Journal of Education, Society and Behavioural Science

32(2): 1-10, 2019; Article no.JESBS.50327
ISSN: 2456-981X
(Past name: British Journal of Education, Society & Behavioural Science, Past ISSN: 2278-0998)

1 to 5 Instructional Grouping Influences on Students' Capacity Building

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JESBS/2019/v32i230170
Editor(s):
(1) Dr. Bakare Kazeem Kayode, Department of Education Foundations, Faculty of Education, Al-Medina International University, Malaysia.
(2) Dr. Stan Weeber, Professor of Sociology, McNeese State University in Lake Charles, Louisiana, USA.
Reviewers:
(1) Nalini Arumugam, Universiti Teknologi Mara, Malaysia.
(2) Oribhabor Chinelo Blessing, University of Africa Toru-Orua Bayelsa State, Nigeria.
Complete Peer review History: https://sdiarticle4.com/review-history/50327

Original Research Article

Received 01 July 2019
Accepted 02 September 2019
Published 22 October 2019

ABSTRACT

The aim of this study is to examine the influence of one to five group formations on students' capacity building. One hundred eighty students from Arba Minch University, College of Natural Science were selected as samples for this study. The data were collected by observation and from the questionnaire filled by the respondent.

Empirical and theoretical findings obtained from this study will contribute to evaluating 1 to 5 grouping influence on statistics student's capacity building in the University. The findings will help in the formulation of national and local teaching methods which is appropriate for the statistics course. A randomized complete block design model was used to compare students' performance in classroom activities by using different study methods including 1 to 5 grouping.

It was observed from experience that all the participants indicated they prefer to remain silent than to give a wrong answer when they do individually, and students' participation was to a large extent influenced by the kind of feedback they get from their classmate when they answer a question. The findings revealed that, in 1 to 5 grouping, students had the willingness to answer questions in class. The results also show that 1 to 5 grouping was helpful in promoting a good classroom environment

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which is free from intimidation and fear of participation to see mistakes as part of the learning process and lead to the creation of new knowledge. Finally results indicated that students perform better regarding grade point activity/GPA when they study in 1 to 5 grouping.

Keywords: 1 to 5 grouping; student; RCBD model; comparative study; capacity building.

1. INTRODUCTION

1.1 Background of Study

Many studies have been conducted concerning teaching and learning, and there had been considerable interest in ways of improving the teaching and learning in University. Recent assessments and studies had shown that students are faced with numerous challenges as they learn different concepts and skills they were presented with.

Education is the base for economic and social development. Through education, one can develop skills, strategic economic growth, promote progress and be relevant to the needs of the country. A diverse body of literature demonstrates that the future development of the world and individual relies on the capacity of individuals and countries to acquire, adapt, and advance knowledge. This capacity depends, in turn, on the extent to which the population has attained literacy, innumeracy, communication and problem-solving skills. Many governments view investments in education as a better and cost-effective scheme through which social, health and economic issues such as delinquency, unemployment, gender equity and nutrition can be addressed. Therefore, overall development efforts, high priority should be given to education [1].

To live in the modern world, every person needs certain basic information, and it is a task of education to transmit this information to people. In order to address these objectives, one needs a well organized program of study that school and the educational institution should implement. Such systematic programs generally require good methods of teaching.

The teachers need to become active, when they search for efficient strategies in making students think resourcefully and critically, in guiding them to work in teams, in directing them to determine and define the concepts, and in building stimulus by raising students' self-esteem through ensuring their learning success. These factors are required to be considered by the teachers on a permanent basis [2].

In order to reach all learners, teachers use differentiated instruction strategies. These strategies are meant to accommodate each individual student's learning style, readiness and interest, and they involve using a variety of different instructional methods, such as flexible grouping. Teachers have been grouping students in varying ways since back in the school house days. Teachers did grouping students based on their age or ability. Today, teachers are discovering that grouping and regrouping students in a variety of ways throughout the school day actually makes their job easier and makes their students more productive. Flexible grouping is more than just moving a students' seat, it is a practical way to differentiate as learning needs dictate [3].

