PODCAST AUGMENTED INSTRUCTION, LEARNING STYLES AND PRE-SERVICE PHYSICS TEACHERS' COGNITIVE LEARNING OUTCOMES IN COLLEGES OF EDUCATION IN NORTH-CENTRAL, NIGERIA

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Abstract
This study examined three modes of podcast augmented instruction, learning style and pre-service physics teachers' cognitive learning outcome in Colleges of Education in North-Central, Nigeria. It was a pretest, posttest and delayed posttest and quasi experimental research using 3x3 factorial design. Two hundred and seventy-eight students from intact Physics classes in three Colleges of Education were selected based on convenience and substantial population, and were used as the sample for the study. The study answered three research questions and tested three hypotheses. Thermal Physics lessons were delivered as classroom lecture. Audio, Enhanced and Video podcast lessons on same content were published online and broadcasted as augmented instructions. Thermal Physics Achievement Test, Thermal Physics Retention Test and Learning Style Inventory were used as data collection instruments. The reliability coefficient of the test instruments and Inventory instrument were 0.78 and 0.89 respectively. The data collected were analyzed based on the research question and hypotheses using mean and MANCOVA in SPSS. The results revealed that the Physics contents taught using different modes of Podcast Augmented Instructions were well received and retained by the students irrespective of their learning styles. It was recommended that the use of podcast (audio, enhanced and video) should be encouraged in our higher institution in Nigeria with special consideration for video podcast in practical oriented courses.

Keywords: M-Learning, Podcast, Pre-service Teachers, Physics, Cognitive Learning Outcomes and Learning Styles.

Introduction

The technological advancement of instructional process was earlier geared towards mass instruction which was characterised by personal computers, amplifiers, projectors and interactive whiteboards. Another development in the technological trend was the introduction of individualised instruction which gave rise to the strategic and systematic approach of combining time and modes of learning. The most dramatic development in this direction was the introduction of mobile devices into teaching and learning setting called mobile learning (m-learning). M-learning inherits e-learning advantages over traditional lectures, but extends its reach by making use of portable wireless technologies. Devices such as digital media player, smart phone and personal digital assistants that could be used for m-learning come in handy and can be accessed anytime even while travelling on transport or waiting in an office. Learners can make better advantages of their unexpected free time using these portable devices to learn.

Podcasts are audio or video content that can be downloaded on a computer or fed to a mobile music player (mp3 player or iPod). Podcasting allows anyone to create and self-publish a syndicated "radio or video show" and gives broadcast radio or television programmes a new way to distribute content. Most podcasts are made by people who are very passionate about their subject.

The process for podcasting can be broken down into five steps. The complexity of those steps is dependent on the purpose of the content to be created and the quality level at which it will be produced. (i) Create or capture and edit the content, (ii) Publish content to the web site or blog, (iii) Subscribe to the content using an "RSS News Reader" (Users), (iv) Download the content into content management software (CMS) (Users), and (v) Play content on download device or synchronize CMS with portable media player and play (Users) (Morris & Terra, 2015).

There are three common types of podcast identified as audio-only, enhanced, and video. (Brown et al., 2009)

(i) The audio-only podcast (Podcast) is an audio delivery format created using voice recorder or Audacity.
(ii) Enhanced podcast (Screencast) is a combination of audio and visuals such as slides, images or graphics. It is in form of presentation with narration and chapters,
(iii) Video podcast (Vodcast) is created using digital camcorder and video editing software such as iMovie.

In recent times, podcast have been used by different researchers to improve teaching and learning in different ways. McKinney *et al.* (2008) introduced podcast in a psychology class and found out that students' performance was improved. Moss *et al.* (2015) used podcast as teaching and learning tool to increase students' motivation across a semester and recorded positive result. Farshi and Mohammadi (2013) and Farangi *et al.* (2015) recorded increased motivation, positive attitude, increased student engagement and performance when podcast was introduced as medium of delivery in English Language classes. However, the potentials of podcast in teaching and learning have not been fully harnessed in Nigeria education institutions.

