teacher asserted that

“I was told by some of my students that they don't like the subject (Mathematics) because they can't seem to master any concepts and our friends who are good at it thinks that we are not serious and this discourages their engagement in the Mathematic ”(Field data, 2022).

In yet another response with the teachers, one of them indicated that

“I believe that having a mastery experience is good as it helps students feel motivated to undertake any topical challenge in mathematics and thus increase on their engagement in the subject” (Field Data, 2022).

Relatedly, another teacher interviewee mentioned that “*students who don’t engage in mathematics always perform poorly in the subject because they don’t appreciate it and share with their colleagues who have some mastery experience*” (Field Data, 2022).

Relationship between Vicarious Experience as Sources of Mathematics Self-Efficacy and Mathematics Engagement

Table 4.5: Descriptive Statistics of Students’ Rating on the Extent to which they experienced the Following Six Items Related to Vicarious Experience as Source of Mathematics Self-Efficacy

Statements	Responses (N = 129)					Mean	SD	Overall rating
	Never	Rarely	Sometimes	Often	Always			
Seeing adults do well in mathematics pushes me to do better	0 (0%)	0 (0%)	0 (0%)	0 (0%)	129 (100%)	5.00	0.000	Always
When I see how my mathematics teacher solves a problem, I can picture myself solving the problem in the same way	0 (0%)	0 (0%)	24 (18.6%)	0 (0%)	105 (81.4%)	4.63	0.781	Always
Seeing students young than me do better in mathematics than me pushes me to do better	24 (18.6%)	0 (0%)	0 (0%)	0 (0%)	105 (81.4%)	4.26	1.563	Always
When I see how another student solves a mathematics problem, I can see myself solving the problem in the same way	0 (0%)	0 (0%)	0 (0%)	29 (22.5%)	100 (77.5%)	4.78	0.419	Always
I imagine myself working through challenging mathematics problems successfully	0 (0%)	0 (0%)	30 (23.3%)	29 (22.5%)	70 (54.3%)	4.31	0.827	Always
I compete with myself in mathematics	0 (0%)	0 (0%)	0 (0%)	29 (22.5%)	100 (77.5%)	4.78	0.419	Always

Source: Primary data, 2022

The study furthermore indicated that students in this study have a positive view of their vicarious experiences in mathematics. However, there is some variations in the students’ responses with some students reporting higher levels of vicarious experiences than others. This can be observed from the higher values of standard deviations.

Qualitative results are in agreement with quantitative results whereby one of the teachers mentioned that

“When students have vicarious experiences, they have less chances of engaging in mathematics” (Field Data, 2022). Furthermore, another teacher asserted that “I believe students who have more vicarious stand lesser chance of getting engaged in mathematics than their fellows as I have been able to witness in my teaching mathematics ”(Field data, 2022).

In yet another response with the teachers, one of them indicated that

“I believe that vicarious experience is good for encouraging students to be engaged in mathematics subject among secondary schools students as I have been able to understand it over the years while teaching mathematics subject” (Field Data, 2019).

Relationship between Verbal Persuasion as Sources of Mathematics Self-Efficacy and Mathematics Engagement

Table 4.7: Descriptive Statistics on Verbal Persuasion

Statements	Percentage Response (%)					Mean	SD Dev	Overall rating
	Never	Rarely	Sometimes	Often	Always			
My head teachers address is an inspiration	0 (0%)	0 (0%)	100 (50.2%)	30 (15.0%)	69 (34.8%)	3.84	.311	Never
Head teachers address makes me always carry math calculations	0 (0%)	0 (0%)	20 (10.0%)	30 (15.0%)	149 (75%)	4.65	1.420	Sometimes
Teachers' address inspired me faster to math	0 (0%)	0 (0%)	19 (9.0%)	150 (75.0%)	30 (16.0%)	1.59	.917	Never
Model teacher encourages my engagement to math	0 (0%)	19 (9.0)	0 (0%)	10 (5.0%)	170 (86.0%)	1.51	1.143	Never
My parents inspire me to math	0 (0%)	0 (0%)	0 (0%)	30 (15.0%)	169 (85.0%)	1.23	.312	Never
Math club is an inspiration towards engagement	0 (0%)	0 (0%)	0 (0%)	29 (15%)	170 (85.0%)	1.14	.498	Never

Source: Primary data, 2022

The study revealed that students who are persuaded are highly engaged in mathematics than those who are not easily persuaded.

Qualitative results are in agreement with quantitative results whereby one of the participants expressed that

“I have been able to verbally persuade some of students in getting seriously engaged in mathematics and the results have so been realized” (Field Data, 2022).

