International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 7 Issue 4, April 2020

ISSN: 2394-4404

Relationship Between Learning Setting, Ability And Achievement In Mathematics Among Male Secondary School Students In Kisumu County, Kenya

Ferdinand Ukanda

Lucas Othuon

Department of Educational Psychology, Maseno University,
Private Bag, Maseno, Kenya

Abstract: ***Learning settings can be established using students of different ability levels namely; high ability, medium ability and low ability. The learning settings may have students of similar or mixed ability and this may affect their achievement on mathematics tasks. The purpose of the study was to determine the relationship between learning setting, ability and the interaction between ability and learning setting. A factorial research design was used in the study. The independent variables were learning setting and ability level. The dependent variable was achievement in mathematics test. The population of the study consisted of 240 Form Three students from a public boys' secondary school. A stratified random sampling technique was used to select a sample of 48 students. The stratifying criterion was the ability level across streams. Findings of the study indicated that student ability had a significant effect on achievement in mathematics ($p<.05$). However learning setting did not have a significant effect on performance in mathematics ($p>.05$). The interaction between learning setting and ability did not have a statistically significant effect on achievement in mathematics ($p>.05$). The findings are of significance to teachers, educational policy makers, test developers and test users.***

Keywords: ***Learning setting, Ability grouping, Ability level, Mathematics achievement, Analysis of variance.***

I. BACKGROUND TO THE STUDY

Secondary schools in Kenya place their learners into learning units consisting of small groups of about four or five students or a large group of about forty students. The composition of the learning units by ability of the students has raised concerns to school administrators. Ability may be classified as high ability, medium ability and low ability, according to achievement test results. The high ability students have a high capacity of understanding the tasks presented to them. The capacity of the medium ability is lower than that of the high ability while that of the low ability students is lower than that of the medium ability students. The ability level can be used to establish different learning units among the learners. Students of similar ability can be placed into one learning unit in a practice that is known as streaming according to ability. Mixed ability learning units can also be established consisting of students of varied ability.

According to Smith (2011), students engage in individual learning of mathematics concepts when they are placed in learning settings of similar ability. On the other hand the mixed ability learning setting can encourage students to consult with each other and therefore enhance their learning opportunities. Hetherington and Parke (1993) were influenced by Vygotsky's social cultural theory which states that development is as a result of interaction between the child's social world and its cognitive development and with partners who jointly solved problems together. This interaction can be determined by the composition of the partners in terms of ability. The partners can help each other in solving problems together. Subsequently they can solve the problems on their own when the help is gradually withdrawn.

Mark (2011) observed that most learning units consist of students of mixed ability. The learning units were established according to comprehensive test scores, enabling schools to place students randomly into classes according to how soon they reported to school. This random placement of students resulted in the formation of learning units consisting of students of similar or those of mixed ability. Mansor et al (2016) observed that some schools created learning units of similar ability in varied ways. In some schools, the bright students were purposively placed in one classroom while the weak ones were placed in another. It was also noted that in some instances the bright students were asked to sit in front of the class while the weak ones sat at the back.

Though teachers may have mixed feelings about the most appropriate way of establishing learning units, learning settings may have some influence on the learning outcomes of the students. The design of a learning setting is quite important since different kinds of settings encourage and optimize certain kind of behavior while minimizing and discouraging others (Dukmak, 2009). For instance it is perceived that a similar ability learning setting may promote competitive instincts while a mixed ability setting may encourage co-operation among the learners (Smith, 2011).

Hallam and Ireson (2003) observed that a learner interacts with the learning environment, changes it and is in turn changed by the consequences of his actions. It is therefore important that before a school decides on which method to use in establishing learning units for its students it must consider the kind of learning environment that is being created. This can be better understood if the relationship between the learning setting, ability and student achievement is understood. Therefore the purpose of the study is to determine the relationship between learning setting, student ability and student achievement in mathematics.

OBJECTIVES OF THE STUDY

The objectives of the study were to:

- ✓ Determine the relationship between learning setting and achievement in mathematics.
- ✓ Determine the relationship between ability and achievement in mathematics.
- ✓ Determine the relationship between the learning setting, ability and achievement in mathematics.

II. METHODOLOGY

RESEARCH DESIGN

A factorial research design was used in this study. In a factorial design the researcher can modify certain variables and observe the effect of these modifications on the variable of interest (Kerlinger, 1986). In this design, every possible combination of factor levels was observed and therefore the set of factors was completely crossed. The design was therefore used to investigate the effects of learning setting and student ability on achievement in mathematics. The independent variable is learning setting having two levels; individual and the group learning setting. Student ability had three levels namely high, medium and low ability levels. The dependent variable was measured using a mathematics achievement test.

