



RESEARCH ARTICLE

GENDER, SELF-EFFICACY BELIEF, SOURCES OF SELF-EFFICACY ASSOCIATED TO ACADEMIC ACHIEVEMENTS IN APPLIED MATHEMATICS: THE CASE OF FIRST YEAR ENGINEERING STUDENTS OF SOUTH WESTERN UNIVERSITIES OF ETHIOPIA

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ABSTRACT

Research works the relationship between students' mathematics self-efficacy and academic performances are scarce in African context. This study, therefore, is conducted to fill this gap. 218 first year engineering students completed scales on self-efficacy belief and sources of self-efficacy beliefs in math. The result indicated moderate mean on both variables. 19.3% of the variance on first semester grade in applied Math I explained by performance experience; and 21.4 % of the variance on first semester grade in applied Math I was explained by students self efficacy belief in math I. The independent sample t test revealed statistically significant mean differences between male and female students on mean scores of self efficacy belief in math I and first semester academic grade in applied math I but not statistically significant mean differences on all of sources of self efficacy belief in Math. Further study on the applicability and generalizeability of the findings with more rigorous design in other contexts is one of the recommendations.

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INTRODUCTION

Globally, it is well documented that mathematics education in university level is bounded by several challenges. Several of the challenges reside on the student level, instructor level and institutional level (Brewer, 2009). Ethiopia is not free from these challenges. Among the challenges, students' academic performance and the perception among students that mathematics is a difficult subject to learn are the main ones (Eshetu, Dilamo, Tsfaye & Zinabu, 2009). Students' academic performances in Mathematics have continually becoming a challenge at all levels of education. For example, the recent students' National Learning Assessment (NLA) in grade 4, 8 and 10 shows that students' performances in Mathematics are discouraging (NLA, 2011). In higher institutions, as a long time instructor of Mathematics, the Co-author of this proposal experiences that several students have low self efficacy belief in math and score a fail grade in applied mathematics course at Jimma University, Technology Institute.

In spite of these challenges, Ethiopia designs a policy with respect to the proportion of students' intake in higher institutions to the various streams. The policy dictates that 70% of students' entry in a university should be in science and technology streams which require a good understanding and skill of science and mathematics (Eshetu *et al.*, 2009). As a result, a significant number of students who join the technology stream need to have adequate understanding and skill in science and mathematics. However, the current trends shows that students' knowledge and skill in math is not encouraging (NLA, 2011; Eshetu *et al.*, 2009). Different factors could be responsible for academic performances in Mathematics. In addition to the cognitive factors affecting mathematics performances, the literatures indicate that the non cognitive factors play paramount role in influencing students' academic achievement in math. In line with this, Higbee and Thomas (cited in May, 2009) reveal the importance of the affective domains in influencing mathematics achievement and also point out the deficiencies of teaching only the content of mathematics to have student who are good at math. They indicate that the university instructors need to think of strategies in promoting students' affective domains besides teaching the content. The most important affective domain is

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students' self efficacy. A number of scholars indicate the importance of self efficacy in influencing students' academic performances in mathematics (for example, Eshetu *et al.*, 2009; Hutchison, Follman Sumpter & Bodner, 2006) and also some scholars find out that self efficacy beliefs predict significantly academic performances of students (for example, Zimmerman, 2000). Moreover, various scholars indicate that source of self-efficacy as an important variable in influencing students' academic achievements (Bandura, cited in May, 2009; Usher & Pajares, 2009; Zeldin, Britner, & Pajares, 2008). Various scholars also report inconsistent findings with respect to the relationship of gender to students' self-efficacy belief and sources of self-efficacy belief (Pajares & Miller as cited in May 2009; Hall & Ponton as cited in May 2009). Therefore, it is imperative to study how gender, self-efficacy belief and sources of self-efficacy affecting students' academic performance in mathematics in Ethiopian context.