Education is an inevitable tool for sustainable development and a vehicle for advancing the frontier of knowledge. Making education relevant is a matter of ensuring that it generates, informs and maintains the students' vision of life including their professional activities (Okemakinde *et al.*, 2013). According to the Federal Republic of Nigeria (2013) in National Policy on Education, education shall continue to be highly rated in the national development plans because it is the most important instrument of change, and that quality of education at all levels should be geared towards inculcating acquisition of competencies necessary for self reliance among others. Science and technical education is needed to prevent waste of human labour. The importance of science and technology to national development in the life of our country cannot be overemphasised.

If there is any field of human endeavour where technology advances rapidly, it is the physical sciences such as Physics. Physics is the study of matter, energy, and the interaction between them. Physics does not just deal with theoretical concepts; it is applied in every sphere of human activity including development of sustainable forms of energy production and conservation. Many of the everyday technological inventions that have impacted the world today have their foundations in discoveries in Physics. Udoh (2012) established that learning of Physics offers the student an opportunity to think critically, reason analytically and acquire the spirit of enquiry. Udoh further asserted that Physics is crucial for effective living in the modern age of science and technology. Researches on physics education have shown that students have abundant difficulties in acquiring and retaining contents (cognitive learning outcome) in all topics of Physics, and particularly in the concepts of thermodynamics; despite its importance in day to day living.

Since no education system may rise above the quality of its teachers, pre-service teacher education shall continue to be given major emphasis in all educational planning and development (Federal Republic of Nigeria, 2004). Teacher education is a programme that trains men and women to become professional teachers. It involves making those in training to acquire requisite knowledge in their various subject areas and theories and principles that guide the practice of teaching (Ojediran, 2016).

Nwachukwu (2001) mentioned certain factors that are crucial for functional science and technology education implementation, and one of which is that the trainees must be ready to fully participate and well receive what is being taught. The consideration of learning style in instructional delivery has been documented in the science, engineering and technology programmes of several universities (Sutliff & Baldwin, 2001). Technically, an individual learning style refers to the preferential way in which the student absorbs processes, comprehends and retains information (Teach, 2016).

Learning style is defined as the way an individual concentrates on, processes, internalizes, and remembers new and difficult academic information or skills. Some educators are of the opinion that regardless of the teachers' abilities, including being experts in their technical fields, failure to learn will occur unless an understanding of the personal differences among students is known and teachings proceed accordingly. In other words, everyone is different. It is important for educators to understand the differences in their students' learning styles so as to design and implement effective strategies for teaching and learning process. Information that is accessed using strategies that are aligned with students' learning preferences is likely to be understood, motivating and lead to metacognition (Fleming & Baume, 2006). Tulbure (2012) is of the opinion that a strong relationship exist between learning styles, teaching strategies and academic achievement.

The relationships between VAK models and academic success have been established by researchers. While others see it as a key element, some of these researchers are of the view that learning style is not the main factor to enhance students' achievement, but it can be used to identify the tendency of learning possessed by students due to their preferences. Nevertheless, the consideration of learning style in instructional delivery has been documented by most researchers. It is important for educators to understand the differences in their students' learning styles so as to design and implement effective strategies for teaching and learning process. VAK model appears to provide teachers with a perfect plausible model which includes an organized framework, instructional materials, strategies and activities to be carried out in the learning environments. For this, it is necessary to carry out more research on the relationship between learning style using VAK model, different podcast modes as delivery media and students' achievements and retention. More so, comparing three different learning styles using three modes of podcast augmented learning strategies in Physics is a novel research in this digital age in Nigeria.

Podcasting is a fairly new concept, so there are relatively few formal evaluations of its educational value at this point in time. Many researchers are speculating optimistically about the potential effects of podcasting on the quality of educational experience and outcomes, but some are still cautious on the effects that certain modes of podcasting might establish on students due to their respective learning styles. Generally, studies comparing the effects of audio, enhanced and video podcasts are very scarce. In addition, considering variables such as achievements and retention of physics students exposed to podcast augmented instructions in relation to their learning styles make this a unique study. Hence, it is necessary to carry out this study.