POPULATION

The population of the study consisted of 240 Form Three students from an urban secondary school that streamed its students according to ability. The school was selected purposively because it is a boys' school that streamed its students according to ability. The school had six streams which were considered large.

SAMPLE AND SAMPLING TECHNIQUE

Stratified random sampling technique was used to select 48 students. The stratifying criterion was based on the classification of streams in terms of Ability.

Stream	3A	3B	3C	3D	3E	3F	Total
Population	40	38	41	42	37	42	**240**
Sample	12	0	12	12	0	12	**48**

Table 1: Student Sample by stream

Table 1 shows how a stratified random sample was selected with an equal number of students from four of the six streams. The 3A stream was classified as the high ability group. The medium ability group was represented by the 3C and 3D streams while the low ability group was represented by the 3F stream. The actual selection was done by putting names of all the students in a box and picking 12 of them at random. The selected students were then used to form twelve groups each consisting of one high ability, two medium ability and one low ability student. The composition of the twelve groups was described in Table 2.

Ability	Groups												
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**TOTAL**
High	1	1	1	1	1	1	1	1	1	1	1	1	**12**
Medium	2	2	2	2	2	2	2	2	2	2	2	2	**24**
Low	1	1	1	1	1	1	1	1	1	1	1	1	**12**
Total	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**48**

Table 2: Sample distribution by ability and groups

Table 2 shows how the students from each stream were assigned to the twelve groups according to their ability level. The names of the twelve students were put in four different boxes each representing the high, medium and low ability strata. A name was randomly picked from each box and assigned to a group. This was done to ensure that a group had one high ability student, two medium ability students and one low ability student. These groups were used in the group learning settings.

INSTRUMENTATION

A mathematics achievement test was used in the study. The test consisted of complex questions on Algebra. The test was scored on a 0-10 point scale, with the minimum possible score of 0 and the maximum possible score of 10. The test was pretested with similar students from a parallel school. An internal consistency reliability coefficient (Cronbach's alpha)

of 0.75 was obtained. The test was also assessed by research experts from the department of Educational Psychology at Maseno University to ensure it had face validity.

DATA COLLECTION PROCEDURE

The instructor gave the students in the study some learning materials which consisted of instructional booklets and their answer booklets; some complex questions and a package of stepwise solutions to the complex questions on Algebra. The students were shown how to use them to solve basic problems. They worked alone and consulted with the instructor after studying all the hints. They thereafter worked through the complex questions. This was done on some particular concepts on Algebra which were learnt individually.

The students then worked in groups of four with the learning materials consisting of concepts on algebra which were different from those done individually. Each group consisted of one high ability student, two medium ability students and one low ability student. The students were shown how to help each other in solving problems and solicit for explanations from each other in case of difficulties. It was assumed that the mathematics concepts were new and the students had not had any prior knowledge of the concepts. The topic selected had not been taught in class during their normal class lessons. It was also assumed that there was no differential teacher effect and that the data collected was purely as a result of the experimental conditions.

After the last learning sessions the students were given a mathematics test which was administered under power conditions. The test consisted of complex items which tested the concepts learnt in the individual learning setting and the group learning setting. The tests were administered under the supervision of the instructor while strictly observing the examination ethics. They sat for the tests alone and no consultations were allowed. The tests were scored, coded and entered for further analysis.

METHODS OF DATA ANALYSIS

Analysis was done using the Statistical Package for Social Sciences (IBM SPSS Version 20) computer software. Descriptive statistics was used to describe the scores in the individual and group setting. A bar graph was used to display the descriptive data while comparing the performance in the individual and group settings. Two way Analysis of variance was used to test the main and interaction effects of ability and learning setting on the scores on a mathematics test. The level of significance was 0.05 with 1,42 degrees of freedom for the learning setting alone, 2,42 degrees of freedom for ability alone and 1,42 degrees of freedom for the interaction of ability and learning setting. Post-Hoc Tukey statistic was used to compare the difference among the means where the difference was statistically significant.

III. RESULTS

MEAN SCORES FOR EACH ABILITY LEVEL IN THE LEARNING SETTINGS

The mean scores at each ability level were determined at both the individual and group settings.

Table 3 shows the mean scores for ability and the learning settings.

Ability	Group Setting	Individual Setting
High	8.33	7.50
Medium	7.92	7.33
Low	5.67	5.00

Table 3: Mean scores for varied ability and the learning settings

From Table 3, it can be seen that the mean score for the group setting was higher than that of the individual setting regardless of the ability level. The group setting therefore improved the performance of the students in all the ability levels over the individual setting. It was therefore seen that ability contributed to the variations in the mean scores while the learning setting contributed slightly, especially for the low ability students, to the variations in the mean scores of the students.

