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The effects of class size on student performance in a hypermedia supported classroom

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Abstract
The main thrust of this paper was to examine students performance in different class sizes in a hypermedia learning environment. Participants in the study were one hundred and fifty six (156) students of junior secondary schools, selected using purposive sampling method. Hypermedia treatments were administered in the different class sizes, with pre and post tests, which lasted 6 weeks. The study found that students exposed to hypermedia instruction in both small and large classes performed significantly better in their post tests. It was also found that the variables sex, class size and modes of hypermedia instruction have significant interaction on the performance of learners. The study concluded that class size variable should be considered in planning hypermedia instruction.

Keywords: hypermedia

Introduction

Issues around and over class size reduction has received increased attention from teachers, researchers and policy makers. Hanushek (1998) observed that this issue has received both public and professional attention more than other educational issues and has been used as a fundamental metric for quality in learning. The belief that small classes are better is widely held today because of its affordance of closer contact between teachers and students, which is in fact a luxury in the large class. However, many have equally argued that reducing class size will not increase students performance because there are several factors that come to play in the classroom. Gilbert (1995) [8] opined that early research literature on class size seem to show a link between small classes and improved learning. Although the literature suggests that class size *per se* has little or no impact on the acquisition of substantive knowledge or academic skills. Gilbert further stated that smaller classes were found, in later studies to produce statistically significant differences in problem solving, student attitudes to teaching and knowledge retention, even though the significant differences were small. Finn (2003) [7] in a study of small class asserts that for many parents, educators, and policymakers, smaller classes are an apparently foolproof prescription for improving student performance: Fewer students means more individual attention from the teacher, calmer classrooms, and consequently, higher test scores. A meta analysis (which is widely referred to as classic) was conducted by Glass and Smith (1978) on the relationship of class size and achievement. Glass and Smith collected and summarized nearly 80 studies on the relationship of class size with academic performance that yielded over 700 class-size comparisons on data from nearly 900,000 pupils. The two primary positions drawn from this study are that: (i) reduced class size can be expected to produce increased academic achievement, and that (ii) the major benefits from reduced class size are obtained as the size is reduced below 20 pupils. In class size research, the Glass and Smith meta analysis has been considered as robust and well accepted. Other research efforts directed towards class size included the United States state-wide initiatives which are considered as large scale (Englehart, 2007) [5] such as Indiana "Project Prime Time" legislated in 1984, Tennessee "Project STAR", which was legialated in 1983, Winsconsin "Student Achievement Guarantee in Education (SAGE) legislated in 1996/1997 school year.

One of the basic reason behind class size reduction studies is that large classes have not been meeting the expectations of the students. Selingo (1999) [17] in a study observed the rise in Australian school enrollment, whereas new schools were not built; new classrooms were hardly erected; and new staffs were rarely employed. A challenge which often forces teacher-pupil ratio to decrease. He further stated that the number of learners at most colleges and universities was on the increase at a geometric rate due to both increase in the college-age population and an increase in the percentage of high school graduate enrolling in college. Selingo's observation confirms the status quo in the Nigerian schools where there is the case of overpopulation and overcrowding. The researcher had observed over time that the least number of learners in a class was between 60 and 80. Whereas, the National Policy statement on Education, revised version (2004) section 101 (a) (ii) states that,

> *the Federal Government shall prescribe the minimum standards of education at all levels… in primary and secondary schools, there shall not be more than 40 pupils to a class.*

This is in agreement with the policy statement of the USA's National Education Association, America's largest Teachers Union (1998-99) which states that "excellence in the classroom can best be attained in small classes". This point brings fore the need to consider the issue of class size as it affects learning.

Nigerian secondary school classes are considered too large. This reduces the effectiveness of the teacher and the outcomes of learning, because a single teacher may not be able to adequately attend to all students needs at the same

time and within the 40 minutes duration of the lesson. Glass and Smith (1980) [18]; McConnell and Sosin, (1984) [13]; Raimondo, Esposito, and Gershenberg, (1990) [15] opined that the increasing number of students' population would have an adverse effect on their performance. Adeyemi (2008) findings also supports the earlier authors that schools having an average class-size of 35 and below obtained better results in the Senior Secondary Certificate (SSC) examinations than schools having more than 35 students per class.