Objective of the Study

The objective of the study is to determine the effect of three modes of podcast augmented learning on the achievements and retention of Physics students based on their learning styles.

Research Questions

(i) What is the difference in the mean achievement and retention scores of Physics students taught using audio podcast augmented instruction based on learning styleΩ

(ii) What is the difference in the mean achievement and retention scores of Physics students taught using enhanced podcast augmented instruction based on learning styleΩ

(iii) What is the difference in the mean achievement and retention scores of Physics students taught using video podcast augmented instruction based on learning styleΩ

Research Hypotheses

(i) There is no significant difference in the mean achievement and retention scores of Physics students taught using APAI based on learning style (visual, auditory or kinaesthetic).

(ii) There is no significant difference in the mean achievement and retention scores of Physics students taught using EPAI based on learning style.

(iii) There is no significant difference in the mean achievement and retention scores of Physics students taught using VPAI based on learning style.

Methodology

The study adopted a quasi-experimental design. That is, a pretest-posttest design that was modified to accommodate delayed posttest to test retention and a moderating variable (learning style). The treatment variable had three levels of independent variable (APAI, EPAI and VPAI), while the moderating variable had three levels of learning style (auditory, visual and kinaesthetics). The dependent variable (cognitive learning outcomes) had the achievement and retention scores.

Students in all the groups were given pre-test before the treatment using Thermal Physics Achievement Test (TPAT). Learning Style Inventory (LSI) was also given to the students in the three groups so as to determine their learning styles/preferences. Students in group 1 were exposed to Classroom Lecture and augmented with Audio Podcast Instruction (APAI); students in group 2 were exposed to Classroom Lecture and augmented with Enhanced Podcast Instruction (EPAI), and students in group 3 were exposed to Classroom Lecture and augmented with Video Podcast Instruction (VPAI). The post-test was administered on the students in all the groups after the four weeks treatment and retention test was administered after six weeks. The research design layout is as shown in Table 1

Table 1: Research Design Layout

Group	Pre-test	Treatment	Moderating Variables	Post-test	Retention test
Experimental Group I	O_1	APAI (X_1)	Learning Styles	O_2	O_3
Experimental Group II	O_1	EPAI (X_2)	Learning Styles	O_2	O_3
Experimental Group III	O_1	VPAI(X_3)	Learning Styles	O_2	O_3

The population of the Study comprised all the Physics Education Students in the fourteen (14) Federal and State government owned Colleges of Education in the six North-Central states (Benue, Kogi, Kwara, Nasarawa, Niger & Plateau) and Federal Capital Territory Abuja in Nigeria. The target population in these Colleges of Education were the NCE I Physics students. This is because the course content to be taught (Thermal Physics I) was meant for that level. The study was conducted using 278 NCE I students in the Physics Departments in three Colleges of Education that were purposively selected based on convenience and substantial population of Physics students in these colleges; this is to ensure realisation of adequate sample size. Students in intact Thermal Physics I classes comprising of Physics students in any of the combined course such as Mathematics/Physics, Chemistry/Physics, Biology/Physics, Integrated Science/Physics, Geography/Physics and Computer/Physics that have access to smart phones or computers were used as sample for the study. Students from the selected Colleges in their intact Thermal Physics I classes were used for experimental groups I, II and III. The learning styles of all the students in the study were considered. The distribution of sample for the study is shown in Table 2.

Table 2: Sample Characteristic Layout of Physics Students in Experimental Groups

Groups	**Learning Preference**		
	Auditory	Visual	Kinaesthetic
APAI	19	8	47
EPAI	29	7	56
VPAI	37	11	64

From Table 2, the groups comprised a total of 278 students; group 1 comprising 74 students were exposed to classroom lectures and augmented with audio podcast instruction, ; group 2 comprising 92 students was exposed to classroom lectures and augmented with enhanced podcast instruction, while group 3 comprising of 112 students was exposed to classroom lectures and augmented with video podcast instruction.

Different episodes of audio, enhanced and video podcast on Thermal Physics contents were published online and broadcasted to students in group 1, 2 and 3 respectively after each of the four classroom lessons.