1.1.1 Types of student grouping practiced in Ethiopia Educational School

The study conducted on students grouping reveals that there was a range of configuring students in the classroom to different groups. These range from the usual basis on ability grouping, currently practiced in many schools in the world and in some private schools of Ethiopia. The following grouping is the most widely utilized by teachers:

Learning cycle groups: In this type of grouping students are assigned for additional support, time and practice in order to master the content and skills covered in a particular unit or lesson the teacher already has taught to the entire classroom group.

Peer tutoring: A small group of four to six students with a cross-section of characteristics is formed to teach information and skills. This approach includes: Team assisted individuali-zation where each student receives an individual assignment based on learning needs and the team goal is to help one another, complete assigned tasks successfully and to improve each student's performance on a quiz measuring skills and content covered in the student's individual assignment and finally students receive individual scores.

Cooperative groups: Under cooperative grouping, students with diverse ability and

characteristics are combined together and learn from one another, to accomplish assigned learning goals or tasks.

Learning together: A small group is given one assignment sheet to be completed and evaluation is based on how well students work together to complete the assignment sheet and performance on the completed sheet.

1 to 5 grouping: Is a kind of cooperative grouping, where a small group of five diverse students is assigned a topic of study and one student among five leads a group and four group members play different roles by rising their ideas, and their collective ideas are evaluated within a group and presented in the class. It is assumed that, since students with diverse ability and characteristics are combined together they learn from one another within a group and/ or in a class. To accomplish assigned learning goals or tasks and groups was evaluated by different assignments and projects as designed by different courses. Students receive group scores in assignments and projects and individual scores in tests and final exam.

1.2 Statement of Problems

There have nonetheless been relatively few studies that have explored into whether or not one to five group formation influences students' capacity in university. In addition to this, no study has specifically answered the research questions posed in this present study. Hence this research comes as an attempt to examine students' capacity building regarding the impact of 1 to 5 grouping influence on their learning experiences. Examining the influence of one to five group formations on students' capacity building is based on students' performance and it is guided by the following research questions:

What are the factors that hinder classroom activities?

What activities do the students like/dislike in class?

What are possible solutions to build capacity for students?

What makes students' academic performance good?

1.3 The objective of the Study

General objective: The main aim of this study is to examine the impact of one to five group formations on students' performance in statistics.

Specific objectives:-

- To identify determinants that makes students' performance good.
- To evaluate 1 to 5 grouping regarding students capacity building
- To identify good of teaching activity in a university.

1.4 Significance of the Research

Interactive classroom activities engage students in a classroom through their participation in the attainment of knowledge by gathering information, thinking, and problem-solving and articulating what they have discovered. Each activity provides the students with opportunities to deepen their learning by applying concepts, and articulating new knowledge. Many of these activities also provide the instructor feedback about the students' learning. Particularly, it helps students to enhance teaching-learning process, it serves to smooth communication between instructors and students, and it also serves the educational administrations to make the decision to face the classroom activities problems through creating awareness to students and instructors.

2. METHODOLOGY

2.1 Description of Study Area and Population

The study area, Arba Minch University Abaya campus is found in Arba Minch town in the southern parts of Ethiopia which are located approximately 505 kilometres south of Addis Ababa. Arba Minch is the richen town in natural resources and which has different sources of tourist festival (40 springs) among towns in Ethiopia. It is the main administrative, commercial and industrial town of the Southern Regional States of Ethiopia.

Arba Minch University is one of the higher educational institutions in Ethiopia and had about 5 campuses under it. College of Natural Science is situated in Abaya Campus and includes eight departments: Mathematics, Physics, Chemistry, Biology, Statistics, Geology, Metrology and Sport Science. The target population in this study is Statistics 2004, 2005 and 2006, entry students. In this batch, there are about 98, 63 and 61 students respectively.

2.2 Method of Data Collection

The data collection procedures consisted of two parts that are by observation of students'

activities and by using a structured questionnaire. Three different teaching activities were used to measure students' capacity. A set of questions were prepared and the selected students are responded. The contents of the questions were used to extract students thinking towards classroom activities.

2.2.1 Sampling Techniques and Sample Size Determination

In this research stratified sampling technique was employed to select a representative sample. From a total of sample 180 statistics students, 136 students gave the response to extract required information about different teaching activities (teacher-centred, pair and 1 to 5 grouping).