Statement of the Problem

Ethiopia, as one of developing nation in the world, needs to have adequate and well qualified graduates to sustain the rapid economic development of the country and attain the country's Growth and Transformation Plan (GTP III). Specifically, the government of Ethiopia strongly believes that the country's development could be sustained and ensured with adequate and well qualified Engineering professional, among others. As a result, effort should be there to pin point those factors that could possibly thwarted the quality of graduates' in engineering fields. As long time instructor of Mathematics, the Co-author of this proposal witnessed most students perceive mathematics as a difficult subject and as a result refrain from investing the necessary effort. Though it is more than three decades Bandura coined the term self efficacy and a number of research conducted on the area, self efficacy still is bounded by a number of limitations. One of the limitations is that most of the research in area of self-efficacy belief are conducted in Western nations with little emphasis on African context and scholars advocate the importance of conducting similar studies in African contexts too (Mwamwenda, 2009). In line with the above mentioned gap, this research is designed with the aim of investigating the magnitude of first year engineering students on self efficacy and sources of self efficacy beliefs in applied Mathematics I; difference on self efficacy belief, sources of self efficacy belief and academic achievements in applied Mathematics I by gender; how well sources of self efficacy belief predicted students self efficacy belief in applied Mathematics I; and how well self efficacy and sources of self efficacy belief predicted students in applied Mathematics I.

Consequently, the research addresses the following research questions

- What was the magnitude of first year engineering students self efficacy and sources of self efficacy belief in applied Mathematics I?
- Is there a difference on self efficacy belief, sources of self efficacy and academic achievements of applied Mathematics I by gender?
- How well self efficacy and sources of self efficacy belief predicted students academic achievements in applied Mathematics I?

- How well sources of self efficacy belief predicted students self efficacy belief in math I?

Operational Definitions

Mathematics self-efficacy: is a person's assessment of their capability to solve problems in Mathematics, and deal with Mathematics related tasks successfully and satisfactorily. Operationally, mathematics self-efficacy was measured using the Mathematics Self-Efficacy Scale used by May (2009) and adapted to suite the study purpose.

Performance Outcomes: students experiences in mathematics class, which include the positive and negative experiences

Vicarious Experiences: experiences through which students develop high or low self-efficacy through observing other people's performances in mathematics.

Verbal Persuasion: encouragement or discouragement pertaining to an individual performance in mathematics.

Physiological Feedback (emotional arousal): students' experiences of emotional arousal and how they perceive this emotional arousal influences their beliefs of efficacy.

Mathematical Achievement I: was operationalized as first semester students' letter grade in Applied math I.

Theoretical framework

The study used Bandura's theory of self efficacy. Self efficacy constitutes a person's beliefs concerning her or his ability to successfully perform a given task, the choice that a person made for a task, effort invested, determination to continue the task in the face of difficulty, the thinking pattern and emotional responses displayed (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996). Bandura (as cited in May 2009) assumes that self-efficacy beliefs are developed as individuals interpret information from four sources, namely, mastery experiences, vicarious experiences, verbal persuasion and physiological and emotional arousal of the individual to undertake a specific task as depicted in the Figure below.