The instruments that were used in collecting data for the study were researcher developed Thermal Physics Achievement Test (TPAT) and Thermal Physics Retention Test (TPRT). TPAT and TPRT consisted of two sections; section 1 elicited students' data such as learning style and group (delivery medium), and section 2 consists of 50 multiple choice test items with four options (A-D). The instruments were validated by two Physics lecturers from Colleges of Education and two lecturers from Science Education (Physics) Department and Educational Technology Department in the School of Science and Technology Education, Federal University of Technology (FUT), Minna. The reliability coefficient of the TPAT and TPRT was 0.78.

The study was for six weeks. Pretest was administered to all the students in the study. The groups were taught for four weeks using conventional method, and concurrently exposed to the treatments (Audio, Enhanced and Video Podcast Augmented Instruction). Thereafter Thermal Physics Achievement Test (TPAT) was administered to measure the achievements of the students in each of the groups. Thermal Physics Retention Test (TPRT) was also administered after two weeks to measure the retention of the students in the groups. The scores were obtained and the data were analysed based on the stated research question and hypotheses.

Mean analysis were used to answer the research questions. Graphical representations were also used to support the results for easy interpretation where necessary. MANCOVA was used to analyse the hypotheses as it was established that the pretest had significant effect on the achievement, and the achievement and retention are of linear relationship. The results are presented in line with the formulated research questions and hypotheses:

Results

Research Question One: What is the difference in the mean achievement and retention scores of Physics students taught using audio podcast augmented instruction based on learning style?

To answer research question one, the mean gain score and mean decay scores of the APAI group based on Learning Style are as shown in Table 3.

Table 3: Mean Gain Scores and Mean Decay Scores of Students Taught Physics Using APAI based on Learning Style

Learning Style	Pretest	Posttest	Retention	Mean Gain Score	Mean Decay Score
Visual	23.3750	43.5000	37.7500	20.125	5.75
Auditory	23.6842	42.9474	36.8947	19.2632	6.0527
Kinaesthetics	20.4468	40.5106	34.7021	20.0638	5.8085

From Table 3, it was observed that all the students in APAI group benefited from the treatment irrespective of their learning style as shown in the Mean Gain and Mean Decay Score. For instance, Visual learners had mean gain and mean decay scores of 20.125 and 5.75 respectively; Auditory learners had mean gain and mean decay scores of 19.2632 and 6.0527, while Kinaesthetics learners had mean gain and mean decay scores of 20.0638 and 5.8085 respectively. It also shows that Visual learners had the highest mean gain scores and least mean decay indicating higher learning and retention rate while the auditory learners had the least mean gain scores and highest mean decay scores indicating lower learning and retention rate than other students in this group. The graphical representation of the student performances is illustrated in Figure 1.

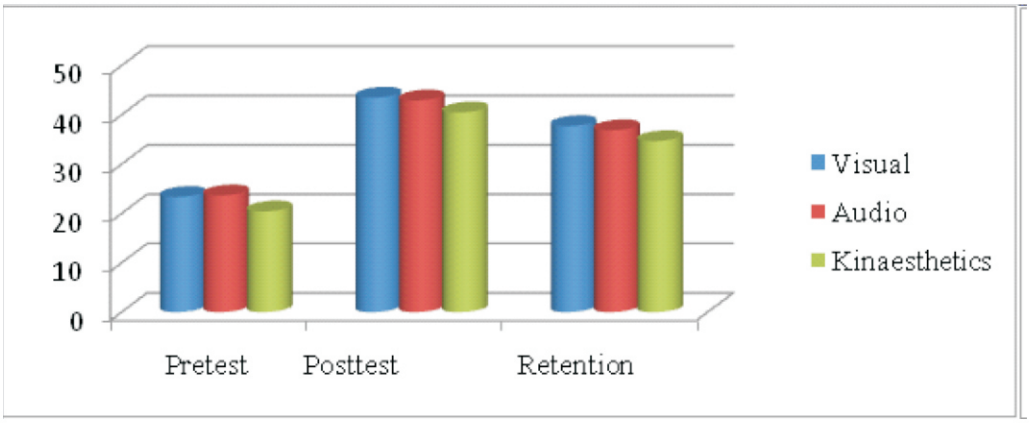

Figure 1: Performances of Physics Students Taught Using APAI based on their learning styles

Research Question Two: What is the difference in the mean achievement and retention scores of Physics students taught using enhanced podcast augmented instruction based on learning style?

