Effects Of A Computer Aided Instructional Method On Students' Performance In Agriculture: A Quasi Experimental Case Study

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Abstract: The purpose of this study was to test the effectiveness of Computer Aided Instructional method (CAI) on improving students' performance in agriculture for primary schools. A quasi-experimental design was used to study the effectiveness of Computer Aided Instruction (CAI) on improving students' performance. Data collected were in the form of students marks recorded as results of teaching the classes using the CAI and views regarding the technology used to deliver classroom instruction. The study revealed that CAI had significant effect on students' performance, the results showed the observed mean difference of -12.12500 at the value of t was -5.008 at P<.005, the mean difference of -12.12500 between the pre-test sores and the post test scores in the experimental group was statistically significant. Therefore, it can be inferred that the computer aided instructional method of teaching had an effect on the performance of primary school kids in agriculture.
[Dichepi Sebeso, Hulela, K., Tapela Bulala. **Effects Of A Computer Aided Instructional Method On Students' Performance In Agriculture: A Quasi Experimental Case Study.** *Life Sci J* 2017;14(3):58-64]. ISSN: 1097-8135 (Print) / ISSN: 2372-613X (Online). http://www.lifesciencesite.com. 10. doi:10.7537/marslsj140317.10.

Keywords: Agriculture, Computer Aided Instruction, students' performance, CD-ROM

Introduction And Background

Agriculture as a subject, is taught in Botswana schools using the traditional didactic methods like other subjects in the curriculum (Boikhutso, 2010). In most cases the traditional methods of lecturing is used with minimal integration of interactive styles of learning. With the advancement of technology in education, one wonders how effective that could be in improving the students learning and performance in agriculture science. Currently, there seem to be limited special courtesy to use innovative practices in the teaching of the subject of agriculture due to limited resources. Research has shown that in Botswana the use of computer assisted instruction (CAI) is still at an infant stage of development (Baffour-Awuah, 2002). There is also minimal research in line with computer aided instructions that could influence technology adoption into the education system. However, progress is being made as the government has in the past decade introduced computers in education at all levels. At primary schools' level, computers were supplied for administration and management purposes. In junior and senior secondary schools computer awareness education is ongoing as introduced as mindfulness subject which was included in schools. At tertiary and university ICT is striving well as a tool for instruction. This is bringing a change and awareness as the education is integrating technology. Likewise, primary schools countrywide have been equipped with computers supplied by the government. In addition, some schools have been assisted through donations from different organisations such as Debswana, the foreign mission organizations and international organizations. For example, the Kgafela primary school in the Kgatleng district and Ghanzi primary school in Ghanzi district have benefited from the British Council which donated twenty (20) computers to each. Our lady of the Desert primary school in Francistown, and Kubung primary school in Maun (Omphle Ntakhwana, Bopa news) also have computers. According to Anowe Motsaathebe, staff reporter (2013) some primary schools in the Kgalagadi district have also benefited from the Civil Aviation Authority of Botswana (CAAB) donation of 12 computers and six (6) printers to some schools in the district. The Chobe primary school was given some computers by the Botswana's High Commissioner at that time was based in Zimbabwe in 2012/ 2013, Mrs Gladys Kokorwe (Botswana Television news). The high commissioner upon handing over the computers to Chobe primary school in Kasane, stressed the importance of preparing students at a lower level with skills, attitude and knowledge on the use of modern technology. The computers were handed over on September 2013 (the Botswana Daily News, 2013). Based on this background, several schools now have computers to effect the computer aided instruction (CAI).

According to Serin (2011) in developed countries, Computer Aided Instruction (CAI) has

become certain in curricular and *the use of computers in education has become inevitable* (pp. 183). Most stakeholders seem to agree that CAI is the way to go in education. Arnold (2000) stated that Computer-Aided Instruction (CAI) is a diverse approach to supporting teaching and learning to students which is also one way to rapidly expanding the range of computer technologies in education. According to Arnold (2000) when using CAI information that is presented to students it is offered in the form of text or in multimedia formats like photographs, videos, animation, speech, and music. The author further stated that appropriate examples of CAI is the '*guided drill which is a computer program that poses questions to students, returns feedback, and selects additional questions based on the students' responses*'. According to Arnold, the CAI tools include word processors, spread sheets, and databases, collect, organize, analyse, and transmit information. As indicated by Kulik and Kulik (1991) application types which include, computer assisted instruction, computer managed instruction, computer enriched instruction are programmed for teaching and learning in science and technology curricular.

