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EFFECT OF VODCAST ON THE PERFORMANCE OF UNDERGRADUATE STUDENTS IN COMPUTER PROGRAMMING

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EFFECT OF VODCAST ON THE PERFORMANCE OF UNDERGRADUATE STUDENTS IN COMPUTER PROGRAMMING

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Abstract

With the growing number of university students currently taking introductory computer programming courses in Nigeria, sizable amounts of lecturers' time are spent on course development and instruction thereby preventing individualized attention. This has led to a decline in students' performance in computer programming. This study investigated the effect of vodcast on the performance of undergraduate students in computer programming. A post-test control-group quantitative design of experiments was used to determine if there was a statistically significant difference between the performance measured by assessment scores of second year university students enrolled for computer programming II course (CMP 212), who received supplementary content-specific vodcasts in addition to lectures (VL group) and those who received conventional lectures only (L group). The population of the study was drawn from the 272 students who enrolled during the 2018-2019 academic session at Federal University Dutsin-Ma, Nigeria. Descriptive statistics and independent sample t-tests were used to analyze the data. A *t-test* equality of means showed that the supplementary use of vodcasts yielded positive outcome with a value of t=14.546, p<.0001 and a mean difference of 21.772. A qualitative survey revealed that 70% of the students conceded to vodcasts enhancing their learning of computer programming. Therefore, it was concluded that vodcasts are valuable teaching tools for students undertaking undergraduate programming courses. Recommendation that universities and other tertiary institutions should adopt the use of vodcasts not just in teaching programming but also in the teaching of other courses was made

Introduction

In most Nigerian Universities, almost all computer science courses involve a bit of programming and they span through a period of four to five sessions (that is, eight or ten semesters). The entry level (100 level) undertake introduction to computer science I and II for first and second semester respectively. In the second year, the students take computer programming I and II in the first and second semester which cover aspects of algorithm development, problem solving skills, coding, debugging, structured programming, manipulation of various data structures such as strings and arrays. This is taught using any of C++, Java etc. The number of courses become more specialized as they progress through the program. These computer programming courses are mostly taught using the lecture method where

the course content is delivered through a teacher directed presentation to an audience of students. This is usually followed by lab sessions where the students are taken through a visual and practical demonstration of the aspects that enable the students to understand and build the requisite skills. At the end of the lecture period, learning is evaluated through examinable questions on theory and alternative to practical. Formative assessment during the semester is in the form of written assignments or lab practical while the summative assessment takes the form of venue-based examinations.

With the traditional lecture style highlighted, the extensive course content of most undergraduate programming courses in Nigerian universities and the expected requirement from the learners is hardly achievable in the short span of a semester which is usually fifteen (15) weeks of lectures and two (2) weeks of summative assessment (Oroma *et al.*, 2012). This is further complicated with the evident high teacher-student ratio of enrolled students with varying levels of educational background against the backdrop of inadequate facilities. Also, poor learning style/attitude, low self-efficacy, lack of motivation and lack of previous exposure with computers are contributing factors as well (Oroma, 2012).

Moreover, teaching and learning computer programming is two-fold. Krathwohl, (2002) observed that, gaining knowledge and comprehension at the lower level extends to a higher level of cognitive work which involves application, analysis and synthesis of the knowledge gained. In this case, it is evidenced by innovative concepts, problem solving, analytical skills and developing useful computer programs applicable to solve real world problems. As was also opined by Crampton *et al.*, (2011) & Krathwohl (2002), the students who take undergraduate computer programming courses do not display deep cognitive knowledge of the subject area and the application of programming concepts is not evidenced. Hence, their performance is on a decline (Oroma *et al.*, 2012). El-Zakhem (2016) reported that the failure rate of undergraduate programming students spans 25% to 80%.