Sampling technique is a system of taking a small ratio of observation from a large population to get information of that large population using some statistical techniques. Stratified sampling technique was used by using batch as strata in order to increase efficiency. Since a cross-sectional of the population is heterogeneous, stratified random sampling has been conducted to do the research. The purpose of stratified random sampling is:

- To reduce sampling errors so that precision is increased.
- When a separate estimate is required at the stratum level, it is applicable for increasing the accuracy of data.
- Sometimes a different part of the population requires different sampling procedures
- To allocate the sample to each class.

Then, the total number of samples 'n' will be calculated as follows:-

$$n = \frac{no}{n+\frac{no}{N}} \quad \text{Where,} \quad n_o = (Z\alpha_{/2})^2 pq_{/d}^2$$

Using proportional allocation the sample size of stratum will be calculated as follow;

$$\frac{nh}{Nh} = \frac{n}{N} \quad \text{Hence,} \quad n_h = N/n \times N_h$$

Where:- $_N$ = total number of students in Arba Minch University, Natural Science, statistics students

n = total number of samples
n_1 = sample from students using 1 to 5 grouping
n_2 = sample from students following pair grouping
n_3 = sample from students following teacher-centred

2.3 Variables Considered under Study

The researcher observed one semester for three different teaching activities and each lesson lasting 2 hours. For the purpose of consistency, classroom observation and interview protocols were used during the data collection process. Students' willingness to answer questions in class, students' participation influenced by the kind of feedback they get from their classmate when they answer a question and identifying activities which lead to the creation of new knowledge and also students' capacity regarding grade score was considered under study.

Classroom activities such as question and answers, class works (problem-solving in the class), assignments (home works), presentations, quiz and others were taken as measures of performance of student/capacity of the student.

2.4 Method of Data Analysis

The data analysis started at the same time the data were collected and in all classrooms, although the researcher had the chance of recording all the lessons observed and the interview conversations with the participants, he took notes during the observation and interview and the filed notes provided a summary of the two data sets.

The data were analyzed under pre-determined themes which were established in the classroom observation and interview protocols. However, the researcher did not only concentrate on these predetermined themes as the room was created for other emerging themes. For example, the predetermine themes in the classroom observation protocol were: Teaching methods, students' participation, students' engagement and assessment. The emerging themes which came up when analyzing the classroom observation were students' skill acquirement. The predetermined themes used in the interviewed protocol were: Interest, participation and peers feedback. The emerging themes which were developed from the interview results are confidence and beliefs. The summary of the individual interview transcripts was then condensed in finding answers to the research questions posed in this study.

2.4.1 Randomized complete block design (RCBD)

Randomized Complete block design model was used to compare students performance in different teaching activities including 1 to 5 grouping to measure students capacity buildings by using batch as a blocking factor.

This design is used in the situation where there is one factor in addition to treatment which may affect the response variable. Blocks can be formed by grouping/stratifying the experimental units that have homogeneous characteristics with respect to the response.

The underlying model for this type of design is:

$$y_{ij} = \mu + \alpha_i + \beta_j + \varepsilon_{ij}$$

i=1,2…a,j=1,2…b,

Where y_{ij} is the response obtained from j^{th} block treated with i^{th} treatment,

μ *is over all mean*

α_i i^{th} *treatment effect*

β_j j^{th} *block effect*

ε_{ij} *error / distarbance term*

Assumptions Randomized Complete Block Design Model

ε_{ij} are independent

ε_{ij} are identically distributed with mean zero and constant variance.

ε_{ij} are normally distributed.