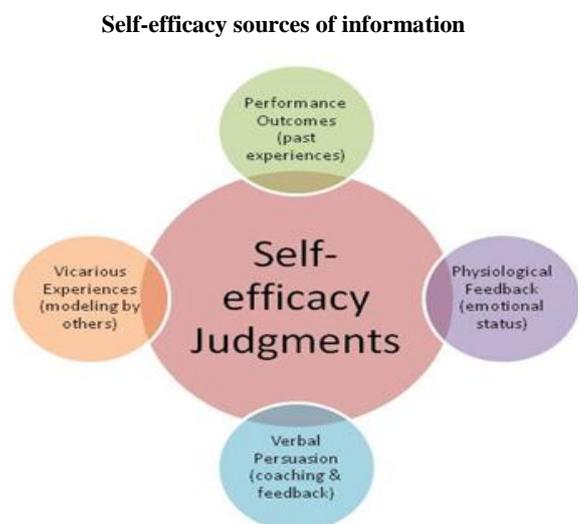


Figure 1. Sources of self-efficacy and self-efficacy belief

Usher and Pajares (2009) explain further how students self efficacy belief is built through the four source of self efficacy in educational contexts as follow. Mastery experience is considered the most powerful of all source of self efficacy in which students interpret and evaluate the results obtained after completing a certain academic task and then self efficacy belief is created or revised according to those interpretations. Students also construct their efficacy beliefs through the vicarious experience of observing others. Students are most likely to alter their beliefs comparing themselves to particular individuals such as classmates, peers, and adults as they make judgments about their own academic capabilities. Usher and Pajares stated that if students observe a classmate succeed at a challenging mathematics problem, for example, they would be convinced that they could also master the challenging tasks. The verbal persuasion and the physiological arousal contribute the least to self-efficacy belief formation (May, 2009). The verbal persuasions that students receive from others such as encouragement from parents, teachers, and peers whom students trust can boost students' confidence in their academic capabilities. The other source of self efficacy belief is emotional and physiological cues such as anxiety, stress, fatigue, and mood in which students interpret physiological arousal as an indicator of personal competence (Usher and Pajares, 2009). Researchers also report that students' self-efficacy beliefs are correlated with students' academic achievement. Specifically, with respect to the relationship between self efficacy with mathematics achievement, scholars argue that students perceive that Mathematics as a difficult subject to be understood and thus they are less likely to invest effort and develop less interest towards the subjects (Eshetu *et al.*, 2009; Tesfaye, 2009). The purpose of this study is, therefore, to investigate the magnitude and sources of self efficacy belief of first year engineering students in applied Mathematics I subject.

MATERIALS AND METHODS

Research Design

Across sectional design was used to find out the magnitude of first year engineering students self efficacy belief in applied Mathematics I subject and students' sources of self efficacy belief in applied I Mathematics subject.

Study site, Study participants and Sampling techniques

South western university was purposely selected as study sites on the ground that suitability for data collection. The study participants were first year engineering students who were selected from the South Western Universities (Jimma, Mettu and Wolkitie Universities). 218 students (120 students from Jimma, 48 students from Mettu and 50 students from Wolkitie universities based on proportional allocation method) were taken for the study.

Study instruments

Data were secured by means of a self efficacy scale and sources of self efficacy. A scale on self efficacy adapted from May (2009) was administered. The self efficacy scale contains 14 items which measure specifically mathematics self-efficacy

for college students. Students rate each item on a five point scale (1-Never; 2-Seldom; 3-Sometimes; 4-Often; 5-Usually). As an example, '*I feel confident to ask questions in my applied mathematics class*', '*I believe I can do well on applied mathematics test*' and '*I believe I can understand the content in applied mathematics course*' were some of the items included in the self efficacy scale. The sources of self efficacy scale, which was adopted from (May, 2009) originally contained 40 items but reduced to 36 items after the pilot test and various researches have shown that the test is reliable and valid (Edgar, 2014). Students rate each item on a five point scale (1-Never; 2-Seldom; 3-Sometimes; 4-Often; 5-Usually). Of which 8, 9, 9 and 10 items intended to measure performance accomplishments, vicarious information, verbal persuasion, and emotional arousal, respectively. As an example, '*I usually made high scores on my achievement tests in mathematics*', '*Most friends of mine did poorly in high school math courses*', '*I was often encouraged to join clubs in high school which required math ability*' and '*Mathematics makes me feel uncomfortable and nervous*' were some of the items included under performance accomplishments, vicarious information, verbal persuasion, and emotional arousal subscales, respectively. The psychometric qualities of the self efficacy and source of self efficacy scales were checked with a pilot test at Jimma University, taking 25 first year material engineering students from Jimma University technology institute. Based on the pilot test, some items were modified and even some items were deleted as they had low inter item correlation to their respective total number of items in each subscales. As an example, '*I am rarely able to help my classmates with difficult math problems*' from performance accomplishments scale, '*My favorite teachers were usually math teachers*' from vicarious information, '*My adviser has singled me out as having good math skills and has encouraged me to take college math courses*' from verbal sub scales were some of the items deleted. The inter item reliability estimate using Chronbach alpha (level) ranging from .724 to .961 which were rated as acceptable. See the table below. Interviews and FGDs guidelines were also prepared and used for the study too. In addition, self reported students' grades in applied math I for the first phase of study was collected.

Study procedures

Official letters of support from Jimma University were secured before starting the study. The data was collected in the middle of the semester using the following procedures.

The mathematics self efficacy and source of self efficacy scales were administered while students being in their normal classroom taking 30 to 40 minutes from applied Mathematics class. FGDs with students and interview with teachers were also conducted right after the administration of the instruments.

