American-Eurasian Journal of Scientific Research 10 (1): 18-21, 2015
ISSN 1818-6785

DOI: 10.5829/idosi.aejsr.2015.10.1.1144

Meta-Analysis of Research Findings on Influence of School Location on Students' Achievement in Mathematics

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Abstract: This study integrated the collective research findings of previous studies on the influence of location on students' achievement in mathematics at senior secondary school level. The study covered all published and unpublished research findings on the influence of school location on students' achievement in mathematics and was limited to studies conducted between 1992-2012. One research question and two null hypotheses guided the study. The design of the study was a meta-analysis survey design'. Purposive sampling technique was used in collecting relevant studies. The data collection instrument was adapted from instrument developed by Ovute [6] and modified to suit the present study. The inter-rater reliability of the instrument was 0.81. Frequencies, percentages, mean scores and standard deviation were used in answering the research questions while t-test, effect size and Winer combined test were used in testing the null hypothesis at 0.05 level of significance. Some of the findings included; At $p < 0.05$, there was no significant difference between the mean achievement scores of rural and urban students in mathematics. The magnitude of effect size varied with the design characteristics across different location, the effect size associated with studies conducted in co-educational schools was moderate and there was variation of effect size with study outcome variables. Based on these findings, it was recommended that meta-analysis research should be conducted in other areas of science and mathematics education to accumulate research findings on such areas in order to come up with unified data or information that will help to guide future research.

Key words: Meta-Analysis · Influence of School Location · Mathematics · Students' Achievement

INTRODUCTION

Mathematics is pervasive in today's world of entrepreneurial development. Mathematics competence is very vital for every individual's meaningful and productive life. Mathematic is a specialized cognitive tool and an undisputed agent of nation's development and transformation. Its application is universal to all learning and everyday living from counting process to measuring properties predicting events, computing taxes, profits, drawing maps, budget planning, providing models, to synthesis of results. All these are indications that mathematics is useful in domestic, business, scientific and technological breakthroughs, problem solving and decision making in different situations in life [1-3]. Mathematics permeates all aspects of human endeavour. Contributing on the usefulness of mathematics Adeniran [1] succinctly pointed out that knowledge of mathematics help to the manufacturing of new materials, machines and tools needed for industries and road construction; production of enough food for local and international markets; and in the invention of new designs based on mathematics knowledge.

Although many studies have been conducted toward finding the influence of school location on students' achievement in mathematics such as Ellis and Williams [4]; Bahara [2]; among others, there is no evidence that results of such research have been utilized or allowed to make any significant impact on mathematics teaching and learning. One major problem that might be responsible for this was the divergent or dissimilar conclusions of the many studies in the area that addressed common research questions and/ or hypotheses. In order words, the findings of many studies on the influence of school location on students' achievement in mathematics at the secondary school level as reported in literature have

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shown inconsistencies or disagreement among the many studies done. For instance, whereas Ali, Adenyi, Olarinoye, as reported in Ovute [6] found no significant difference between the mean achievement of males and females in mathematics at secondary school level, while study result of Eze [6], showed a significant difference between the achievement of males and females in mathematics tests respectively.

The issue of location and mathematic achievement is also another area that has been widely researched, but with diverse results. This area also calls for a synthesis and aggregate of such inconsistencies and diverse results in order to examine the pattern and therefore build up an accumulated knowledge on the issue of location and mathematics achievement. This is what a procedure known as meta-analysis does.

Meta-analysis of a research according to Glass in Ovute [6] is the technique of combining result of independent studies for the purpose of integrating the findings. Meta-analysis is usually conducted on a group of studies that are related through sharing a common hypotheses or operational definitions of independent or dependent features. The procedure of Meta-analysis has been used in aggregating the results of many previous studies in common areas.

In the application of meta-analysis, many and various methods are available for use. Such method include Fisher combined test, Winder combined test, Steffer combined test and Effect size. However, the methods of effect size and the combined tests shall be employed in the preset study. Effect size, as explained by Cohen in Ovute [6] is the degree to which the null hypothesis is false". Effect size allows for the examination of the relationship between independent and dependent variables of a given study. In a given study, the independent variables which may affect the results of the study include:

- The type of study such as method of assignment of subjects to treatment (random, intact, matched or self – select) duration of treatment and type of treatment.
- Design of study (true experiment, Quasi-experiment survey design, correlational, etc).

Purpose of the Study: The general purpose of the study was to integrate the collective research findings of previous studies on the influence of location on students' achievement in mathematics at the secondary school level. Specifically the study sought to:

Calculate the effect size for each of the previous studies on the influence of location on students' achievement in mathematics.

Scope of the Study: The geographical scope of the study is Nigeria and any relevant research findings within the 36 states and capital were included in the study. The study covered all published and unpublished research findings on the influence of gender and

Research Question: What are the results of previous studies on the influence of location on student achievement in mathematics as shown by the mean scores?

MATERIALS AND METHOD

Design of the Study: The study adopted a meta-analysis survey design in collecting the results of previous primary studies reported with respect to influence of location on students' achievement in mathematics. The ancestry approach of information retrieval whereby citations were tracked from one on study to another using bibliographic/references was adopted in locating the studies to be included in the present analysis. The design is appropriate because it ensured that many related studies are located. Also, it will ensure that studies results reported at different levels are not repeated during the process of analysis.