$\alpha_i \approx iidN(0,\sigma^2)$

$\beta_j \approx iidN(0,\sigma^2)$

Covariance ($\varepsilon_{ij},\alpha_i) = \text{cov}(\beta_j,\alpha_i) = \text{cov}(\beta_j,\varepsilon_i) = 0$,

2.4.2 Structure and layout for data collected from RCBD

Let a be the number of treatments and let each treatment be blocked b times and let y_{ij} be response obtained from the j^{th} block treated with i^{th} treatment for (i=1,2,…., a) and (j=1,2,……b) then the response obtained from RCBD can be expressed and summarized as:

Table 1. Structure and layout for data collected from RCBD

Treatment/ block	I			Block total($y_{.j}$)
	1	2 ……	a	
j 1	y_{11}	y_{21}	y_{a1}	$y_{.1}$
2	y_{12}	y_{21}	y_{a2}	$y_{.2}$
..	..	..	..	…
B	y_{1b}	y_{2b}	y_{ab}	$y_{.b}$
Trt total	$y_{1.}$	$y_{2.}$	$y_{a.}$	$y_{.}$

Where y_{ij} is the response obtained from j^{th} block treated with i^{th} treatment. And treatment total, block total and the grand total can be calculated respectively as $y_{i.} = \sum_{j=1}^{b} y_{ij}$, $y_{.j} = \sum_{i=1}^{a} y_{ij}$ $y_{..} = \sum_{i=1}^{a} y_{i.}$

2.4.3 Analysis of variance in RCBD (ANOVA Table)

Table 2. Analysis of variance (ANOVA) for the RCBD model

Source of variance	DF	Sum of squares	MS	F_{CAL}	F_{tab}
Treatment	a-1	SS(trt)	MST	MST/MSE	_
Block	b-1	SS(Block)	MS(block)	MS(block)/MSE	_
Error	(a-1)(b-1)	SSE	MSE		
Total	**ab-1**	**Total SS**			

Where $Total\ ss = \sum\sum y_{ij}^{\ 2} - y_{..}^{\ 2} / ab$

$Treatment\ ss = \sum y_{i.}^{\ 2} - y_{..}^{\ 2} / ab$

$Block\ ss = \sum y_{.j}^{\ 2} - y_{..}^{\ 2} / ab$

Error SS=Total SS-Treatment SS-Block SS

F-test or Analysis of Variance (ANOVA) is used for determining if the groups of students who use 1 to 5 grouping, pair cooperative learning and traditional method significantly differ in the level of performance of statistics concept and capacity building in statistics.

3. RESULTS AND DISCUSSION

Main purpose of this study was to examine the influence of one to five group formations on students' capacity building and to explore students' views regarding their participation in the statistics lessons.

The results established that most of the participants had the enthusiasm and willingness to participate in the teaching-learning process by volunteering to answer a question if they know the answer in 1 to 5 grouping formation. Similar to the findings by Felder [4] the results from the study established that students learn differently and participated at different levels during lessons. The findings also established that the kind of feedback that students get from their instructors influence their level of participation and willingness to answer questions in class. The findings, therefore, provide some useful information for statistics teachers' in promoting a classroom environment free from intimidation and fear of participating in the teaching-learning process.

A descriptive statistics in Table 3 compares attitudes of student's for a different instructional grouping. In 1 to 5 grouping most of the respondents agree that classroom activities are very important to improve their academic performance, because percentages of agree and strongly agree categories show significant increments for attitude measuring factors, and students respond always and frequently to the statement 'you attentively follow instruction of instructor is high in 1 to 5 grouping as compared to pair and teacher-centered. About 31.5% of students have excellent involvement in classroom activities in 1 to 5 grouping formation. Generally, students answered that 1 to 5 grouping improves the classroom activity and involvement of students in their day to day teaching-learning activities, which in turn improves the capacity of students to undertaken classroom activities in teaching-learning process. Willis [5] supported the influence of working together by citing Burns (2006) as "modern technology encourages teachers and students to work together as they explore ways to improve the teaching and learning process".

Descriptive statistics in Table 4 shows variation in student performance in different teaching activity, it indicates values for mean, standard deviation and Coefficient of variation (CV). The CV is a relative measure of variation between data sets and it is always expressed as a percentage.

$$CV = \frac{SD}{Mean} 100\%$$

The CV will be small if the variation is small. Of the three groups, the one with less CV is 1 to 5 grouping indicating that there is small variability among student performance. From these results, we can understand that student can perform better by sharing ideas when they do in a group than they do individually. Apart from the classroom related factors, Mji and Makgato [6] argued that major factors associated with performance among students are the provision of adequate teaching and learning materials, and promoting critical thinking among students as they have different materials and the chance to explore the problem from different perspectives.