This is of great concern especially because the curriculum demand that they develop practical skills necessary to utilize their knowledge in higher level programming courses and outside the school (Crampton, *et al.*, 2011). The development of computer programming skills is better achieved through visible demonstrations by the teachers. It is only then that the novice programmers obtain the courage to practice on their own (Van Heerden & Goosen, 2012). Constrained by human and material resources, practical demonstrations are hardly achievable.

To overcome the challenges, new and emerging technologies are readily providing solutions. Lectures and word-based resources have been a standard for many centuries, but they no longer meet students' current criteria of comfort, attitude and predisposition for Information and Communication Technology (Siddiq *et al.*, 2016). Information technology has a positive impact across all fields of study. The Internet has made worldwide communication easy by providing access to vast data, challenging assimilation, and assessment skills. Educational improvement revolves around the information age. Technology has been shown to positively influence student learning when students explore technology rich tasks that require them to use higher order thinking skills simultaneously, such as analyzing or evaluating information or creating new representations of knowledge (Polly, 2011).

To further develop applied information technology skills in the students, the social constructivist approach of active participation in studying must be adopted (Frank, et al., 2003). The technologies used to enhance this pedagogy are blogs, discussion forums, learning units, vodcasts and self-assessments. These types of assessments evaluate the students' knowledge and allow students to demonstrate a mastery of the theory in practical ways (Rand, 1999). Studies have shown that computer aided teaching enables students to learn faster and achieve better performance (Mehmet, 2004); more satisfaction is obtained during classes than otherwise (Millekin and Barnes, 2002).

A significant technological advancement in teaching and learning is the utilization of digital media such as podcasts, vodcasts and screencasts as a supplementation or an alternative to the traditional lecture method (Stephenson, *et. al.*, 2008). Vodcast is a combination of audio and visual material to form a resource (Mann *et al.*, 2009). It is the process of authoring and publishing visual content in the form of still images, animation, or video (Brown & Green, 2006). The video file is then posted to a website, or any digital space using a rich site summary or simple syndication (RSS) envelope and viewed or downloaded to any media device – computer, tablet or smartphone (Parson *et al.*, 2009). Thus, vodcast is video-on-demand podcast. Podcasting is formed from the combination of the words 'ipod' and 'broadcasting' (Mugwanya *et al.*, 2011), also referred to as 'Personal on Demand' broadcasts (Podcasts). Web-based broadcasting is used to automatically transfer digital audio to portable media players in MP3 format and distributed through a subscription service such as iTunes. It can be accessed directly through a computer or indirectly through a portable device like an iPod or mobile phone.

Vodcasting does not replace listening to live lectures or reading but augments these activities and increases the portability and accessibility of learning resources. It is used by teachers who create such content to support their teaching strategy and strengthen students' interest in learning (Ng'ambi, 2008). The use of vodcast to teach programming has been found to have significant impact on students' learning (Van Heerden & Goosen, 2012).

The concept of combining such technological aids with lectures has grown in popularity among students in tertiary Institutions (Evans *et al.*, 2004; Heilesen, 2010). Students are fascinated by them because they provide them with control over their own learning environment in terms of where and when they learn (Heilesen, 2010; Chester *et al.*, 2011; Fill & Ottewill, 2006). Basically, podcasting was used in tertiary education for production of lectures that elaborate on certain difficult concepts and emphasize the key areas. As time progressed, podcasts were replaced by vodcasts which gave students a similar experience with the classroom presence. Vodcasts offer learners the feeling of personal interaction with the teacher (Risenga, 2010). The learners can hear instructions and see what they should do. This gives them control over the use of the resource. In Fernandez *et al*., (2009), learners consented that vodcasts are powerful technologies for complementing traditional lectures and subject resources. Kay (2012) opined that vodcasts improves students learning. However, empirical evidence to prove that vodcast improve students' learning performance is scarcely available due to varied opinions. McNulty *et al.,* (2009) stated that the effect of vodcasts is not constant. These findings are not readily generalized because of certain factors that could interplay in the outcome of such investigations such as the format of the vodcasts, the purpose for which it is administered and the attainment level (Rae & McCarthy, 2017).