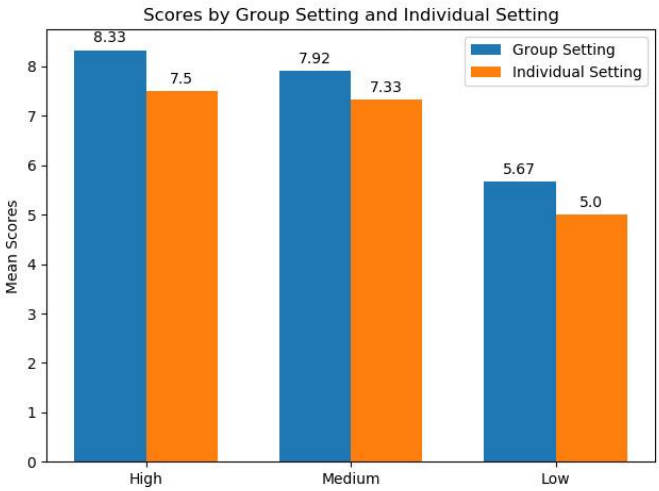

Figure 1: Mean Scores by Group Setting and Individual Setting for High, Medium and Low ability students

Figure 1 shows the graph of the relationship between the mean scores of the students of varied ability levels in the individual and group settings. It can be seen from Figure 1 that the performance of students was better in the group setting than the individual setting regardless of the ability level. The group setting therefore contributed to the better performance of the students over the individual setting. The High ability students however performed better than the medium and low ability students indicating that ability contributed significantly to the performance of the students. Figure 1 therefore shows that there was a relationship between the learning setting and ability on the scores on mathematics.

RELATIONSHIP BETWEEN LEARNING SETTING AND ABILITY

The following null hypotheses were tested in order to

investigate the main and interaction effects of ability and leaning setting on the scores in mathematics.

- ✓ There was no significant relationship between learning setting and scores in mathematics.
- ✓ There was no significant relationship between the ability and scores in mathematics.
- ✓ There was no significant combined relationship between ability, learning setting and scores in mathematics.

These hypotheses were tested using two way Analysis of variance. The independent variables were ability level and learning setting. The dependent variable was the scores on a mathematics achievement test. The level of significance was 0.05. Table 4 shows results of two way Analysis of Variance at a level of significance of 0.05.

Statistically significant differences in the mean scores were noted for ability only (F = 3.966, df 2, 42, P=0.038) and not for learning setting (F=3.479, df 1, 42 P=0.094) and the interaction between ability and learning setting (F= 1.562, df 1, 42, P=0.987).

Source of Variation	Sum of Squares	df	Variance Estimate	F Ratio	Sig
Learning Setting	20.21	1	20.021	3.479	0.094
Ability	42.354	2	21.177	3.966*	0.038
Ability × Learning setting	16.687	2	8.344	1.562	0.987
Within Group error	224.25	42			
Total	303.312	47			

**0.05 level of significance*

Table 4: Two way Analysis of Variance for Scores on a Mathematics test

The findings failed to reject the Null hypothesis of no significant effect of the learning setting and no significant combined effect of the learning setting and ability on the total scores at a level of significance of 0.05. However the null hypothesis of no significant effect of ability on the total scores was rejected at 0.05 level of significance. The alternative hypothesis of a significant relationship between ability and the total scores was accepted at 0.05 level of significance.

From the findings it was evident that whether the students were in the individual or group learning setting, it did not have a significant effect on the scores on a mathematics test. However ability did have a significant effect on the scores on mathematics achievement test and the interaction between ability and the learning setting was not significant at 0.05 level of significance. Table 5 shows results of Post-Hoc Tukey comparison of the ability levels.

Ability	Mean Score	Difference	Tukey Value	Sig
High	5.350	2.29*	1.906	0.022
Medium	7.625	1.33	1.906	0.083
low	6.665	0.96	1.906	0.253

**0.05 level of significance*

Table 5: Post-Hoc Tukey comparison for the Ability levels

From Table 5 it can be seen that the difference between the High and Medium ability levels was significant at 0.05 level of significance. The difference between the medium and low ability students was not significant. From the result the learning setting accounted for 4.76% of the variance in the total scores while ability accounted for 10.26%. The combination of both the learning setting and ability accounted for only 1.95% of the variance in the total scores. A strong association existed between ability and the total scores. The other proportion of scores could have been accounted for by other factors. The possible factors that could have contributed to the unexplained variance were suggested to be;

- ✓ The level of interest and attitude towards mathematics
- ✓ The student's personality in the group settings
- ✓ The levels of motivation.

