Factors Influencing Students' Academic Achievement in Linear Algebra.

Kati Robert
Department of Science and Mathematics Education,
Kibabii University, Kenya
rkati@kibu.ac.ke

Abstract
This study investigated the relationship between students' year of study, gender and academic achievement in Linear algebra in a selected university in Kenya. One hundred and one 3rd and 4th year students were sampled for the study. The students were taught the same content by the same lecturer. An achievement test was then administered to them. The relationship between the selected variables and academic achievement in Linear algebra was tested using t-test at 0.05 level of significance. The study found that students' gender was not significantly related to academic achievement in Linear algebra. Students' year of study was significantly related to academic achievement in Linear algebra. It is anticipated that the findings of this study will give curriculum developers new insights into emerging issues on performance and influence the Ministry of Education on policy formulation.

Key words: *Gender, academic achievement, year of study.*

1.1 Introduction

Since Linear algebra course is one of the most important subjects of mathematics, which are the basis of abstract algebra, students are required to learn them at a higher level (Ozdag & Aygor, 2011). Only about one half of the students enrolled in a college algebra course in college are likely to complete this course successfully despite the fact that college algebra is essentially mathematics that a well-prepared student should have completed in high school (Hofacker, 2006). Analyses indicate that much of the increase in students' long-term trend results comes from growth in mathematical topics. A focus on reasoning and sense making, when developed in the context of important content, will ensure that students can accurately carry out mathematical procedures, understand why those procedures work, and know how they might be used and their results interpreted" (NCTM 2009, p. 3). In a broader sense, a focus on reasoning and sense making is needed to prepare students for using mathematics in the classroom; in the workplace, including scientific and technical communities; and in life.

Concerns about students' college mathematics performance have been raised for some time (National Commission on Excellence in Education, 1983). Ozdag and Aygor (2011) observed that students solved the concrete problem, which was given before, using a routine process without any thought. Also when the students were asked an abstract example, their rate of success dropped. After examples of this style were given by the lecturers, another abstract question was asked at a different time, it was observed that the student had developed their perspective and more students got the answer correct.

Hill and Parker (2006) used a sample of more than 3,000 students in studying performance in mathematics course work at a large mid-western university, and reported that students who completed the Core-Plus mathematics curriculum in high school began their

university mathematics course work with less difficult courses and subsequently completed even less difficult mathematics courses than students who did not complete Core-Plus in high school. Males were more likely to take more difficult initial college mathematics courses for each stratum and students with a humanities' major were more likely to take more difficult initial college mathematics courses relative to students in other majors (NCTM, 2010). In the United States female students enrolled in advanced math courses at the high school and college levels out perform their male colleagues (Bridgeman & Wendler, 1991; Kimball, 1989; Stout et al., 2011).There is also no evidence for gender differences in overall aptitude for mathematics (Spelke, 2005). Yet, women are still less likely to enroll in majors or domains that require taking mathematics courses (Aziz et al, 2015).

Many studies have been conducted to investigate the effects of age on students' achievement. There are studies that show insignificant differences in achievement in algebra across age groups (Abubakar et al., 2011 and Josiah, O & Etuk-iren, O.A, 2014). A study showed that (i) the correlation between age and school achievement diminishes as students become older; (ii) schools provide equalizing experiences and thus the longer the students study in the schooling process, the more the impact of the age on students' achievement is diminished (White, 1982). In addition, as the students move up the age, more students drop out of school, thus reducing the magnitude of the correlation. On the contrary, results from longitudinal studies have contradicted White's results by demonstrating that there is a gap in students' achievements as students get older (Walker et al., 1994). Also there was evidence that older children fared better academically than the younger ones (La Paro et al., 2000)

Linear Algebra is a unifying and generalizing theory. The unifying and generalizing nature of linear algebra has a didactical consequence: it is difficult to motivate the learning of new theory because its use will be profitable only after it may have been applied to a wide range of situations. (Dorier, Robert, Robinet, & Rogalski, 2000). Mathematics education research first developed works on calculus, but in the past 20 years, many studies have been carried out about the teaching and learning of linear algebra (Dorier, 2002).

As research findings have shown controversial results regarding the male and female performance in mathematics, this study investigated the effect of student gender on university students' performance in linear algebra. And as the literature has rarely examined the effect of a students' year of study on performance in linear algebra, this study also investigated any possible influence a students' year of study on performance in linear algebra.