Researchers have sought to demonstrate the effect of digital teaching (multimedia) tools, in particular, video podcasts otherwise known as vodcasts on students' perception, motivation and performance in various subject areas (Hamzah, *et al.*, 2019; Rae & McCarthy, 2017; Tohill, 2008; Salmon & Edirisingha, 2008). No empirical studies (till date) have examined the effect of vodcasting on learning computer programming concepts at undergraduate level for regular (face-to-face) students. This research seeks to fill this void.

Research Objective

This study is aimed at investigating the effect of content specific vodcasts to supplement the teaching of undergraduate computer programming

Research Questions

In conducting this study, the following research questions were positioned:

1. Are there desirable changes in the students' performance as a result of the supplementation of lectures with vodcasts in teaching undergraduate computer programming course?

2. How do students perceived the use of vodcasts to learn computer programming?

Research Hypotheses

To answer these questions, a basic assumption is stated in the null hypothesis as follows:

HO_1: Vodcasting has no significant effect on students' performance in undergraduate computer programming courses.

Review of Related Literature

Learning is a function of communication which is a two-way interactive process (Dina & Maher, 2006). It is obtained by integrating information obtained by visual and auditory stimuli between separate cognitive channels (Mayer, 2001; Walls *et al.*, 2010). Thus, the advantage afforded by vodcasting enables the student to control the time, place and pace of learning using appropriate resources. Chetty & Barlow-Jones (2012) opined that "social constructivism is a didactic approach that allows learning to take place in a social, interactive and collaborative manner with the intention of students developing skills such as reasoning, problem solving, the development of higher mental processes and metacognition". Clark (2009) observed that when a technology tool is matched to the appropriate audience, there could be an increase in the level of student engagement and effective instruction. Using vodcasting as a supplementary tool allows the addition of videos, audio content and powerpoint presentation to the main curriculum of many disciplines (McGarr (2009). Tohill (2008) reported that podcasts generally have been used more frequently in teaching engineering and science (33.3%), computer and information technology (33.3%), while 13.3% goes to business and law.

In Bentley College also in the USA, students in an introductory information technology class, worked in pairs and produced vodcasts to teach topics based on the course lecture materials to their peers (Frydenberg, 2006). Some researchers performed experimental study and reported that podcasts had no significant effect on the students' grades when measuring between the podcast group and the control group (Copley, 2007; Lazzari, 2009; Abt & Barry, 2007). Meanwhile, Lakhal *et al.,* (2007) posited that the effect is on students' satisfaction and not their performance.

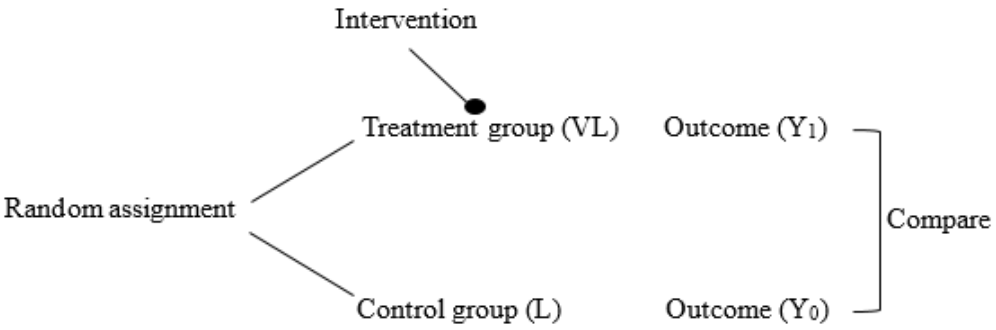
Researchers (Martin & Beckman (2011), Hargis & Wilson (2005), Bollinger *et al.,* (2010), Williams & Michael (2007), Clark *et al.,* (2007) and Bongey et al., (2006)) conducted studies on perceived students' interest in the use of vodcasting and reported significant approval rate by learners. The impact of vodcasting can be approached from the perspective of user survey which evaluates general students' perspective and secondly, an experimental design can be conducted with focus on evaluation using test results or grades. Most of the empirical studies have dealt with cognitive and affective impact of podcasting emphasizing improvement of students' performance, learning and comprehension. (Khechine *et al.,* 2013). Van Heerden & Goosen (2017) undertook quantitative research and concluded that educational technologies contribute significantly to helping first year programming students engaged in Open and Distance Learning (ODL) to address their learning challenges. Bozalek *et al.,* (2013) suggested that educational technologies should be implemented in higher education to ensure a transformation of effective teaching. Heydarpour *et al.,* (2013) conducted research on the adequacy of podcasting on the performance and attitudes of students of medicine. With the students' long lectures and bulky revisions, they found podcasting to be useful as 46% of the students' downloaded all the materials and 96% agreed that podcasting had a positive impact on course preparation. The studies conducted by Nozari & Siamian (2015) found a positive correlation between utilizing podcast and students' motivation.