Table 3. Comparison of classroom activity of student's among 1 to 5 grouping, pair and teacher-centred study

No	Variable	Category	Percentage		
			1 to 5 grouping	Pair cooperative	teacher-centred
1	Classroom activities are very important to improve classroom performance	Strongly Disagree	*3.45*	6.9	35.50
		Disagree	*10.34*	31	30.34
		Agree	41.38	*27.6*	30.48
		Strongly Agree	44.83	*34.5*	5.17
2	You attentively follow the instruction of the instructor	Never	2.08	*11.45*	*44.8*
		Sometimes	9.34	*12.34*	*27.6*
		Frequently	34.48	32.38	*17.2*
		Always	55.17	33.83	*10.3*

No	Variable	Category	Percentage		
			1 to 5 grouping	Pair cooperative	teacher-centred
3	How do you rate your involvement in classroom activities?	Very Poor	0.00	0.00	0.00
		Poor	0.00	*6.90*	20.50
		Satisfactory	10.34	17.24	20.34
		Good	24.48	24.14	33.48
		Very Good	35.17	20.69	15.17
		Excellent	*31.5*	31.03	10.5
4	In class, you gather new knowledge	No	*30*	35	51
		Yes	*70*	65	49
5	Kind of feedback that students get from their instructors is high	Strongly Disagree	*12.45*	*30*	*40*
		Disagree	*11.34*	*35*	*26*
		Agree	32.38	21.5	20.5
		Strongly Agree	33.83	14.5	14.5

Table 4. Comparison of average marks awarded for different instructional grouping

Batch	Average mark awarded using different methods of activity		
	1 to 5 grouping (25%)	Pair cooperative (25%)	Teacher centered (25%)
2012/13(1st)	15	14	13.25
2013/14(2nd)	16.5	17	12.75
2014/15(3rd)	18	17.25	13
Average (100%)	66.4	58.28	52.65
Instructional category	**Mean**	**Standard deviation**	**Coefficient of variance**
1 to 5 grouping	66.4	12.74	19.18%
Pair grouping	58.28	18.76	32.18%
Teacher centered	52.65	22.22	39.22

Table 5. Analysis of variance (anova) for performance of student

Source of variance	DF	Sum of squares	MS	F_{CAL}	P-value
Treatment/Methods of teaching	2	21.93	10.97	8.88	0.02
Block /batch	2	6.22	3.11	2.52	0.10
Error	4	4.94	2.07		
Total	**8**	**33.1**			

Individual 95% CIs for Mean Based on Pooled St Dev

```
Category      N    Mean   StDev
1 to 5 group  55   66.40  12.74                    (----------*----------)
Pair group    41   58.28  18.76               (------------*------------)
Teacher cen     41    52.65    22.22    (-----------*------------)
                                  ---+---------+---------+---------------------+---
                                    49.0      52.5      56.0                  69.5
```

F_{cal}=8.88 with the corresponding p-value=0.01 in Table 5, indicating that there is a significant difference in mean of student capacity, therefore, we reject H_0: $\alpha_1 = \alpha_2 = .\alpha_3$ and conclude that there is a significant difference between treatment mean.

In addition to determining that differences exist among the means, investigators did interest to know which means differ. If H_0 is rejected we would expect that at least one treatment mean is different from others. To identify such means, comparison among treatments were made. Table 5 displays estimated mean for performance of students by classifying students in three categories. The average marks of students obtained in three methods of teaching are 66.4, 58.28 and 52.65 respectively for 1 to 5 grouping, pair grouping and teacher-centered methods of teaching. This value with its corresponding confidence interval indicates that there is a

significant difference between treatments mean. Research by Burke and Sass [7] established that positive and highly significant peer effects exist in reading and mathematics lesson within every level of schooling. They added that as much as individual characteristics impacts on students' achievements, peer influence plays a vital role in students' achievements and participation. Sullivan et al. [8] also found that students' positive and negative response and attitude toward school mathematics and engagement are to a large extent influenced by peer influence. They added that the classroom culture and for that matter, peer influence was a strong determinant of student participation and engagement than the curriculum and other related factors.