Analysis

Quantitative analysis

Mean score for the various subscales of source of self efficacy and self efficacy measure were computed to find out the magnitude of students' source of self efficacy and self efficacy.

Table 1. Pilot test result

Sub-scales	No. of Original items	No. of items deleted	No. of items for the study	level
Performance accomplishments	10	2	8	.724
Vicarious information	10	1	9	.837
Verbal persuasion	10	1	9	.736
Emotional arousal	10	None	10	.874
Self efficacy belief	14	None	14	.961

Table 2. Mean score on sources of self-efficacy belief among university students

Sources of Self Efficacy	Mean	St. Dev.
Performance accomplishments	3.55	.675
Vicarious information	3.30	.582
Verbal persuasion	3.57	.557
Emotional arousal	3.39	.716
Self efficacy belief	3.60	.814
First semester grade in applied m math I	2.37	1.62

Table 3. A correlation between source of self efficacy and self efficacy belief in math

Variables	1	2	3	4	5
1 Performance experience	1				
2 Vicarious experience	.461**	1			
3 Verbal persuasion	.585**	.490**	1		
5 Emotional Experience	.732**	.507**	.542**	1	
5 Self efficacy belief in Math	.725**	.481**	.442**	.524**	1

** . Correlation is significant at the 0.01 level (2-tailed)

Moreover, to check a significant mean difference among the four sources of self-efficacy belief in math, a repeated measures ANOVA test was conducted. Finally, a correlation analysis and step wise regression analysis was conducted to find out which source of self efficacy related and predicted students self efficacy score and academic achievements, respectively.

Qualitative analysis

Qualitative analysis was conducted by coding key data elements from the interview and FGDs transcripts seeking the smallest units that contain meaningful information. Furthermore, these categories and codes were merged to thematic areas. Possible themes, patterns and language within the interview and FGDs transcripts were explored in order to interpret meanings.

Finally, the quantitative data from the questionnaire and the qualitative evidence were synthesized and presented.

RESULTS

218 freshmen students from Jimma, Mettu and Welkite Universities participated for the study. Out of 218 students, 209 (96%) students filled out the questionnaire correctly. The mean age of the participants was 19.6 with a standard deviation of 1.26. On a five point scale (1 Never 2= Seldom 3=Sometimes 4 =Often 5=Usually), the mean score of the participants on sources of self efficacy were computed. The mean scores for performance accomplishments, vicarious information, verbal persuasion, and emotional arousal were 3.55, 3.30, 3.57, and 3.39, respectively. The highest mean score was obtained for performance accomplishment (M = 3.55) and the lowest mean score was obtained for vicarious experience (M = 3.30). To check a significant mean difference among the four sources of

self-efficacy belief in math, a repeated measures ANOVA test was conducted. The test revealed that statistically significant mean differences in the mean level of sources of math self-efficacy (Wilks' Lambda = .834, F (3, 243) = 5.173, p = .002, $\eta^2 = .166$). The multivariate $\eta^2 = 0.16$ indicated that the mean difference magnitude was partly large. The pair wise comparisons carried out with Bonferroni procedure showed that the level of performance accomplishments that students experienced as a source of math self-efficacy belief was statistically significantly higher compared to the level of vicarious experience; and the level of emotional arousal was significantly higher compared to the level vicarious experience. The mean score on self efficacy belief in mathematics among university students was 3.60 with a standard deviation of .81.

Relationship between source of self efficacy and self efficacy belief in math

Self efficacy belief had statistically significant positive relationship with all sources of self efficacy belief in math.

Performance experience exhibited a strong positive relationship with self efficacy in math ($r=.725$, $p=.000$); vicarious experience exhibited a moderate relationship with self efficacy in math ($r=.481$, $p=.000$); verbal persuasion exhibited a moderate relationship with self efficacy in math ($r=.442$, $p=.000$) and emotional experience exhibited a moderate relationship with self efficacy in math ($r=.524$, $p=.000$). A regression was performed to ascertain how well the sources of self efficacy belief in math predicted students self efficacy belief in math. The model explained 52.1 % of the variance on self efficacy belief in math. Performance experience significantly predicted students self efficacy belief in math, $b=.979$, $t=10.727$, $p=.000$.

