Effects of Multimedia Instructional Formats on Senior Secondary School Agricultural Science Students' Achievement in Minna Educational Zone, Niger State, Nigeria

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Abstract
The study investigated the effects of multimedia instructional formats on students' achievement in agricultural science. The sample comprised of 250 (121 boys and 129 girls) students selected from four senior secondary schools in Minna Educational Zone of Niger State, Nigeria. There were three experimental groups and a control group. The experimental groups were taught with Multimedia instructional formats and the control group was taught using lecture method. The research design was a quasi experimental pre-test post-test control group design. The Agricultural Science Achievement Test (ASAT) of a 40 items with internal consistency reliability co-efficient of 0.75 was used to measure the student's achievement before and after the treatment. Two (2) hypotheses were formulated and tested at 0.05 alpha levels. The data were analyzed using Mean, Standard Deviation and ANCOVA. The findings of the study showed that student in experimental groups achieved significantly better than their counterpart in control group. There was statistically significant difference in the achievement of Male and Female students in favour of Male. Based on the findings, it was recommended among others that the use of Multimedia instruction formats for teaching and learning should be encouraged in Nigerian schools.

Key words: Effect, Multimedia Instructional Formats, Students, Achievement, Agriculture, Niger State.

Introduction

Science and technology according to Khan (2004) are the vehicles of development in the modern globalized world today and the difference between what developed countries have and what developing countries lack is modern science and an economy based on modern technology. Similarly, no nation can envisage progress and prosperity without effectively building and harnessing capacities for them. To Rahman (2008) an integrated and systematic effort to build these capacities must be stirred up within developing countries at the highest level, which should trickle down to the grass-root levels as a mark of commitment. Furthermore, Maputo (2003) remarked that developing countries stand at a juncture where they are presented with no other choice than to use science and technology as tools of sustainable development. The secret behind this assertion is that Science and Technology (S & T) are the keys to development, prosperity and sustainability, and nations well equipped with the tools of S&T open-up gateways leading to limitless horizons of success. In a similar view, Kwakamba (2013) added that science and technology are the powerful resources for understanding natural and social phenomena, and undoubtedly, their role promises to be even greater in the future, as the understanding of mankind regarding the growing complexity of the relationship between society and the environment becomes deeper.

Technology is the primary vehicle through which humanity progresses, this is so because the development of new technology has been absolutely vital for both human survival and human progress (Khan, 2004). Indeed, technology could serve to eliminate much of the biggest problems facing the nation such as world hunger, poverty, lack of access to education and other issues. A reversal of these technological misfortunes can only come about as a result of renewed focus on technological education and research (Kwakamba, 2013).This agrees with one of the objectives of secondary school education as identified in the National Policy on Education (FRN, 2004). According to the policy, the provision of relevant manpower training in

the area of applied science, technology and commerce at sub-professional grade is a national concern and commitment. Prokop, Tuncer and Chuda (2007) agreed with these views and suggested that teachers should have the knowledge of how students learn Science and Mathematics and how best to teach them. They further contended that changing the way of teaching science and mathematics is a continuing professional concern, and educators believed that any nation wishing to develop must not neglect the teaching of science and applied sciences in its schools (Egun, 2002).

Agricultural science is an applied science, concerned with the preparation of individuals for occupation and acquisition of appropriate knowledge and skills to enhance increase in productivity. According to Uko (2012) the study of applied science and business management principles goes beyond knowledge and skills development as learners are expected to develop an understanding of the significance of agriculture in global society. In addition, the foundation for agricultural education is laid at the primary school and subsequently built upon at the secondary school level, from where concretization and implantation of higher order skills will take place at the tertiary level of education (Colleges of Education, Polytechnics and the Universities). Agricultural Science is a practical subject based on scientific concepts and principles from the field of sciences: Biology, Chemistry, Physics, Earth science, Environmental sciences and the results of research studies. As a school subject, agricultural science has close links to environmental education and education for sustainability, both in terms of content and in terms of its accompanying educational activities (Ofri, 2013). Awaritefe (2000) saw it as the social science of economics and geography; Maduabum (2003) and Egun (2002) acclaimed that, the subject is one of the sciences that are "an embodiment of other sciences". The different aspects of this Subject are the key to build an effective human capital for society; promotes knowledge by raising agricultural productivity, provide employment opportunities, and produce staple foods for the populace and raw material supply for the agro-allied industries.