1.2 Objective of the study

The main objective of the study was to investigate the relationship between students' year of study, gender and academic achievement in Linear algebra in a selected university in Kenya

1.3 Hypotheses of the study

The study sought to test the following hypotheses**:**

1. There is no significant relationship between university students' gender and achievement in linear algebra.
2. There is no significant difference between 3rd and 4th year university students' achievement in linear algebra.

1.4 Methodology

The study adopted Ex post facto research design.

The sample in this study consisted of 101 university students enrolled in a public university in Kenya. The sample comprised of 75 third years and 26 fourth years. The students were taught by the same lecturer using the same course content and pedagogy. Students' achievement in the linear algebra I course was based on their performance in two tests, and a final exam. Tests 1, and 2 accounted for 30 % of the total mark and the final exam accounted for 70 %.

Linear algebra I is a basic introductory algebra course designed to introduce students to the basic concepts of algebra.

2.0 Results

The study sought information on students' performance in linear algebra in order to use the data to establish the relationship between the students' year of study, gender and academic achievement in Linear algebra.

2.1 Hypothesis one

There is no significant relationship between university students' gender and achievement in linear algebra.

An independent-samples t-test was conducted to compare achievement in linear algebra for males and females. The results of the analysis to test the above hypothesis is summarized in tables 1 and 2

Table 1

Group Statistics					
Sex		N	Mean	Std. Deviation	Std. Error Mean
Marks for the students	Male	75	61.3333	12.84664	1.48340
	Female	26	64.7692	10.48926	2.05711

Table 2

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Marks for the students	Equal variances assume	2.041	.156	-1.228	99	.222	-3.43590	2.79795	-8.98763	2.11583

	d									
	Equal variances not assumed			-1.355	52.925	.181	-3.43590	2.53618	-8.52299	1.65120

From the analysis, there was no significant difference in scores for males (M = 61.333, SD = 12.84664) and females [M = 64.7692, SD = 10.48926; t(99)= -2.28, *p* = .222]. The magnitude of the differences in the means was very small (eta squared=.04774). Based on the data, the study therefore failed to reject the null hypothesis and concludes that there is no relationship between students' gender and academic achievement in linear algebra.

2.2 Hypothesis two

There is no significant difference between 3rd and 4th year university students' achievement in linear algebra.

An independent samples t-test was conducted to compare achievement in linear algebra for third and fourth year students. The results of the analysis to test the above hypothesis are summarized in tables 3 and 4.

Table 3

Group Statistics					
Academic year		N	Mean	Std. Deviation	Std. Error Mean
Marks for the students	Year 3	75	60.6400	12.70735	1.46732
	Year 4	26	66.7692	10.03318	1.96767

Table 4

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Marks for the students	Equal variances assumed	2.315	.131	-2.228	99	.028	-6.12923	2.75105	-11.58791	-.67055
	Equal variances not			-2.497	54.809	.016	-6.12923	2.45453	-11.04861	-1.20985

	assumed										

From the analysis, there was a significant difference in scores for third year students (M = 60.6400, SD = 12.70735) and fourth year students [M = 66.7692, SD = 10.03318; t (99) = -1.228, p = 0.222]. The magnitude of the differences in the means was very small (eta squared =.015). Based on the data, the study therefore rejected the null hypothesis and concludes that there is a difference between 3rd and 4th year university students' achievement in linear algebra.

3. Discussions

This study analyzed the relationship between students' year of study, gender and academic achievement in Linear algebra in a selected university in Kenya.

The study found that students' gender did not significantly affect achievement in linear algebra. The finding concurs with Spelke (2005) who concluded that there was no significant relationship between students' gender and academic achievement. Contrary to findings that students' gender was a prime predictor of academic achievement (Bridgeman & Wendler, 1991; Kimball, 1989; Stout et al., 2011). The study also found that a students' year of study contributes to their achievement in linear algebra. The significant differences in achievement in linear algebra across years of study in this study agrees with Walker et al. (1994) and La Paro et al. (2000), but disagrees with Abubakar et al. (2011) and Josiah, O & Etuk-iren, O.A (2014).

4. Conclusions

The study concluded that students' gender did not have significant effect on academic achievement in linear algebra. However, students' year of study significantly affected academic achievement in linear algebra.

5. Recommendation

The study recommends the need to establish the reasons for lower in linear algebra by 3rd years yet linear algebra is a prerequisite course in many mathematics courses

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