Based on existing literature, the null hypothesis of this research – vodcast has no significant effect on students' performance in undergraduate programming is debunked.

Methodology

A post-test control-group quantitative design of experiments was used for this study to determine if there was a statistically significant difference between the performance measured by assessment scores of second year university students enrolled in computer programming II course who received supplementary content-specific vodcast in addition to lectures, and those who received conventional lectures only. The post-test-only control-group design is the most appropriate research design as the independent variable is manipulated while monitoring a control group (Gall et al., 2007). This is a structured post-test randomized experiment where the participants were randomly assigned to two groups – vodcast/lecture (VL) and lecture (L) accordingly (see figure 1), and a treatment was given only to VL, then both groups were measured on the post-test. The independent variable is identified as scores obtained from the assessment test administered to the VL group while the dependent variable is the scores of the students in the L group.

Figure 1
Post-test Control Group Design



The population of the study was drawn from the students who enrolled for computer programming II course (CMP 212) at Federal University Dutsin-Ma (a public university) situated in Dutsin-Ma Local Government Area of Katsina State, Nigeria during the 2018-2019 academic session.

For this study a sample size of $N = 272$ (n = 136 control group and n = 136 treatment group) was used with a statistical significance level of $\alpha = .05$, a medium effect size, and a statistical power of .80 (Gall *et al.,* 2007). Two-stage cluster sampling was used to control sources of variation in the experimental results. The students currently belong to five previously established classes – physics, chemistry, industrial chemistry, mathematics, and computer science,

therefore, they were clustered according to their classes then simple random sampling was used to place the students into the control and treatment groups respectively.

The first measuring instrument administered in this study was a series of twelve (12) video podcasts designed by the researcher/course lecturer and presented to the students. The vodcasts were strictly in line with the course content but not a reproduction of lectures. They had clear audio and visual effects and had a maximum duration of 15 minutes each. Each vodcast concluded with a series of programming tasks which required practical activity. The second instrument was a standardized end-of-semester exam which is mandatory for all students enrolled in computer programming II, to test the basic skills and knowledge acquired and contribute 70% to the cumulative measurement of the student's academic growth and performance. The exam consists of six (6) questions out of which four (4) are compulsory. Each question has three (3) sub-questions bordering on problem-solving strategy, language syntax, programming structures, input/output statements, coding, debugging, data types, operators and expressions, looping structures, functions (declaration & calling), arrays, pointers and recursion. Fifty (50) percent of the questions were theoretical in nature while the remaining fifty percent bordered on writing programs or debugging code segments. A third instrument used was a survey questionnaire which captured the demographic information of all participants and information on the perception to the use of vodcasts was captured from the participants in the treatment group. The reliability of the research instrument was calculated using Cronbach's alpha and a reliability value of alpha was obtained as 0.82.