Area of Study: The area of study is Nigeria. Nigeria is a country consisting of thirty-six states (36) and a capital city (Abuja). In each of the 36 states and Abuja, there are many institutions of learning and research. Many studies have been conducted in various areas including the location on students' achievement in mathematics. The scores of research in this area have varying and conflicting findings which need to be identified and analyzed to come up with a single result, hence the meta-analysis used in the present study.

Population of the Study: The population of this study consisted of all previous empirical research findings on the effect of school location on the achievement of students in mathematics in secondary school. The previous studies included in this analysis addressed the common research question(s) and / or hypotheses with reference to the effect of school location on students' achievement in mathematics in Nigeria schools. The result of literature search provided the number of studies to be used for the study.

Sample and Sampling Technique: The study included in this present meta-analysis, have these features (characteristics):

- It should involve students' achievement in mathematics
- The study was conducted in Nigeria. Since a common examination syllabus is used in all primary and secondary schools within Nigeria, it is considered useful to restrict the sampling of studies to schools within Nigeria. The result to be generated will be generalizeable to students' achievement in mathematics in Nigeria schools for the fact that the same mathematics contents are taught to the students. The study reported the relative effects of school location on students' achievement in mathematics. In other words, only studies that determined the effect of school location on students' means achievement in mathematic will be included in the present study.
- The study or abstract of the study or data on the study was available to the researcher. This will enable the coding of the study features (characteristics) that are required for the meta-analysis.

The sampling technique adopted is the purposive sampling technique. It is purposive because the researcher has a focus of sampling result of primary studies that dealt with the influence location on student achievement. The sequence of searching for primary studies that were used in the present study included: first degree project, master degree project reports; doctoral dissertations, journal article and reports; and published journals. This order is necessary because it ensured that primary and most comprehensive source of information are examined first to avoid any duplication of date in situations where researchers reported all point of their research later in professional journals. The search for the studies that meets the requirement stipulated involved the researcher scanning the bibliographies of the master's degree projects, journal articles, books, dissertations and conference proceedings/papers. Following up these references, the articles and studies were used in the work.. The technique known as ancestry approach [3] retrieve information by tracking citations from one study to another through bibliographies cited in studies. When studies are reported more than one time, the most completed version was used.

Validation of Instrument: In developing the instrument due attention was given to guidelines provided by meta-analysis like Cohen and Glass in Ovute [7]. A pilot instrument was developed and given to two experts in measurement and evaluation and one in mathematics education, the experts were requested to scrutinize the study coding sheet and of previous findings. Following the corrections, the coding sheet was modified and used for collecting information from studies identified for the meta-analysis.

Reliability of the Instrument: Rater reliability was carried out using four (4) selected article that were included in the study. Two experts in measurement and Evaluation were given the four articles (studies) to read independently. The experts made the number of ratings from each of the study. Based on their ratings, an inter-rater agreement 0.81 was calculated using the formula provided by Countler, Thompson White and Morgan in Ovute [7].

The value ® calculated represented the index of reliability of the instrument used for data collection.

Method of Data Collection: All previous primary studies that dealt with influence school location on students' achievement in mathematics were collected using ancestral tracking system, where references are used in locating or identifying the primary studies. The coding sheet used in coding the features of each work located.

Method of Data Analysis: The data collected was analyzed using frequencies, percentages, mean scores and standard deviation to answer the research question. T-test statistic, effect size and Winer combined tests were used in testing the null hypotheses formulated for the study. The frequencies and percentages were used to show in numerical term the results of studies that will be analysed. The mean and standard deviations were used to determine the effect size. Effect size estimate was calculated for each study using the formula:

$$\text{Effect size} = \frac{X_1 - X_2}{Sd_2} \quad [7]$$

where,

X_1 = mean of male students/ or students in rural school

X_2 = mean of female students/or student in urban school

Sd_2 = standard deviation score of either group.

d ,0.2 means small effect

$0.2 < d < 0.49$ means medium effect

$0.5 < d > 0.8$ means large effect

RESULTS AND DISCUSSIONS AND CONCLUSION

The previous study results on the influence of school location on student's mean achievement score in mathematics showed that the students in schools located in urban areas consistently achieved higher than those in rural areas.

Research Question

Table 1: What has been the magnitude of effect size associated with the results of previous studies on effect of school location on students' academic achievement in mathematics?

	Urban		Rural			Effect Size
	---		---			$\frac{X_1-X_2}{Sd}$
S/N	N	$\overline{N}$	N	$\overline{N}$	Control Group	
1	100	40.22	98	30.60	6.41	1.50
2.	28	17.20	30	14.30	4.81	0.60
3	33	175.00	29	225.0	100.0	-0.50
4	70	14.50	70	10.24	2.20	1.94
5	60	24.48	60	2.14	8.23	0.53
6	90	34.00	90	28.05	6.37	0.93
7	1140	74.64	1140	62.90	16.48	0.71
8	60	20.90	60	18.75	3.18	0.68
	Total (Mean $\bar{x}$					

Discussion/Conclusion

Also, the accumulated results of previous studies analyzed in this present research have shown that school location has significant influence on the achievement of students in mathematics. The magnitude of effect size associated with school location is high, thus indicating the great impact of school location on students' achievement in mathematics.

Further, the effect size associated with design characteristics varied. In other words, the design characteristics of primary studies have impact (influence) on the results of such study with regard to the influence school location on students' achievement in mathematics. Therefore, the accumulated results of previous studies on the influence of school location on students' achievement in Mathematics has shown has location has influence on students' achievement in Mathematics in favour of the urban students.

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