IV. DISCUSSION OF FINDINGS

The findings from descriptive statistics indicated that leaning setting had an effect on the total scores on a mathematics test. Inferential statistics indicated that the learning setting had no significant effect while Ability had a significant effect on the scores on a mathematics test. The High ability students in both settings did better than the other students. However descriptive analysis showed that the performance of students of different ability levels also depended on the learning setting. However the interaction effect of learning setting and ability was not significant. From descriptive statistics, the performance of students from different ability levels depended on the learning setting.

The finding of no significant effect of the Learning setting on the total scores on a mathematics test was consistent with previous research. Forgasz (2010) found no relationship between the learning setting and scores on a mathematics test. However Forgasz used composite test scores in different subjects. Gallagher and Merrotsy (2011) have shown differences in attainment scores of students in mixed ability group settings.

Ability was seen to have a significant effect on the total scores on a mathematics test. These findings were in agreement with research by Liem, et al (2013). They confirmed that the intellectual dimension of the students was the strongest variable that predicted high academic achievement. The findings of no significant interaction effects of the learning setting and ability are not consistent with previous research by Macqueen (2013) who revealed that low ability students did better in the group setting than the individual setting. The medium ability students' performance was the same regardless of the learning settings. Macqueen (2013) also found out that helping each other was positively related to achievement. Smith (2011) found out from his study that the composition of groups according to ability positively contributed to the learning of mathematics. The study found out that the effect of the learning setting depended on the ability levels of the students.

V. CONCLUSION

From the findings of the study it was concluded that the learning setting had no significant effect on the performance of the students. Ability had an effect on the performance of the students regardless of the learning setting. The interaction effect of learning setting and ability on the total scores was not significant.

VI. RECOMMENDATIONS

The following recommendations were based on the findings of the study.

- ✓ Mixed ability group settings should be established in most secondary schools since they were conducive to better learning in all the three ability levels.
- ✓ Educational policy makers in Kenya should consider the relationship of ability and learning setting when establishing learning units in secondary schools.

VII. SUGGESTIONS FOR FURTHER RESEARCH

The following were suggestions for further research;

- ✓ Research on Ability grouping focusing on a larger sample of students.
- ✓ Research on ability grouping and learning settings at other levels of education like Primary schools colleges and the University.
- ✓ Research on ability grouping and learning settings using other subjects.
- ✓ Research using a true experimental design and the use of a control group.
- ✓ Research on ability grouping and learning settings using a population consisting of Girls only and also a sample consisting of mixed gender.

REFERENCES

[1] Dukmak, D. (2009). Ability Grouping and Teacher- - Student Interaction among High achieving students in middle primary schools in the United Arab Emirates.
[2] Forgasz, H. (2010) Steaming for mathematics in Victorian Secondary schools. Australian mathematics Teacher 66(1): 31-40
[3] Gallagher, S., Smith,S.R. & Menotsy, P. (2011). Teachers' perceptions of the socio- emotional development of intellectually gifted primary age students and their attitudes towards ability grouping and acceleration. Gifted and Talented International. 26(1); 11-24.
[4] Hallam, S. & Ireson, J. (2003). Secondary school Teacher's Attitudes to and Believes about Ability Grouping. British Journal of Educational Psychology, 73, 343-356.
[5] Hetherington, E.M., & Parke, R.D. (1993) Vygotsky's Social cultural Theory. In child Psychology. A contemporary view point. New York, Mc.Graw- Hill Inc 331-339.
[6] Kumar,P.A. (2004). Abilty grouping and academic achievement. Masalah Pendidikan jilid, 27,109-118.
[7] Liem,G., Martin, A,. Mclnerney, D & Young, A.(2013) The-big fish little pond effect and the national policy of within school ability streaming: Alternative frames of reference. American Educational Research Journal 50(2): 326-370.
[8] Macqueen, S.(2013). Grouping for inequity. International Journal of exclusive Education 17(3): 295-309.
[9] Mansor, A,N., Manium, P. Hunt, M.C & Nor, Y.M.(2016). Benefits and disadvantages of of streaming practices to accommodate students by Ability. Creative Education 7, 2547-2558. Available on line at http://dx.doi.org/10.4236/cc.2016.717241.
[10] Marks, R. (2009). Ability in Primary Mathematics Education: Patterns and Implications, Proceeding of the British Society for Research into Learning Mathematics, 31, 91-96. http//dx.doi.org/10.1080/14794802.2011. 624753.
[11] Smith, C. (2011). "Ability in Primary Mathematics Education. Patterns and implications" Proceedings of the British Society for Research intolearning mathematics, 31. 97-118