Traditionally, agriculture has been recognised as the art of tilling the soil and a way of life for families in rural communities. With modern technology and a rising world population, agriculture today is seen as an art, a skill, an applied science, a multi-faceted discipline, a business and a vocation, focused primarily on food production (Uko, 2012). It is on this basis that the Federal Republic of Nigeria formulated the basic objectives of teaching agricultural science at the secondary school level as follows:

1. To stimulate and sustain students' interest in agriculture.
2. To inculcate in students farming skills
3. To enable students acquire basic knowledge and practical skills in agriculture.
4. To prepare students for future studies in agriculture and
5. To produce prospective future farmers (FRN, 2009):28.

Despite these laudable objectives, pedagogical approach to the subject is bound up with a routine rehearsal of copious notes and storytelling. These patterns of pedagogy are part of culturally embedded systems in the classrooms and the result is learners misunderstanding, loosing vital information and poor retention. In spite of the importance and popularity of agricultural science, the subject is fading away in the minds of most students and academic achievements at senior secondary school level had been poor as reported in prescribed standardized examinations like West African Senior Secondary School Certificate Examination (WASSCE), National Examination Council (NECO) and National Technical Education Board (NATEB) (Egun, 2007). Agricultural science according to Balogun (2004) is better taught by "doing" hand-on experiences which involve observation, experimentation, field practice, manipulation of tools, equipment, machineries and other facilities capable of promoting the development of problem-solving skills, scientific interest and attitude, functional knowledge and manipulative skills. In support of this view, Mayer (2009) noted that adding visualizations to a text-based lesson can improve students' understanding of the material. In continuation, Mayer (2009) opined that advances in computer and communication technologies have created renewed interest in adding visualizations to verbal instruction in order to help people learn. Supporting this view, Nusir, Alsmadi, Al-Kabi, and Shardqah (2012) remarked that multimedia technology is probably one of the most exciting innovations in the information age that can facilitate teaching and learning. Norhayati and Siew (2004) added that, the rapid growth of multimedia technologies over the last decade has brought about fundamental changes to computing, entertainment, and education.

Gender imbalance in Nigerian schools is one of the prevalent problems that lead to inability of girls to

study scientific and technical subjects thereby limiting the females' educational career and employment choices. Chachil (2006) remarked that one prominent problem of a gender balanced instruction in Science, Technology and Mathematics (STM) is the issue of sex stereotyping which is reflected in schools, in textbooks, and lesson notes. Studies have revealed that girls who drop-out of primary school are more than boys by ten million and that nearly two-thirds of the world's (780 million) illiterates are women (UNESCO 2006). This is made manifest in the statistics of entries on gender basis of students' result in agricultural science where, 1,367,713 students sat for the examination, 792,757 were boys representing (57.96%) while only 574,956 representing (42.04%) were girls (WAEC 2012). Reacting to this, Francis (2008) suggested that Girls should be allowed to be actively involved in the Science, Technology and Mathematics laboratories, workshops, seminars and classes to enhance their performances in schools. Nsofor (2001) agreed with this and added that incentives should be given to females in form of awards, scholarship in school to encourage female participation in Science, Technology and Mathematics education. Thus, gender difference in students' achievement in agricultural science concepts is investigated in this study.

A continual dilemma experienced by agricultural science educators is how to respond to the changing face of society (where modernization embellish farming practices) and stay abreast of the possible impacts that technology could have in the academic achievements of agricultural science students. Similarly, Abbas, Bimbo & Ojo (2012) hold the view that effective teaching of agricultural science (especially practical applications of agriculture) must employ the use of multimedia instructional approach as a new teaching tool in a school system. The question in mind is; can multimedia instruction formats improve students' achievement? Hence, the need for this study.

Research Questions

The study was guided by the following research questions:

1. Is there any difference in the mean achievement scores of students taught agricultural science using multimedia instruction formats (Animation + On-Screen Text [A + T], Animation + Narration [A + N], Animation + On-Screen Text + Narration [A + T + N]) and those taught with conventional lecture method?
2. Is there any gender difference in the achievement of students taught agricultural science using Multimedia instructional formats?

Research Hypotheses

The following hypotheses were formulated and tested at 0.5 alpha levels.

Ho_1 There is no significant difference in the mean achievement scores of students taught agricultural science using multimedia instruction formats (A+T, A+N, A+T+N) and those taught with conventional lecture method.

Ho_2 There is no significant gender difference on the achievement scores of students taught agricultural science using Multimedia instruction.

Research Methodology

The research design adopted for this study was a quasi-experimental non-randomised pretest-posttest control group design. The design involved three experimental groups and one control group. Subjects in the four groups were pretested before the treatment to determine the equivalence of the groups and after the treatment, they were post tested.