Table 4. Beta coefficients, t value and significance lever for performance experience as predictor of students self efficacy belief in math I

	b	Std. Error	Beta	t	Sig.
Intercept	.054	.334		.161	.873
Performance experience	.979	.091	.725	10.727	.000

Table 5. A zero order correlation between source of self efficacy belief and academic achievement in math I

	1	2	3	4	5
1 Performance experience	1				
2 Vicarious experience	.461**	1			
3 Verbal persuasion	.585**	.490**	1		
4 Emotional Experience	.732**	.507**	.542**	1	
5 First semester grade in applied Math I	.445**	.194*	.138	.270**	1

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 6. Beta coefficients, t value and significance lever for performance experience as predictor of students first semester grade in applied Math

	b	Std. Error	Beta	t	Sig.
Intercept	.054	.334		.161	.873
Performance experience	1.123	.184	.445	6.093	.000

Table 7. A correlation between self efficacy and academic achievement in maths

	1	2
1 First semester grade in applied Math I	1	
2 Self efficacy belief in Math	.470**	1

** . Correlation is significant at the 0.01 level (2-tailed).

Table 8. Beta coefficients, t value and significance level of self efficacy belief in math I As a predictor of students first semester grade in applied Math I

	B	Std. Error	Beta	t	Sig.
Intercept	-1.05	.615		-1.708	.000
Self efficacy belief in Math	.930	.167	.470	5.582	.000

Table 9. Mean score on sources of self efficacy and self esteem by sex

	Sex	Mean	Std. Dev.	T	df	Sig. (2-tailed)
Performance experience	male	3.63	.637	1.581	165	.116
	female	3.46	.702			
Vicarious experience	male	3.31	.557	.742	173	.459
	female	3.24	.613			
Verbal persuasion	male	3.58	.563	.579	168	.563
	female	3.53	.552			
Emotional Experience	male	3.45	.692	1.341	164	.182
	female	3.29	.775			
Self efficacy belief in Math	male	3.73	.823	2.415	119	.017
	female	3.36	.771			
First semester grade in applied Math I	male	2.56	1.666	2.227	185	.027
	female	2.01	1.483			

The rest of the sources of self efficacy belief variables were not statistically significant predictors of self efficacy belief in math

Relationship between sources of self efficacy and first semester grade in applied Math I

Students first semester grade in applied Math I had statistically significant positive relationship with all sources of self efficacy except verbal persuasion. Students performance experience exhibited a moderate relationship with self efficacy in math ($r=.445$, $p=.000$), vicarious experience had a weak

relationship with self efficacy in math ($r=.194$, $p=.015$), verbal persuasion exhibited a weak relationship with self efficacy in math ($r=.138$, $p=.087$), emotional experience exhibited a weak relationship with self efficacy in math ($r=.270$, $p=.001$). A regression analysis was performed to ascertain how well the students' sources of self efficacy belief in math predicted students' first semester grade in applied Math. The model explained 19.3 % of the variance on First semester grade in applied Math I. Performance experience significantly predicted students self efficacy belief in math, $b=1.123$, $t=6.093$, $p=.000$. The rest of the sources of self efficacy

belief variables were not statistically significant predictors of self efficacy belief in math. The rest of the sources of self efficacy belief variables were not statistically significant predictors of self efficacy belief in math.

Relationship between self efficacy belief in math and first semester grade in applied Math I

Students self efficacy belief in math had a moderate and statistically significant relationship with students first semester grade in applied Math I ($r = .470$, $p = .000$). A regression analysis was performed to ascertain how well the students self efficacy belief in math I predicted students first semester grade in applied Math I. The model explained 21.4 % of the variance on First semester grade in applied Math I. Self efficacy belief in Math significantly predicted first semester grade in applied Math I, $b = .930$, $t = 5.582$, $p = .000$.