Class size issues and students performance

Fabunmi, Brai-Abu and Adeniji (2007) [6] investigated the extent to which factors like class size, student classroom-space and class utilization rate would determine the performance of secondary school students in Senior Certificate Examinations (SSCE) conducted by the West Africa Examinations Council (WAEC) in Oyo State, Nigeria between 1997 and 2002 school years. The study was ex-post factor under a descriptive survey research design, 200 out of the 336 secondary schools in the state were randomly selected for the study. The multiple regression analysis and one-way analysis of variance were used to analyze the data. Findings revealed that the factors class size, student classroom space and class utilization rate, when taken together, determined significantly, students' academic performance in Oyo state between 1997 and 2002. These factors, when taken separately, also determined significantly secondary school student's academic performance in the state. The authors expressed concern that these findings are of great significance for educational planners, policy makers and both federal and state governments. These factors have to be taken into consideration while planning and also providing secondary education.

Kraft (1994) [11] in his study of the ideal class size and its effects on effective teaching and learning in Ghana concludes that class sizes above 40 have negative effects on students' achievement. In another review, Asiedu-Akrofi (1978) indicates that since children have differences in motivation, interests and abilities and that they also differ in health, personal and social adjustment and creativity, generally good teaching is best done in classes with smaller numbers that allow for individual attention.

Studies examining class size effect on performance was compiled by Robinson and Wittebols, (1986) [16]; Robinson, (1990). The authors reviewed more than hundred (100) separate studies, but did not support the expectation that smaller classes will of themselves result in greater academic gains for students. The effects of class size on student learning vary by grade level, pupil characteristics, subject areas, teaching methods, and other learning interventions. In particular, the review concludes that small classes are most beneficial in reading and mathematics in the early primary grades. It was also found that "the research consistently finds that students who are economically disadvantaged or from some ethnic minorities perform better academically in smaller classes". Slavin (1989) reviewed only those studies that lasted a minimum of one year. Larger classes were compared to classes that were at least 30 percent smaller and had 20 students or fewer; and involved either random assignment of youngsters to class sizes or matching to assure that the groups were initially equivalent. From the eight studies identified by Slavin, it was concluded that substantial reductions in class size have a small positive effect on students, and the effect was not cumulative and even disappears in later years. Slavin's reinterpretation of the Glass-Smith findings is that large effects are not likely to be seen until the class size is reduced to one (i.e one teacher to a student). This is however an expensive venture for the government and parents.

Hypermedia and students learning

Moore (1994) [14] description of hypermedia is that it is "the hottest thing to happen to education since the arrival of the microcomputer". Empirical studies on effectiveness of hypermedia in the classroom have been documented, with emphasis on observation of different variables and effect on students' performance. Although there are conflicting reports, some reports indicate significant increase in performance others confirms that hypermedia has no much impact on students' performance.

Due to the recent advocacy for hypermedia in instruction, few studies of hypermedia on educational outcomes appeared before 1993 (Liao, 1998) [12]. Liao then started with the review of two reports of meta-analyses on effects of hypermedia on learning across 35 and 43 research studies. The review concluded that CAI and text influenced learning the most, hypermedia's influence on learning was next, while the least influential was traditional instruction and videotape instruction. Liao's 1998 study covered research published in journals between 1986 and 1997. The source of meta-analysis is a factor to be considered in critique. The fact that half of the reports here were sourced journal indicates that the majority of studies included in the synthesis have been critically reviewed by journal reviewers. Liao reported a medium but significant effect size of 0.48 or a percentile of 68 on achievement (Liao, 1998) [12]. An effect is said to be medium when Effect Size (ES) = 0.5 and large when ES = 0.8 (Cohen, 1977). It was medium because it was not up to 0.5, but was significant when compared to other modes of instruction.

Dillon and Gabbard (1998) in another meta-analysis of hypermedia, review published findings from experimental studies on hypermedia emphasizing quantitative, empirical methods of assessing learning outcomes. Specifically, the review was categorized into three research themes that included studies of learner comprehension compared across hypermedia and other media, effects on learning outcome offered by increased learner control in hypermedia environments, and the individual differences that exist in learner responses to hypermedia. The authors sought published studies of hypermedia use and learning outcome that were empirical based, experimental (that is considered as meeting rudimentary scientific requirements for selection, manipulation, and control of variables), and primarily quantitative. Emphasis was on the measured effects of hypermedia usage on learning outcomes, which is defined as any desirable and demonstrable changes in learner behavior or task performance as a function of instruction or information presentation. The review concentrated on research findings published between 1990 and 1996 and abstracted or cited in the Educational Resources Information Center (ERIC) database or the PsycLIT database. These databases were selected as representative of the core literature indexes in the areas of education and learning.