Population and sample

The population of the study comprised of all the senior secondary school students in Minna educational zone, Niger state. The target population of students in these schools were (3,368) senior secondary two (SS2) students in co-educational schools in Minna Educational zone. The sample of this study was made up of two hundred and fifty (250) students from four co-educational senior secondary schools of Minna educational Zone, Niger State. The researchers adopted a purposive sampling technique where four schools with well equipped computer laboratories were sampled as experimental groups and control group. One intact science class was used from each of the four senior secondary schools sampled for the study. Among the 250 students sampled for the study, 121 were boys, while 129 were girls.

Research instruments

Research instrument were the multimedia instructional formats on agricultural science (MIFOAS) and agricultural science achievement test (ASAT). There were three versions of Multimedia Instruction Formats used in the study. These include: Animation + Text (A+T); Animation + Narration (A+N); Animation + Text + Narration (A+T+N). These multimedia instructional Formats were developed by the researchers based on the concepts taught to the students in the study, namely: introduction to farm machines and implements as contained in the senior secondary two (SSII) agriculture core curriculum. It is an interactive and self-study Formats. The instrument was validated by experts in computer science, educational technology, agriculture and educational measurement and evaluation. The test instrument consisted of 40 multiple choice test items relating to the concept of the study. This instrument was used to measure student's academic achievement in agricultural science.

The reliability of the instruments was determined by the pilot test method using Pearson product moment correlation (PPMC). The reliability coefficient (r) 0.75 was obtained.

Data collection procedure

The four (4) sampled schools were visited two weeks before the commencement of the experiment to seek for official permission from the school authorities and also commence the training of research assistants. Total of (6) weeks were used for the study. During the first week, pre-test was administered to all the groups (experimental and control), followed by the treatment which took the total of four weeks to the experimental groups using (MIFOAS) and the control group using a conventional lecture method. The following arrangement and schedule was duly followed during the process of data collection, each student was assigned to a single computer system and each lesson lasted for fourty (40) minutes. The control group were thought for the same period (of time) using traditional teaching method. After the lessons were completed, a one week period was used as revision, followed by the administration of Agricultural Science Achievement Test (ASAT) as post-test to all the groups.

Data analysis

The research questions were answered by computing the mean achievement scores and standard deviation of the experimental and control groups while hypotheses were tested at 0.05 probability level using the Analysis of Covariance (ANCOVA) and scheffes' test.

Results

The results of the mean and standard deviation of the student's achievement are presented in table 1 and 2 based on the research questions:

Table 1 Means and Standard Deviation of the Posttest mean Achievement Scores of Experimental and Control Group

Variable	No. in sample (N)	Mean($\bar{x}$)	SD
Exp. Group 1	55	19.04	3.085
Exp. Group 2	58	21.57	5.120
Exp. Group 3	65	19.92	3.918
Cont. Group	72	18.35	2.903

Table 2 Mean and Standard Deviation of the Posttest Mean Achievement Scores of Male and Female Students in Experimental Groups

Groups	Gender	No. in sample (N)	Mean ($\bar{x}$)	SD
Exp Group 1	Male	23	18.61	3.173
	Female	32	19.34	3.033
Exp Group 2	Male	30	23.33	5.378
	Female	28	19.68	4.137
Exp Group 3	Male	28	20.75	4.160
	Female	37	19.30	3.658

The result in table 1 indicated that the mean achievement scores of students in the experimental groups were higher than that of students in the control group. Table 2 showed that male and female students in experimental group II had higher mean achievement score than their male and female counterparts in experimental group I and III. To determined whether there was a significant difference in the posttest mean achievement scores of the experimental groups with multimedia instructional formats and those in control group with conventional lecture method, students' mean scores were subjected to analysis of covariance (ANCOVA) as shown in table 3.

Table 3: ANCOVA Comparison of the Posttest Mean Achievement Scores of Experimental and Control Groups

Source of variable	Sum of Squares	df	Mean Square	F-value	P-value
Corrected Model	368.343	4	92.086	6.298	.000
Intercept	7180.002	1	7180.002	491.084	.000
Covariate (Pretest)	7.013	1	7.013	.480	.489
Treatment	344.958	3	114.986	7.865	.000
Error	3582.073	245	14.621		
Total	100540.000	250			
Corrected Total	3950.416	249			

Table 3 Presents ANCOVA results of the posttest Mean Achievement scores of Experimental Groups (I, II, III) and the Control Group. The table revealed that there is significant difference between the posttest mean achievement of experimental groups and the posttest of control group ($F(3, 249) = 7.865$, $P < 0.05$). Therefore the multimedia instruction produced a significant effect on the posttest achievement scores of students when covariate effect (pretest) was controlled. This implies that a statistically significant difference exist between experimental groups (A+T, A+N, A+T+N) and the Control group; thus, hypothesis one (Ho_1) was rejected.