Alsultan, et. al (2006) described Computer Assisted Instruction (CAI) as an application of computer in implementing classroom instructions by integrating both the software and hardware. The author also explained that several softwares are used to build up the CAI packages such as Macromedia Director MX, Macromedia Flash and SWiSH Max. The findings of studies investigating the use of CAI in education have reported the positive results. For example, a study by Yusuf (2010) reported improvement of performance of students who were taught using CAI as a group or as individuals and were found to be better than their counterparts exposed to the conventional classroom instruction'. Collins and Derek (2010) found that the use of CAI significantly increased student final exam grades which was positive. Even though a lot of research studies have been conducted addressing different areas of technology in education there is still minimal studies in the area of Computer Aided Instruction particularly in developing countries.

According to Tella and Oyedeko (2010) teachers that used ICTs to teach courses have a strong perception that ICT contributes positively towards the performance of pupils. Susun (2003) examined the benefits of Computer Assisted Instruction (CAI), computer assisted interactive learning (CAL) and Computer-Mediated Communication (CMC) as used in adult education. The conclusion drawn was that indeed computers had the benefits such as extending students learning outside of classroom settings, using learning time efficiently, sustaining students' motivation, individualizing instruction as well as providing access to information tools. Benefits of CAI an ICT component cannot be overemphasized as there were studies that concurred with Tella and Oyedeko, Conoley *et al* (2007), and Koch *et al* (2008).

In addition to the above,, the following benefits were also drawn from using computer technology in education such as PowerPoint. The powerpoint helps teachers organise the information, enhances students' attention and note taking behaviour. This gives the weaker students a chance to communicate without depending on text, increasing access to learning materials and stimulating learner motivation. Furthermore, the use of ICT gadgets like iPods and MP3s in academics also motivates learning thus making lessons more enjoyable as such enhancing specific classroom content areas.

Despite these positives of computers, Mc Grath and Zhiwen (2011) reminded that some barriers such as lack of skills, resources and large number of students in classes particularly in developing countries could affect the use of technology. According to Kotrlik and Redmann (2009) teachers in Louisiana have in the past years increased adoption and use of technology in teaching but were faced with the problem of accessing the technology they need to use. Mumtaz (2000) indicated that the challenge in the integration of ICT in teaching and learning process was also dependent on the teacher's beliefs, perceptions and attitudes. Factors such as time, access, knowledge and support acquired contributed to teachers' use of ICT in their professional development (Hutchison, 2012). Kotrlik and Redmann asserted that authority of education should develop models that would assist in the integration of technology in the teaching and learning processes. Such models should take into consideration accessibility to resources, quality of software and hardware, incentives to change, support in the schools and national policies, teacher commitment and background in formal computer training (Mumtaz, 2000)). Sowunmi and Aladejana (2013) reported that *simulation games can be very useful in improving teaching and active learning or learning by doing especially where there are minimal facilities for computer assisted instruction* (pp.117).

In an attempt to overcome the barriers to improve the use of ICT, Williams *et al* (2007); Carlspn and Gadio, (n.d) reported that technology in developing countries can be enabled by providing sufficient hardware, appropriate software, technical training, and continuous professional development of teachers and willingness of teachers to change. According to Carlsiin, teacher preparation that involve the use and application of technology is key factor to improved student performance. Czerniewicz and Brown (2005)

asserts that in South Africa, those that work in higher education should not only play a role of influencing the adoption of ICT, but they should recognize that integrating it in teaching and learning require access to resources. According to Bose (2004), to improve the integration of ICT in education there is need for one to address issues of standardization of curriculum and syllabus, computer awareness, strengthening of public network infrastructure and teacher competency. Ololube, Ubogu and Egbezor *(*2007) emphasized that effective usage, integration and diffusion of ICT in distance learning placed policies at a balanced investment of education programmes. Lumande, Ojedokun and Fidzani (2006) thus recommended the use of opportunities for students to adequately access computers.

In conclusion, assessment is one of the areas of education that is lagging behind on the use of ICT particularly in developing countries. Although ICT plays an important role in evaluation it has not been fully utilized in many countries including Botswana. In formative assessment technologies can be designed to perform the *rapid assessment of student understanding, timely and targeted feedback, scaffolding of learning, interactive learning and assessment of higher-order skills, and tracking of student learning in different contexts and over time* (p7). For example the teacher can conduct on-the-spot surveys to check if students have learnt the content using the clicker (earner response systems (LRSs).

The purpose of this study was to investigate the effect of using CAI as compared to teaching a class using the traditional lecture method in agriculture. This topic was identified as important to teachers in providing the necessary light in agriculture for primary schools. The study was to ascertain the effect of using Computer Aided Instruction as compared to a traditional lecturer method in teaching agriculture to primary schools standard five pupils. This technique was identified as being important to education in providing the necessary results in the form of performance.