Another teacher participant mentioned

“My students just hate mathematics because of hearsay from the wrong perceptions in the school community but with good verbal persuasion; students can get engaged in mathematics” (Field Data, 2022).

Relatedly, another teacher participant asserted that

“I believe that most of the students can well get engaged if teachers are motivated to persuade the students to get engaged in mathematics and they do with other subjects. Students lack good career guidance about the benefits of the subject and hence don't give it much importance” (Field Data, 2022).

Another participant said

“I think that given serious attention by all the stakeholders, most of the students would improve on their engagement in mathematics than they are doing now. Therefore, just a little push and motivation would encourage more students get engaged” (Field Data, 2022).

Relationship between Physiological (and emotional) State Experiences and Mathematics Engagement of Students in Secondary schools in Nyimbwa Sub-County

Table 4.9: Descriptive Statistics of Students' Responses to Items Related to Physiological State Experiences during Mathematics Learning

Statements	Responses(N = 129)					Mean	SD	Overall rating
	Never	Rarely	Sometimes	Often	Always			
Just being in mathematics class makes me feel stressed and nervous	100 (77.5%)	29 (22.5%)	0 (0%)	0 (0%)	0 (0%)	1.22	0.419	Never
Doing mathematics work takes all my energy	79 (61.2%)	50 (38.8%)	0 (0%)	0 (0%)	0 (0%)	1.39	0.489	Never
I start to feel stressed-out as soon as I begin my mathematics work	99 (76.7%)	30 (23.3%)	0 (0%)	0 (0%)	0 (0%)	1.93	1.696	Rarely
My mind goes blank and I am unable to think clearly when doing mathematics work	80 (62%)	24 (18.6%)	25 (19.4%)	0 (0%)	0 (0%)	1.57	0.798	Never
I get depressed when I think about learning mathematics	108 (83.7%)	21 (16.3%)	0 (0%)	0 (0%)	0 (0%)	1.65	0.312	Never
My whole class becomes tense when I have to do mathematics	84 (65.1%)	45 (34.9%)	0 (0%)	0 (0%)	0 (0%)	1.7	0.957	Never

Source: Primary data, 2022

The results from the study furthermore asserted that students with good physiological state lead to better mathematics engagement.

Qualitative results were in agreement with quantitative results whereby one of the participants expressed that “Physiological state of students plays a pivotal role on student mathematical engagement” (Field Data, 2022).

Another participant mentioned

“My students in good physiological state are more engaged in mathematics than those with low physiological state” (Field Data, 2022).

Relatedly, another participant asserted that

“I believe that most of the students that are with good physiological state are more mathematically engaged than others that have low physiological state” (Field Data, 2022). Another participant said “I think that having a high physiological mood is good for students' engagement in mathematics among mu students” (Field Data, 2022).

CONCLUSIONS

Based on the findings of this study it can be concluded that; it's statistically proved that mastery experience positively relates to mathematics engagement, findings also pointed out that vicarious experience relates negatively to mathematical engagement, furthermore results pointed out that verbal persuasion positively relate with mathematics engagement, findings also pointed out that physiological state relate positively with mathematical engagement all the above among secondary school students in Nyimbwa Sub-county in Luweero District

RECOMMENDATIONS

The study recommends; that teachers of mathematics should ensure they give regular feedback to the learners in regards to their performances since they motivate them to engage more. Students have also got to know that the failure in Mathematics of their peers does not necessarily mean they will fail as well. Furthermore about the need by school authorities such as the head teacher, director of studies and teachers to continuously consider rewarding and persuading their learners to engage more. Lastly that the government needs to educate and sensitize the school administrators to cater for their students' wellbeing, carry out effective teaching to enable them have mastery experience in order to get engaged in mathematics and excel in their academics.

Areas for Further Research

The researcher suggests that further research should be done on the relationship between mastery experience, vicarious experience, physiological state and mathematical engagement in different sub-counties. This will help in creating awareness among head teachers on how to help the students become more engaged in mathematics and hence improve their performance.

The researcher suggests that further research should be done to establish not only teachers' understanding of such evidence-based strategies, but also the degree to which these strategies are actually being implemented in the classroom. This will help to understand the extent at which strategies of engagement are implemented. In this respect, further research should look at how practicing teachers understand and foster behavioural engagement, as well as establish whether these strategies are being implemented effectively.

The researcher also suggests that further research should seek to establish teachers' understanding of the importance of developing positive relationships as a strategy to increase students' sense of belonging, and subsequently, students' emotional engagement in their learning. There is also a corresponding need to establish if effective strategies to support students' emotional engagement are in fact being implemented in the classroom.

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