Similarly, the achievement of students in the groups were compared using mean gain score between the pretest and posttest for each of the group as shown in table 3.

Table 3a Mean Gain Score of Students Taught Agricultural Science Using Multimedia Instruction Formats (A+T, A+N, A+T+N) and those Taught with Conventional Method.

Groups	Pre-test	Post-test	Mean Gain Score
Exp Group 1	9.80	19.04	**9.24**
Exp Group 2	8.98	21.57	**12.59**
Exp Group 3	8.78	19.92	**11.14**
Control Group	9.61	18.35	**8.74**

Table 3a revealed that Experimental group 2 had the highest mean gain score of 12.20 followed by Experimental group 3 with the mean gain score of 11.44 and Experimental group 1 with the mean gain score of 9.24, while the Control group had the lowest mean gain scores of 8.44. Therefore, the differences are in favour of the experimental groups, particularly group II. The mean gains were further illustrated in figure 1.

Figure 1 Graphical illustration of students' Posttest Mean Achievement Scores of Experimental Group I, II, III and the Control Group

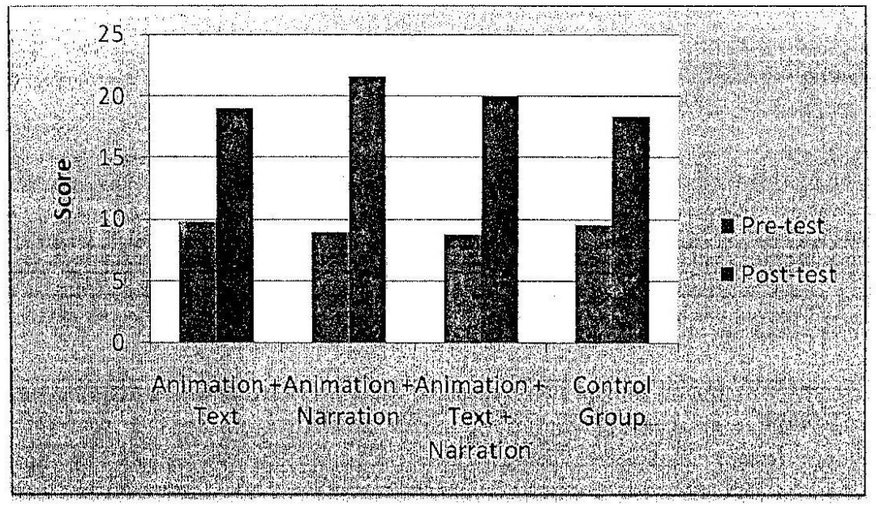


Table 4 ANCOVA Comparison of the Posttest Mean Achievement Scores of Male and Female Students Taught Agricultural Science Using Multimedia Instruction Formats

Source of variable	Sum of Squares	df	Mean Square	F-value	P-value
Corrected Model	436.687	6	72.781	4.539	.000
Intercept	5504.528	1	5504.528	343.256	.000
Covariate (Pretest)	14.256	1	14.256	.889	.347
CODE	166.570	2	83.285	5.194	.006
Gender	98.084	1	98.084	6.116	.014
Error	2742.195	171	16.036		
Total	75705.000	178			
Corrected Total	3178.882	177			

S= Significant at 0.05 level

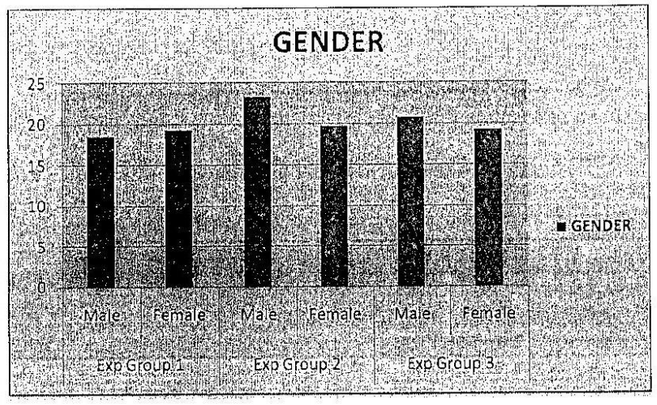
Table 4 indicated that there was a statistically significant difference in the mean achievement of Male and Female students taught agricultural science using Multimedia instruction formats. The results yielded an F-value of 6.116 and a P- value of 0.014 ($F(1, 177) = 6.116$, $P< 0.05$). This shows that the result was significant because $P<0.05$. Hence, hypothesis two (Ho_2) was rejected. Since ANCOVA has indicated generally that there was significant difference among the groups, a follow up scheffes's multiple comparison test was carried out to find out where the significant difference occur. Table 4a shows the result of scheffes's post hoc test on the mean scores of the three groups.