Difference on source of self efficacy, self efficacy belief and academic achievements in math by gender

With respect to gender difference in mean score of self efficacy, self efficacy belief and academic achievements in math, male respondents score better than female respondents in all of the variables as indicated below in the table. The independent sample t test, however, indicated that the observed differences on the all of sources of self efficacy belief in Math were not statistically significant. The observed mean differences on mean scores of source of self efficacy and self esteem were not statistically significant, $p > .05$. However, the test revealed that there were a statistically significant mean differences between male and female students on mean score of self efficacy belief in math ($t = 2.415$, $df = 119$, $sig = .017$) and first semester academic grade in applied math I ($t = 2.227$, $df = 185$, $sig = .027$).

Result of FGDs with students

Experience in applied math I and their experiences affecting their self efficacy in math previously

- *The discussants said that they were frustrated in learning mathematics and they lost their confidence because of*
- *The background they had in math was not good*
- *Teachers made them to frustrate learning the subject. When they made a mistake teachers discouraged them totally*
- *Teachers did not focus on explaining the topic rather they rush and try to cover chapters*
- *Teachers did not give us time to do exercise and they did not give us feedback*
- *When we started to study maths we get easily bored and become dependent on few talented students*
- *Solution to mitigate the problem*
- *The discussants pointed out the following points*
- *The teacher should not discourage us. Rather, words of encouragement are better*
- *Teachers should have to see whether we understood the content or not by giving exercise and feedbacks rather than trying to cover only the contents*

- *Encouragement and follow-up from teacher should be there and hard working from their part may change the situation*

Interview with math teacher

- Teachers were also interviewed. The interviewed teachers responded as follow.
- *What do you think the problem in math while you are teaching?*
- *The interviewed teachers said that problem in math is mainly related to students' background. Student loses confidence easily, become frustrated and stop working hard in math.*
- *One of the interviewed teacher said that I admit that we didn't consider whether students understand the lesson or not because the chapter are too large to be covered and large class size*

DISCUSSION

The objectives of the study are to investigate the magnitude of first year engineering students self efficacy belief and to assess the magnitude of first year engineering students' sources of self efficacy belief in applied Mathematics I; examine differences on self efficacy belief, source of self efficacy belief and academic achievements of applied math I by gender; investigate how well self efficacy and sources of self efficacy belief predicted students academic achievements in applied math I and investigate how well sources of self efficacy belief predict self efficacy belief in math I in first year engineering students at Jimma, Mettu and Welkiteie Universities. To this end, the study come up with first year engineering students exhibited a moderate sense of self-efficacy in maths. Though it is in different domains and level, this finding is consistent with the findings of Kiran (2010). Kiran find out that students self efficacy beliefs in elementary science are moderate. The study also finds out moderate level of the various sources of self-efficacy beliefs. This finding is also consistent with the finding of other researcher. Kiran (2010) reveal that the sources of self-efficacy beliefs are from performance accomplishments, vicarious information, verbal persuasion and emotional arousal. Similarly, the sources of self-efficacy belief differ significantly in this research. There is a statistical significant difference between the level of performance accomplishments and level of vicarious experience; and the level of emotional arousal and the level vicarious experience. The study shows that performance accomplishments and vicarious information are significant predictors of first year engineering students self efficacy belief in math. In line with this finding, Bandura (as cited in May 1997) report that students who feel they master the skills and succeed at challenging assignments experience a boost in their efficacy beliefs. The largest contribution to the prediction of math self-efficacy is made by performance accomplishments. This finding is also consistent with the finding of Loo & Choy (2013). Loo and Choy showed that performance accomplishments are significant predictors of first year engineering students' self-efficacy belief in math and related engineering courses.

However, vicarious, verbal persuasion and emotional arousal do not predict significantly first year engineering students' self-efficacy belief in math similar to the existing literatures. Several findings have shown that performance experience as powerful tool as a source of self efficacy belief followed by vicarious experiences with little contribution of the verbal and emotional arousal sources of self efficacy (May, 2009). The reason might be the cultural difference in countries as indicated by the cross-cultural study of Klassen (2004). The culture can play an important role concerning the sources of students' self-efficacy. More specifically, Klassen's study reveal that while Anglo Canadian students use mastery experience and emotional arousal as the leading sources of their math self-efficacy, indo Canadian students use the four sources of self-efficacy beliefs. In this research we discover a statistical significant relationship between students self-efficacy belief in math and students academic achievement in applied math I consistent with the findings of several studies. There are growing bodies of research works showing a relationship between self-efficacy beliefs and academic performance. Several of research works show that the correlations between self efficacy and Mathematics are positive and statistically significant (Williams as cited in Mwamwenda, 2009) consistent with the findings of this research.