The usual computer programming II lectures held through a period of 15 weeks in the semester anchored by the course lecturer. At the end of the semester, the treatment group (comprising a 136 out of N=272) was selected and viewed the 12 vodcasts sequentially in a secured computer laboratory over the duration of three weeks under close supervision. The students were properly checked to prevent entry and use of storage devices and all computers were disconnected from the internet. This was done to avoid cross contamination of both groups which could pose a threat to the validity of the research (Cook & Campbell, 2001).

After this, the post-test was administered to both the treatment and control groups totaling 272 students. The researcher administered and collected the post-tests then proceeded to score them using a validated marking scheme. A survey questionnaire was also administered. The questionnaire had two (2) sections. The control group (136 participants) gave responses to section A only and the treatment group (participants) responded to section A and section B. All the data collected was transferred to a spreadsheet and further analyzed through IBM SPSS software application. Descriptive statistics and inferential statistics were used to analyze the data collected.

Results

Q1. Socio-Economic Characteristics of respondents

The demographics show that in the VL group, female students are 16.9% while the males constitute 83.1%. For the L group, the distribution of females to males is 14% to 86%. Out of 272 students, only 42 are married which is represented by 15.4% of the population. Also, the highest population of the sample falls within the age interval of 20-24 years with a percentage of 53.7.

To verify the first assumption of the study that there is no significant relationship between the socio-economic characteristics of the students and their performance, the scores of the male and female learners were analyzed using and independent sample t-test. A test for normality of the data was first determined to confirm the assumption for parametric testing using the Kolmogorov-Smirnova and Shapiro-Wilk tests. A p value of 0.314 was obtained for the females and 0.168 for the males; both are >0.05 implying the data is normally distributed (Fields, 2009). Table 1 and Table 2 are the results obtained from the group statistics and the t-test. The results reveal that there is no statistically significant difference in the VL scores between the females and the males at 95% confidence level because assuming equal variances, t=.247 and p=.805.

Table 1
Group Statistics of Gender vs VL score

	Gender _VL	N	Mean	Std. Deviation	Std. Error Mean
VL	Male	113	43.53	13.978	1.315
	Female	23	42.74	14.104	2.941

Table 2
Independent T-test for VL vs Gender

		Levene's Test for Equality of Variances		T-test for Equality of Means				
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
VL	Equal variances assumed	.197	.658	.247	134	.805	.792	3.202
	Equal variances not assumed			.246	31.429	.807	.792	3.222

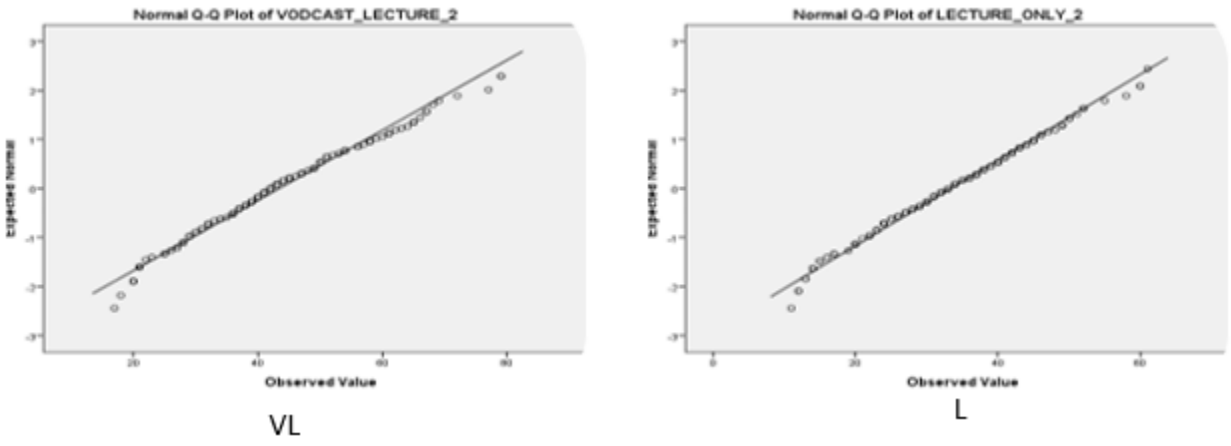
Q2. Compare Vodcast-Lecture (VL) vs Lecture (L)