Table 4a Summary of Scheffes's Post Hoc Multiple Comparison Table of the Posttest Mean Score of for Gender of Experimental Groups 1, 2, and 3

	Variable	Mean Difference	Std. Error	Sig.	Lower Bound	Upper Bound
EXP 1	Male Exp 2	-2.53*	.753	.004	-4.39	-.67
	Female Exp 3	-.89	.733	.483	-2.70	.92
EXP 2	Male Exp 1	2.53*	.753	.004	.67	4.39
	Female Exp 3	1.65	.723	.078	-.14	3.43
EXP 3	Male Exp 1	.89	.733	.483	-.92	2.70
	Female Exp 2	-1.65	.723	.078	-3.43	.14

Table 4a indicated that there were statistically significant differences in the post-test mean achievement scores of male and female students in experimental group I in favour of male. Similarly, there is significant difference in mean achievement scores of male and female students in experimental group II in favour of male students. It also indicates a significant difference in the mean achievement scores of male and female in experimental group III in favour of female students. This is graphically illustrated in figure 2.

Figure 2 Graphical illustration of male and female students' Posttest Mean Achievement Scores



Discussion

The students in experimental group I, II, III taught agricultural science using multimedia instruction formats (A+T, A+N, A+T+N) performed significantly better than those in control group taught using conventional lecture method. This means that the developed Multimedia instruction formats have an enhancing effect on the teaching and learning of agricultural science than lecture method. The result also indicated that there was significant difference in the mean achievements of male and female of experimental group I, II, and III. Scheffe's post hoc multiple comparison tests also revealed that male students taught using multimedia instruction formats achieved significantly higher than female students in experimental group 1 and 2. Furthermore, the scheffes' post hoc indicated that female students achieved significantly better than male students in experimental group 3. The finding of hypothesis 1 is highly consistent with the basic tenets of multimedia instruction which postulates that "learning from material made with more than one medium is usually more effective than material comprised of only one medium". This is partly due to the fact that different parts of the brain process different information. For example, some parts of the brain process text while other parts process visuals. In addition, when multimedia formats activate more regions of the brain, there are increases in learning gains compared to materials that require fewer parts of the brain in processing information. This implies that the developed multimedia instruction formats on the selected agricultural science concepts stand to satisfy the demand of the cognitive theory of multimedia learning which suggests that students learn better from words and pictures than from words alone, since dual presentation of information help students construct verbal and pictorial mental models together and build connections between these models rather than constructing either a

verbal or a pictorial mental model.

The above finding is in agreement with the previous finding of Frear and Hirschbuhl (2000); Mayer (2009) and Adegoke (2011). They found that students who used computer-based multimedia instruction performed better in terms of test score's compared to those who received instruction through traditional classroom lectures. These findings suggest that learning outcomes of students in science can be enhanced with multimedia instruction. In the case of gender, male students tend to be more comfortable learning with multimedia than female. The contributing factor to this finding may be attributed to the instructional content "farm machines and implements" as being male related occupation. In the aspect of gender, the result was in agreement with the earlier findings of Wiliam (2000); Nsofor (2010) and Ahmed (2013). They came out with a finding that the use of multimedia instruction enhanced the performance of male students more than the females.

Conclusion

Students exposed to multimedia instructional formats achieved better than students taught with the conventional lecture methods. This is evidenced by the way they learn and interact freely with less dominance from their teachers. Also, it should be noted that male students appear to be more comfortable learning with multimedia instructional formats than their female counterparts.

Limitation of the study

The study is limited by the shortage of functional computers that can meet the requirement of the students sampled in each school. Also the noise caused by generators during the lessons caused distraction to the students while teaching with multimedia instructional formats.

Recommendations

1. Relevant and functional multimedia instructional packages should be made available by the government and proprietors of private schools to aid learning of abstract and difficult subject areas.
2. Teaching and Learning with computer is still at infant stage in Nigeria system of education especially in secondary schools. Agricultural science teachers should be provided with an intensive training in design and development of multimedia based lessons the same way as they are writing their traditional lesson plans.
3. As a matter of commitment and responsibility, the federal, state, local government, private individuals, organizations and alumni associations should endeavour to provide schools with needed computer systems, accompanying software, manpower and routine maintenance. Teachers on their part should be tasked to learn computer and use computer as their teaching tool.

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