Materials And Methods

This quasi-experimental investigation was designed to determine the effect of a computer aided instruction (CAI) on the performance of primary school pupils in agricultural science. This study was a quasi-experimental research that employed the Non randomised control group pre-test post-test control group design. In this design as described by Ary et.al (2006) the researcher was able to control the treatment and the measurement of the dependent variable but could not control the assignment of the subjects to treatment.

Figure 1: Non Randomised Control Group Pre-Test Post-Test Control Group

Group	Pre Test	Independent Variable	Post Test
E	Y_1	X	Y_2
C	Y_1		Y_2

Adapted from Ary., et.al (2002).

Key:

E = Experimental group given computer based instruction;

C = Control group taught using the Traditional lecture method;

Y1= Pre-test given to all the classes at the same time.

X = Independent variable/Treatment used in the study.

Y2 = Post-test given to all classes at the same time.

The Target Population

The study targeted two primary schools, one in Sebele near Gaborone and the other one in Mochudi in the Kgatleng district. There were 3 intact standard five classes for the study with a total population of 103 students, one class at boitumelo primary school with 22 pupils and 2 classes in Kgafela in the Kgatleng district with 82 pupils and 1 class in Sebele in the south east district. In addition, the facility in the Kgatleng district was installed with various software and interactive smart board to facilitate teaching and learning through the use of a CD-ROM package. Thus, the schools were purposively selected to take part in the experiment because they had 20 computers each and were not distant from the researcher. Gay et.al (2003) described purposive selection as the type of sampling whereby the researcher selects a group based on circumstances such as proximity, accessibility and resource availability.

Instrumentation

Three data collecting instruments were designed by the researchers: aptitude test instrument to test the level at which students were prior to introducing the treatment, the attainment test instrument to gather data on the extent to which learners have learnt after being taught using the CAI and the survey questionnaire for gathering the views of pupils after being taught using CAI. The two attainment tests were designed by the researcher comprising of one word test items based on the objectives of the syllabus pertaining to the topic

taught during the experiments. The aptitude test was designed to gather data prior to the treatment to establish where student were in terms of knowledge on agriculture and the attainment test was designed to test the degree of attainment by students.

A Compact Disk – Read Only Memory [CD-ROM] was also designed by the researcher with the help of the fourth year student from Botho University to compile and package the instructional materials required for the experiment. The text materials were obtained from the Botswana upper primary school syllabus available online and re-typed to organize the subject matter contents in the form that was appropriate for students' learning.

A Computer Disc Read Only Memory (CD-ROM) was prepared by the researchers containing agriculture subject matter contents taught to standard five pupils. The subject was pre-tested at Boitumelo primary school in Sebele (School A) and implemented at Kgafela School (School B) in Mochudi.

The modules were as follows; introduction to agriculture, farm tools, biotechnology, soils, crop husbandry and animal husbandry. Each topic was created into a reading text illustrated with the help of pictures to capture the interest of students reading the text, objectives, and practice questions to be studied by students. The content was divided into (i) description of the concept, (ii) examples of each phenomenon described (iii) practice questions to make students involved. The CD-ROM structure comprised of hyperlinks to be interactive.

The survey instrument was designed being exposed to teaching using the computer aided instructional (CAI) a survey instrument was designed and administered to assess the attitudes of students after the use of computers in teaching and learning of Agriculture. The study was set to investigate if there is no difference between agriculture students' scores gained before being taught using CAI and grades obtained after using CAI.

Results And Discussions

Results were presented based on the objectives of the study whereby each variable in the objective formed the sub heading. The Variables include demographic characteristics, students' performance when using CAI, and student attitudes toward the technology. Thus, results were as follows;

Objective 1: Demographic Characteristics Of Pupils

Table 1: *Demographic Characteristics of Pilot School*

		Pilot School (School A)		Experimental (School B	
Pupils' Characteristics	**Variables**	**F**	**%**	**F**	**%**
	Control group	10	45.45 %	41	50.62%
	Treatment group	12	54.55 %	40	49.38 %
Gender					
	Boys	13	59.09 %	46	56.79 %
	Girls	9	40.91 %	35	43.21%
Age in years					
	≤10 Years old	1	4.55	1	1.23%
	10-13 Years old	21	95.45	79	97.53 %
	≥13 years old	0	0	1	1.23 %
Attended pre-school					
	Yes	9	40.91	36	44.44 %
	No	13	59.09	45	55.56 %
With computers at home					
	Yes	12	54.55 %	38	46.91%
	No	10	45.45 %	43	53.09 %
Availability of Video games at home					
	Yes	8	36.36 %	54	66.67%
	No	14	63.64 %	27	33.33 %
Parents or relatives with cell phones					
	Yes	19	86.36 %	66	81.48%
	No	3	13.64 %	15	18.52 %