In the second research question, the researcher seeks to know whether there are desirable changes in the students' performance because of the supplementation of lectures with vodcasts in teaching undergraduate computer programming course. To answer this question, a difference of two means independent sample t-test was carried out to compare the average scores between the treatment group (VL) and the control group (L).
The hypotheses are as follows:

$$Ho => \mu VL = \mu L \quad (1)$$
$$Ha => \mu VL \neq \mu L \quad (2)$$
$$\alpha = 0.05$$

Before proceeding with the t-test, a test for normality was plotted in a graph for the VL and L group to check the normality of the data before proceeding with the parametric test. Figure 2 shows that the data is normal with very few outliers.

Figure 2
Normality Plot for Vodcast-Lecture and Lecture



The median value of the L group which was found to be 33 was used as a cut point in performing the t-test. Table 3 and table 4 are results of the t-test conducted.

Table 3

Group Statistics

	Lecture	N	Mean	Std. Deviation	Std. Error Mean
VL	>= 33	71	53.80	9.876	1.172
	< 33	65	32.03	7.246	.899

The results reveal that there is a statistically significant improvement in the test scores of the VL group in comparison with the L group.

Table 4

Independent Samples Test for VL vs L

Question(s)	Levene's Test for Equality of Variances		T-test for Equality of Means					
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	
Vodcasts helped me understand the topics								
Vodcasts will enhance my academic achievement.	7.045	.009	14.546	44.9 43.5	27.9 25.0	6.6 4.4	15.4 21.772	5.1 8.1.497
assumed								
Equal variances not assumed			14.741	128.084	.000		21.772	1.477

	SA (%)	A (%)	N (%)	D (%)	SD (%)	TOTAL (%)
Do you consider vodcasts an effective way of learning programming?	50.0	26.5	3.7	13.2	6.6	100
Vodcasts helped me understand the topics	44.9	27.9	6.6	15.4	5.1	100
Vodcasts will enhance my academic achievement.	43.5	25.0	4.4	21.772	8.1.497	100

For equal variances assumed, Levene's test reveal F=7.045 with p=.009. The t-test equality of means shows the value of t=14.546, p<.0001 with a mean difference of 21.772 for N=136. The null hypothesis is hereby rejected, and the alternate hypothesis accepted. By implication, the supplementary vodcasts contributed positively to the performance of the students in the assessment test. This finding is in harmony with that of Van Heerden & Goosen (2017) and Rae & McCarthy (2017) in similar studies.

Q3. Students' perception analysis

The third research question had the primary objective of investigating the students' perception of the use of vodcasts to learn computer programming. A survey questionnaire was administered to the treatment group after they viewed the 12 vodcasts and took the assessment test. While exploring the demographics, only 16.2% of 136 students took computer science subject in secondary school. This could account for the poor performance of a significant number of students in the VL group as supported by Doukakis *et al.,* (2013). Also, as much as 80% of the students' admitted to owning a personal laptop or a smartphone. This implies that most of the students can access vodcasts if made available to them. Other responses on students' perception are shown in table 5.

Table 5

Students' Perception on the use of Vodcasts

Note: SA-Strongly Agree; A-Agree; N-Neutral; D-Disagree; SD-Strongly Disagree

Q4. Rate your mastery of C++ programming skills for the topics covered in the vodcasts you viewed.

This question was meant to give room for self-evaluation based on the topics covered in the 12 vodcasts. This response will enable the identification of areas of difficulty for subsequent adjustments in teaching method and vodcast content. The result is as shown in table 6. Collapsing the first two (excellent and very good) as very good and the last two (fair and poor) as poor, the students did not grasp the concept of language syntax (75% poor); arrays (57% poor); problem analysis and algorithm (55% poor) and pointers (51% poor). They performed averagely well in coding and debugging. From the foregoing, the poor grades observed generally can be explained.