The research also finds out that male students score better on all of the four sources of self efficacy and self esteem. However, the findings are not statistically significant with respect to source for self efficacy belief in math. There are inconsistent research findings on gender differences on source of self-efficacy and mathematics self-efficacy. A research done by Zeldin *et al.* (2008) indicate that mastery experience is the primary source of the men's self-efficacy beliefs while social persuasions and vicarious experiences are the primary sources of self-efficacy beliefs. Some researchers find out a significant difference between the mathematics self-efficacy of male and female students, with male students score significantly higher levels of mathematics self efficacy than female students (Pajares & Miller as cited in May 2009) consistent with the present findings. Female students' lower levels of mathematics self-efficacy may be due to commonly held beliefs that mathematics is a male-dominated field or that female students are not typically good at mathematics. Such beliefs lead female students to think that they should not be good at mathematics, regardless of effort invested. On the contrary, some researchers did not get statistically significant mean differences between male and female students in mathematics self-efficacy (Hall & Ponton as cited in May 2009) which is inconsistent with finding of the present research.

Conclusion

The present study aim at investigating the magnitude of first year engineering students' self efficacy belief and assess the magnitude of first year engineering students' sources of self efficacy belief in applied Mathematics I; examining differences on self efficacy belief, source of self efficacy belief and academic achievements of applied math I by gender; investigating how well self efficacy and sources of self efficacy belief predicted students academic achievements in applied math I and how well sources of self efficacy belief predicted

self efficacy belief in math I in first year engineering students at Jimma, Mettu and Welkiteie Universities. The study is not without limitations. The first limitation is that the study used a cross sectional design which could be difficult to tell the cause and effect relationship among the variables in this study. The second limitation lies on the representation. Though the study is done on students of the three universities located in South Western Ethiopia, it is difficult to generalize the findings of the study to other universities as contextual differences could tell different story. In spite of these limitations, however, the study comes up with the following important findings.

- The study finds out that the magnitude of self efficacy belief among students and also the various sources of self efficacy belief are moderate. High level of students' self-efficacy in math is a necessary ingredient to invest an effort in math and earn a high grade eventually. However, the moderate self efficacy belief students show in math undoubtedly affects negatively students' engagement and academic performance in applied math.
- Similarly, students rate all the source of self efficacy belief as moderate which implies that students had experienced an environment that enhance all sources of self efficacy to moderate extent, namely performance accomplishments, vicarious information, verbal persuasion and emotional arousal. However, the environment students experienced in relation to the various sources of self efficacy beliefs should stimulate the mathematics self efficacy belief to a greater extent and also students need to have an opportunity to develop their self efficacy beliefs from the various sources.
- The research also come up with students self efficacy belief and performance experience significantly predict students' academic achievements in applied math I and also the performance experience predict significantly the self-efficacy belief of students in math similar to the research done in Western cultures. Thus, the performance experiences as source of self efficacy belief could be considered as a precursor for enhancing first year engineering students' math self-efficacy belief and academic achievements in the study site.
- The research came up with differences between male and female students in self efficacy belief and academic achievements in favor of male. In a time when there is much attention to female students pertaining to academic issues, such difference is not expected. This gap undoubtedly signifies a gender disparity in science and engineering fields is still an issue in Ethiopia.

Recommendations

The study comes up with important findings. Based on the findings, the following recommendations are made for policy makers, instructors and University's officials.

- Students' self-efficacy belief need to be enhanced to a greater extent through appropriate intervention as the self efficacy belief in math is moderate in this study. One intervention could be aimed at enhancing students' source of self-efficacy beliefs at a class room level through appropriate classroom strategies.

- The concerned bodies need to think of strategies of promoting female students' self-efficacy belief in math and also there should be a work to increase female students' academic achievements in math.
- In the intervention process, performance experience should get due attention from the concerned parties,
- Further studies with larger sample; and also in other setting is necessary to generalize the present study to other educational contexts.

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