The results in Table 1 show that in the pilot study at School A, located at Sebele in the South East district, there were 22 pupils in a one intact class who were assigned to the Control Group and experimental (treatment) group. At least 10 students were assigned to Control group while 12 were assigned to the treatment. The Experiment project at school B in the Kgatleng district had a total of 81 pupils. The

experiment was conducted using the two intact classes. The class of 41 pupils was assigned to the Experimental group and the other class with 40 pupils was used for the Control Group. The results in Table 1 also show that majority 59.09% and 56.79% of the pupils in the pilot and experiment projects respectively were male. This means there were more boys than girls in the two primary schools studied in this project. Noted also in table 1 is that in both the pilot and the experiment the chronological age of pupils studied had majority of the pupils in the age category of 10 – 13 years old that is, 95.45% and 97.53% respectively. Results in Table1 also show that higher proportions of pupils did not attend pre-schools and their parents or guardians did not own cell phones. Also the results indicated almost an equal proportion of availability of Video games at home. The results were mixed in terms of variables studied about pupils in schools.

Objective 2: Does Performance Of Students Improve When Using Cai?

Hypothesis

H0: there is no difference between students' scores when using the traditional method of teaching and the scores obtained when using the Computer Aided Instruction.

Figure 2. t-Test Paired Two Sample for Meanss

Column1	
diff	
Mean	-13.6364
Standard Error	3.309141
Median	-15
Mode	-10
Standard Deviation	10.97518
Sample Variance	120.4545
Kurtosis	1.181583
Skewness	0.6166
Range	40
Minimum	-30
Maximum	10
Sum	-150
Count	11
Confidence Level (95.0%)	7.373225

Figure 2 shows a paired t-test results compared on the basis of differentness between pre-test scores and post test scores obtained in the experiment. In figure 2, the results were computed on paired two samples for means of the same data at School A in a pilot testing the technology. A paired t-test was performed to determine the effect of Computer Aided Instruction (CAI). The results as shown in Figures 2 and 3 revealed that the CAI was effective on improving performance of students in the standard five primary school agriculture content taught. The mean performance results of students (M= 13. 6364, SD = 10. 97518, N = 11) was significantly smaller than zero t (11) = -4.12082, two-tail p = 0. 002074, providing evidence that the CAI is effective in improving students results in agriculture. A 95% CI about mean performance is 13.6364 ±7.3732 = (6.2632, 21. 0096).

This means that the Ha: is increased ≠ 0 (the performance was different from 0) thus fail to reject the null hypothesis.

Figure 3: t-Test: Paired Two Sample for Means

	Variable 1	Variable 2
Mean	48.18182	61.81818182
variance	236.3636	186.3636364
Observations	11	11
Pearson Correlation	0.720109	
Hypothesized Mean Difference	0	
df	10	
t Stat	-4.12082	
P(T<=t) one-tail	0.001037	
t Critical one-tail	1.812461	
P(T<=t) two-tail	0.002074	
t Critical two-tail	2.228139	

Figures 4 and 5 show the results for the experimental school in the Kgatleng district. A paired t-test was performed to determine if the use of CAI was effective in improving students' scores in a test. The mean performance increase (M = 12.125, SD = 15. 31245094, N= 40) was significantly smaller than zero, t (-5. 00805). TWO-TAIL, P = 7.7 e-06, providing evidence that the use of CAI was effective in providing increase in students' performance scores. A 95% CI about performance difference is 12.125 ± 4. 897159391 = (-7.228, -17.022).

The results mean that the Ha: is increased ≠ 0 (the performance was different from 0) thus fail to reject the hypothesis of this research study.

The increase in performance of scores could have been as low as an average of -7% to as high as -17%. If it is as low as -7% it would still mean that the CAI was effective in terms of the researchers' experience with the national examinations particularly in agriculture.

Objective 3: Students attitudes towards the use of CAI.

Table 3 showed the results for the students' agreement or disagreement in relation to the variables studied about Computer Aided Instruction (CAI) in teaching agriculture in selected primary schools. The results showed that majority of the pupils studied agreed to all the variables studied about the CAI. This implies that pupils were positive about computer assisted instruction (CAI) and have enjoyed learning through their use.