Even though results and some literature indicated importance of peer in a group there was a slight difference in finding by Richard A. Catalano [9] discussed that despite the daily instruction emphasizing the importance of working together with their partners to enrich their learning and increasing their ability to complete full laboratory reports, a majority of the students failed to increase their test scores. Chloe Elizabeth Williams [10] conducted the research on diversity in groups and demonstrates that heterogeneous groups can be better performers, specifically at idea generation or perspective-taking; however, this increased performance only comes after an additional period of working together. Willis [5] established that through class involvements, students explore, discover and create new knowledge where they learn from their mistakes and misconceptions to develop new knowledge. The present study is similar to what, [10,8], discussed and recommended by [5].

4. CONCLUSIONS AND RECOMMENDA-TIONS

Empirical and theoretical findings obtained from this study will contribute to evaluating 1 to 5 grouping influence on statistics student's capacity building in Arba Minch University, College of Natural Science. In addition to this, it will help in the formulation of national and local teaching methods that are appropriate for statistics course understanding.

The findings revealed that, in 1 to 5 grouping, participants have the willingness to answer questions in class, students' participation is to a large extent influenced by the kind of feedback they get from their classmate when they answer a question, and it is observed from experience that all the participants indicated they prefer to remain silent than to give a wrong answer when they do individually. The results also showed that 1 to 5 grouping were helpful in promoting a good classroom environment which is free from intimidation and fear of participation to see mistakes as part of the learning process and lead to the creation of new knowledge, and also shown that students perform better regarding grade point activity.

The findings therefore established that the kind of feedback that students get from their classmate and group influence their level of capacity and performance of them. The findings, therefore, provide some useful information for statistics teachers' in promoting a classroom environment free from intimidation and fear of participating in the teaching-learning process. This calls on teachers and students to understand and see mistakes as part of the learning process and correcting such misconceptions leads to the creation of new knowledge. This study is significant in view of the unprecedented calls for new ways of statistics teaching and learning methods which promotes students active participation in the teaching and learning process.

Generally, 1 to 5 grouping improve the classroom activity and involvement of students in their day to day teaching-learning activities which in turn improves the capacity of students to undertaken classroom activities in their day to the day teaching-learning process.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Appendix: Questionnaire

Arba Minch University, College of Natural Science, Department of Statistics

Dear respondents! The aim of this questionnaire to collect information that helps in improving capacity of statistics students in classroom activities in their day to day learning process. Hence, your genuine responses are very helpful in undertaking this study. So please provide factual information concerning classroom activities. Thanks in advance for your voluntarily provision.

1. Sex: Male ☐ Female ☐
2. Age: _____
3. Section: _____
4. Rate your preference of the following classroom and outside class activities (Put thick in your agreement)

Activity	Dislike	Moderate	Like
Class work			
Presentation (Demonstrations)			
Problem solving			
Quiz			
Assignments			
Question and answering			

5. The above listed classroom activities and others are very important to improve the academic performance of students
   Strongly Disagree ☐ Disagree ☐ Agree ☐ Stongly Agree ☐
6. You attentively follow instruction of instructor.
   Never ☐ Sometimes ☐ Frequently ☐ Always ☐
7. How do you rate your involvement in classroom activities
   Very Poor ☐ Poor ☐ Satisfactory ☐ Good ☐ Very Good ☐ Excellent ☐
8. In class you gather new knowledge. Yes ☐ No ☐
9. What did you think as reason for your low classroom activity? More than one answer is possible
   a. Instructors were not gave classroom activities ☐
   b. Some Instructors were apply classroom activities without assessments ☐
   c. Classroom activities have no mark award ☐
   d. Lack of interest (I prefer to exercise in home) ☐
   e. Lack of understanding and skill about topics ☐
   f. Lack of knowledge about the importance of classroom activities ☐
10. Discuss in a group and put your comments and suggestion of different teaching methods (i,e Teacher centered, Pair Grouping , and 1 to 5 grouping) that is used by your instructor, regarding translation or sharing of academic knowledge._____
    _____
    _____

Peer-review history:
The peer review history for this paper can be accessed here:
https://sdiarticle4.com/review-history/50327