Table 6
Programming Skills Evaluation

TOPIC		Excellent (%)	Very Good (%)	Good (%)	Fair (%)	Poor (%)
1	Language syntax	6.6	19.9	18.4	41.2	14.0
2	Data types	8.1	27.9	32.4	18.4	13.2
3	Input/Output Statements	7.4	27.2	30.1	22.8	12.5
4	Operators & Expressions	8.1	29.4	32.4	18.4	11.8
5	Problem analysis/Algorithms	5.1	27.9	26.5	28.7	11.8
6	Looping structures	8.8	27.9	31.6	19.9	11.8
7	Functions (declaration& calling)	9.6	22.1	33.8	24.3	10.3
8	Arrays	8.1	24.3	25.7	30.1	11.8
9	Pointers	6.6	25.7	30.1	24.3	13.2
10	Recursion	11.0	24.3	28.7	28.7	7.4
11	Coding	8.1	27.2	27.9	24.3	12.5
12	Debugging	8.8	27.9	28.7	22.1	12.5

Discussion

While exploring the socio-economic characteristics of the sample population, a test on the scores of both genders showed no statistically significant difference in the VL scores between the female and the male learners at 95% confidence level. With a *p* value of .805, it is evident that both males and females can perform well in programming and any variation is by chance.

The second major finding shows a statistically significant improvement in the test scores of the VL group (treatment) over that of the L group (control). This is like the findings of previous approaches like that of Van Heerden & Goosen (2017) and Rae & McCarthy (2017) among others. Thus, the null hypothesis is rejected, and the alternate hypothesis is accepted.

The information extracted from the survey administered to the students show that 50% of the students strongly agree while 70% of the students agree that vodcasts enhanced their performance and learning of programming. This agrees with Martin & Beckman (2011) and Bollinger *et al.,* (2010). Also, based on the findings, the students have difficulty in four topics - language syntax, arrays, problem analysis and algorithm and pointers.

Both males and females have the intellectual capacity to equally excel if given the right treatment. The use of vodcasts as a supplementary material yielded positive outcome in this empirical study. Although the overall performance of the treatment group is not excellent, several factors could account for this ranging from the period of exposure to the vodcasts and rigid viewing conditions which contradicts the very essence of using vodcasts which is control over the learning environment (Heilesen, 2010). Also, having discovered the areas of difficulty in programming from the survey, efforts can be intensified to simplify the concepts.

Conclusion

This study has succeeded in answering the four research questions posed. A central question of the study was to know whether the use of supplementary vodcasts to teach programming to undergraduate students could bring about desirable changes in the students' performance as compared to the conventional lecture only method. From the discussion of results obtained and from the students' responses to certain survey questions on how they perceived vodcasts, the use of content-specific supplementary vodcasts has positively impacted the performance of students and they concur with it as well. Therefore, it can be concluded that vodcasts are valuable teaching tools for students undertaking undergraduate programming courses. Students' ownership of smartphones and other portable devices could enable easy access to vodcasts. It is recommended that universities and other tertiary institutions should adopt the use of vodcasts not just in teaching programming but also in the teaching of other courses.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Universities and other tertiary institutions should adopt the use of vodcasts and other new teaching approaches not just in supplementing the teaching of programming but also the teaching of other courses.
2. Lecturers should be trained on the production of digital teaching aids in order to have the requisite skills for its proper implementation and delivery.
3. The government and educational stakeholders should support the universities by providing enabling environment through the provision of power, ICT infrastructure and qualified personnel for improved academic performance of students.
4. The school management on their part, should adopt good maintenance strategies for the available ICT infrastructure to ensure sustainability.
5. To bring development to the community and the country at large, parents should be sensitized to invest in education by purchasing the necessary gadgets such as laptops and smart phones that can enable the students to study and learn effectively.

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