Figure 4. t-Test: Paired Two Sample for Means

	Column 1	
Mean		-12.125
Standard Error		2.421111077
Median		-12.5
Mode		-10
Standard Deviation		15.31245094
Sample Variance		234.4711538
Kurtosis		0.859196014
Skewness		0.802908516
Range		60
Minimum		-35
Maximum		25
Sum		-485
Count		40
Confidence Level(95.0%)		4.897159391

Figure 5: t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	42	54.125
Variance	154.75	408.6094
Observations	41	41
Pearson Correlation	0.665612	
Hypothesized Mean Difference	0	
df	40	
t Stat	-5.13484	
P(T<=t) one-tail	3.85E-06	
t Critical one-tail	1.683851	
P(T<=t) two-tail	7.7E-06	
t Critical two-tail	2.021075	

Table 10: The results on student's attitudes towards CAI by age

		≤ 10 yrs	11- 13yrs	≥ 14 yrs	Total
I felt excited when using computers	Disagree	0	19[18.4%]	1 [0.9%]	20
	Agree	2 [1.9%]	81[78.6%]	0	83
CAI made lessons more fun for me	Disagree	0	13[12.6%]	0	13
	Agree	2[1.9%]	87 [84.5%]	1[0.9%]	90
CAI made lessons more interesting	Disagree	0	13 [2.6%]	1[0.9%]	14
	Agree	2[1.9%]	87 [84.5%]	0	89
CAI made me to understand things taught	Disagree	0	15[14.6%]	0	15
	Agree	2[1.9%]	85[82.4%]	1[0.9%]	88
Learning with CAI improved my skill	Disagree	0	21[20.4%]	1[0.9%]	22
	Agree	2[1.9%]	79 [76.6%]	0	81
CAI made me like agriculture	Disagree	0	15[14.6 %]	1[0.9%]	16
	Agree	2[1.9%]	85[82.4%]	0	87
I like learning agriculture using CAI	Disagree	0	15[14.6%]	0	15
	Agree	2[1.9%]	85[82.4%]	1[0.9%]	88
CAI are important to me	Disagree	0	16[15.5%]	0	16
	Agree	2[1.9%]	84[81.5%]	1[0.9%]	87

Table 11: Student's CAI in agriculture

Opinion Statement	**Level Of Agreement**			**Total**
		No	**Yes**	
I Felt Excited When Using Computers	Disagree	8 [7.8 %]	12 [11.7 %]	20[19.4%]
	Agree	**45** [43.7%]	**38** [36.8 %]	83[80.6%]
Cai Made Lessons More Fun For Me	Disagree	7 [6.7 %]	6 [5.8 %]	13[12.6 %]
	Agree	46 [44.7%]	44 [42.7 %]	90[87.4 %]
Cai Made Lessons More Interesting	Disagree	8 [7.8%]	6 [5.8%]	14[13.5 %]
	Agree	45 [43.7%]	44 [42.7%]	89[86.4%]
Cai Made Me Understand Things Taught	Disagree	7 [6.7 %]	8[7.8%]	15[14.5%]
	Agree	46 [%]	42 [40.8%]	88 [85.4%]
Learning With Cai Improved My Skill	Disagre	11 [10.7%]	11 [10.7%]	22[21.4 %]
	Agre	42 [40.8%]	39 [37.8 %]	81[78.6 %]
Cai Made Me Like Agriculture	Disagree	13 [12.6 %]	6 [5.8%]	16[15.5 %]
	Agree	42 [40.8%]	45 [43.7%]	87[84.4 %]
I Like Learning Agriculture Using Cai	Disagree	7 [6.7%]	8 [7.8%]	15[14.5 %]
	Agree	46 [44.7%]	41 [39.8%]	87[84.5 %]
Cai Are Important To Me	Disagree	7 [6.7%]	9 [8.7%]	16[15.5 %]
	Agree	46 [46.7 %]	41 [39.8%]	87[84.5 %]

Table 4 shows the level of agreement and disagreement of students on seven variables related to Computer Aided Instructions in teaching agriculture. In almost all statements describing the use of CAI to teach agriculture in selected primary schools, the respondents indicated agreement. The proportions of agreement ranged from 78.6% to 86.4% which showed highly positive attitudes towards the use of CAI. However, for those pupils who disagreed the proportions ranged from 12.6 % to 19.4% which cannot be ignored since most of the pupils indicated that they were not exposed to pre-schools.

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15. Acknowledgements: The author is thankful to the teachers and standard five students at Boitumelo primary school at Sebele and Kgafela primary school in Mochudi for agreeing to participate in the study.

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3/19/2017