The authors found that (i) Hypermedia afford the most

advantage for learners in specific tasks that require rapid searching through lengthy or multiple information resources and where data manipulation and comparison are necessary. Outside of this context, existing media were reported to be better than or as effective as the new technology. (ii) learners had increased control over access and this was found differentially useful to learners according to their abilities. This means that lower ability students have the greatest difficulty with hypermedia. (iii) The interaction of learner style in the use of various hypermedia features offers perhaps the basis of an explanation for the generally confusing results in the literature comparing hypermedia and non hypermedia learning environments. Dillon and Gabbard's result confirms the findings of Liao that hypermedia has significant positive effect on students' learning.

At the present time, it appears the use of hypermedia in education and learning on achievement and attitude has mixed results, and further studies need to be conducted to determine what causes success in one case and failure in another. The definite possibility exists that learning efficiency (time to master a given set of objectives) may be severely reduced by such things as the sheer amount of poorly catalogued and sometimes inaccurate information, coupled with disorientation resulting from disparate interfaces.

Hypotheses

a. There will be no significant difference in the performance of students with respect to modes of hypermedia treatment in small and large classes.
b. There will be no significant difference in the performance of students with respect to modes of hypermedia and sex.
c. There will be no interaction among the variables sex, class size and mode of hypermedia instruction on students performance.

Methods

One hundred and fifty six (156) participants were purposively selected from six (6) classes in a secondary school. There were six groups: four experimental groups and two control groups. The groups were assigned into treatments groups as follows: Experimental group I: Small Class of learners that were exposed to learner controlled hypermedia-based instruction, Experimental group II: Small Class of learners that were exposed to teacher controlled hypermedia-based instruction, Control group 1: Small class of learners that were exposed to no mode of hypermedia-based instruction, Experimental group III: Large Class of learners that were exposed to learner controlled hypermedia-based instruction, Experimental IV: Large Class of learners that were exposed to teacher controlled hypermedia-based instruction, Control group 2: Large Class of learners that were exposed to no mode of hypermedia-based instruction. Each group consisted of male and female students.

The test instrument used was a 20 multiple choice question which was designed to determine the student's prior knowledge. This was also used as posttest instrument with the same question items as the pretest to verify any increase in achievement at the end of the instruction. The six (6) groups received the same instructional content using different instructional modes. However, participants who studied through learner controlled hypermedia were given an orientation of 20 minutes on how to navigate the instructional content so as to avoid "loss in the hyperspace".

Results

Table 1: Two-way ANOVA results of hypermedia instruction in large and small classes

Class Sizes	Mode of Hypermedia	Mean	Std. Deviation	N
small	Teacher controlled hypermedia	13.8333	1.94625	12
	Learner controlled hypermedia	15.5000	2.35488	12
	No Hypermedia	9.8333	2.12489	12
	Total	13.0556	3.18877	36
Large	Teacher controlled hypermedia	10.4000	2.03558	40
	Learner controlled hypermedia	12.1750	1.69293	40
	No Hypermedia	9.9250	1.28876	40
	Total	10.8333	1.94605	120
Total	Teacher controlled hypermedia	11.1923	2.47369	52
	Learner controlled hypermedia	12.9423	2.32137	52
	No Hypermedia	9.9038	1.49849	52
	Total	11.3462	2.46695	156

Dependent Variable: Posttest

Table 2: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	452.824(a)	5	90.565	27.697	.000
Intercept	15803.419	1	15803.419	4833.014	.000
Class size	136.752	1	136.752	41.822	.000
Media	290.906	2	145.453	44.482	.000
Class size * Media	74.188	2	37.094	11.344	.000
Error	490.483	150	3.270		
Total	21026.000	156			
Corrected Total	943.308	155			

Dependent Variable: Posttest

A, R Squared = .480 (Adjusted R Squared = .463)

Table 1 shows the descriptive statistics of mean and standard deviation of the two variables in question (modes of hypermedia and class size). The table indicates that learner controlled hypermedia yielded the highest mean scores for students in both large and small classes.

Table 2 shows that class size *($p<.05$)* (large and small), and modes of hypermedia *($p<.05$)* (learner controlled, teacher controlled and no hypermedia) have significant effect on performance of students. The two-way ANOVA was conducted to examine the effect of class size and modes of hypermedia instruction on performance of students found a statistically significant interaction between the effects of class size and modes of hypermedia (*$F = 11.344$, $p<.05$).* Simple main effects analysis showed that small classes were significantly more effective when learner controlled hypermedia was used than large classes *($p < .05$)*

Table 3: Two-way ANOVA results of hypermedia instruction among male and female students

Sex	Mode of Hypermedia	Mean	Std. Deviation	N
Male	Teacher controlled hypermedia	11.8077	2.80027	26
	Learner controlled hypermedia	13.7692	2.47075	26
	No Hypermedia	10.1538	1.54123	26
	Total	11.9103	2.74068	78
Female	Teacher controlled hypermedia	10.5769	1.96312	26
	Learner controlled hypermedia	12.1154	1.86176	26
	No Hypermedia	9.6538	1.44062	26
	Total	10.7821	2.02355	78
Total	Teacher controlled hypermedia	11.1923	2.47369	52
	Learner controlled hypermedia	12.9423	2.32137	52
	No Hypermedia	9.9038	1.49849	52
	Total	11.3462	2.46695	156

Dependent Variable: Posttest

Table 4: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	300.385(a)	5	60.077	14.017	.000
Intercept	20082.692	1	20082.692	4685.481	.000
Sex	49.641	1	49.641	11.582	.001
Media	241.885	2	120.942	28.217	.000
Sex * Media	8.859	2	4.429	1.033	.358
Error	642.923	150	4.286		
Total	21026.000	156			
Corrected Total	943.308	155			

Dependent Variable: Posttest

A, R Squared = .318 (Adjusted R Squared = .296)

Table 3 is the summary of performance of male and female students in the different class sizes with the corresponding hypermedia treatment. The descriptive statistics shows that males in the learner controlled hypermedia had the highest mean score (13.7692), while females in the learner controlled hypermedia had a mean score of 12.1154. Two-way ANOVA shows that sex *(F=11.582, p<.05)* and modes of hypermedia *(F=28.217, p<.05)* have significant effect on performance of students. However, there was no significant interaction effect of sex and mode of hypermedia on performance of students *(F=1.033, p>.05)*.

Table 5: Three-way ANOVA of interaction among Class Sizes, Mode of Hypermedia and Sex

Class Sizes	Mode of Hypermedia	Sex	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound
small	Teacher controlled hypermedia	Male	15.000	.690	13.636	16.364
		Female	12.667	.690	11.303	14.031
	Learner controlled hypermedia	Male	17.000	.690	15.636	18.364
		Female	14.000	.690	12.636	15.364
	No Hypermedia	Male	10.833	.690	9.469	12.197
		Female	8.833	.690	7.469	10.197
Large	Teacher controlled hypermedia	Male	10.850	.378	10.103	11.597
		Female	9.950	.378	9.203	10.697
	Learner controlled hypermedia	Male	12.800	.378	12.053	13.547
		Female	11.550	.378	10.803	12.297
	No Hypermedia	Male	9.950	.378	9.203	10.697
		Female	9.900	.378	9.153	10.647

Dependent Variable: Posttest

Table 6: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	531.908(a)	11	48.355	16.926	.000
Intercept	15803.419	1	15803.419	5531.581	.000
Class size	136.752	1	136.752	47.867	.000
Media	290.906	2	145.453	50.912	.000
Sex	69.911	1	69.911	24.471	.000

Class size * Media	74.188	2	37.094	12.984	.000
Class size * Sex	20.270	1	20.270	7.095	.009
Media * Sex	5.595	2	2.798	.979	.378
Class size * Media * Sex	.313	2	.157	.055	.947
Error	411.400	144	2.857		
Total	21026.000	156			
Corrected Total	943.308	155			

Dependent Variable: Posttest
A, R Squared = .564 (Adjusted R Squared = .531)

Table 5 & 6 present three-way ANOVA of the interaction of the variables (sex, cognitive styles, class size and hypermedia instruction) on learners performance. The table shows that the variables have no significant interaction on the performance of learners *(F=.055, p> .05).*

Discussion of Results

Result shows that class size is a very important variable to be considered in using hypermedia to teach Art History. It was obtained from the result that learners who were exposed to hypermedia in the small class performed significantly better than those in the large class. Authors and advocates of small class have always opined that smaller classes produce increased academic achievement because student-teacher interaction is increased, and permits thorough evaluation of students as well as promote greater flexibility. The hypermedia used in the current study combines all the capabilities mentioned above. This finding is also consistent with Glass and Smith (1978); CSR Research Consortium (1999) [4]; American Federation of Teacher (2000) [2]; Fabunmi, Brai-Abu and Adeniji (2007) [6]. However, many critics of class size reduction have raised the issue of funding, that reduced classes will call for more funding and cause a lot of problems for the government and other stakeholders in the education sector. Though the current research did not look into this but believe that stakeholders will only have to weigh the benefits of having quality education as against the cost. But on the final analysis this study has established that reduced classes have greater benefits over large classes. It was also recalled that during the field work, many learners who later got to know that some of their colleagues belonged to small class were willing to volunteer to cross over. It implies that apart from the improved achievement, smaller classes boost learners' morale and motivation to learn.

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