To answer research question two, the mean gain score and mean decay scores of the EPAI group based on Learning Style are as shown in Table 4.

Table 4: Mean Gain Scores and Mean Decay Scores of Students Taught Physics Using EPAI based on Learning Style

Learning Style	Pretest	Posttest	Retention	Mean Gain Score	Mean Decay Score
Visual	18.5714	39.0000	32.8571	20.4286	6.1429
Auditory	20.0345	39.9310	33.9655	19.8965	5.9655
Kinaesthetics	21.1250	40.4643	34.4107	19.3393	6.0536

From Table 4, it was observed that all the students in EPAI group benefited from the treatment irrespective of their learning style as shown in the Mean Gain and Mean Decay Score. The table showed that visual learners had mean gain and mean decay scores of 20.4286 and 6.1429 respectively; auditory learners had mean gain and mean decay scores of 19.8965 and 5.9655, while kinaesthetics learners had mean gain and mean decay scores of 19.3393 and 6.0536 respectively. It also shows that Visual learners had the highest mean gain scores and highest mean decay indicating higher learning and lower retention rate, the auditory learners had the least mean decay scores indicating higher retention rate while kinaesthetics learners had the least mean gain scores indicating learning rate lower than other students in this group. The graphical representation of the student performances is illustrated in Figure 2.

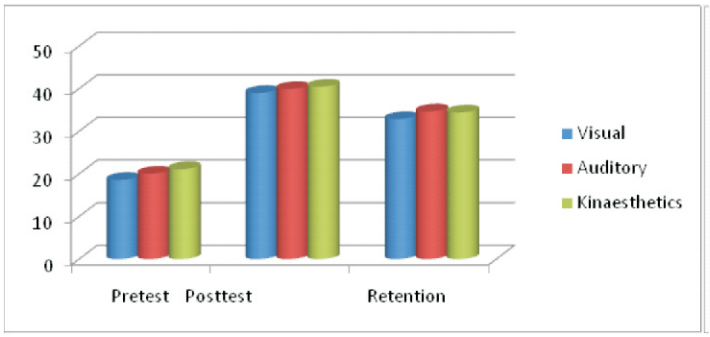

Figure 2: Performances of Physics Students Taught Using EPAI based on their learning styles

Research Question Three

What is the difference in the mean achievement and retention scores of Physics students taught using video podcast augmented instruction based on learning style?

To answer research question two, the mean gain score and mean decay scores of the EPAI group based on Learning Style are as shown in Table 5.

Table 5: Mean Gain Scores and Mean Decay Scores of Students Taught Physics Using VPAI based on Learning Style

Learning Style	Pretest	Posttest	Retention	Mean Gain Score	Mean Decay Score
Visual	19.3636	40.9091	36.5455	21.5455	4.3636
Auditory	20.0270	40.9189	34.5135	20.8919	6.4054
Kinaesthetics	19.5156	40.0781	34.2500	20.5625	5.8281

From Table 5, it was observed that all the students in VPAI group benefited from the treatment irrespective of their learning style as shown in the Mean Gain and Mean Decay Score. The table showed that visual learners had mean gain and mean decay scores of 21.5455 and 4.3636 respectively; auditory learners had mean gain and mean decay scores of 20.8919 and 6.4054, while kinaesthetics learners had mean gain and mean decay scores of 20.5625 and 5.8281 respectively. It also shows that Visual learners had the highest mean gain scores and least mean decay indicating higher learning and retention rate, the auditory learners had the highest mean decay score indicating lower retention rate while kinaesthetics learners had the least mean gain score indicating lower learning rate than other students of different learning style in the same group. The graphical representation of the student performances is illustrated in Figure 3.

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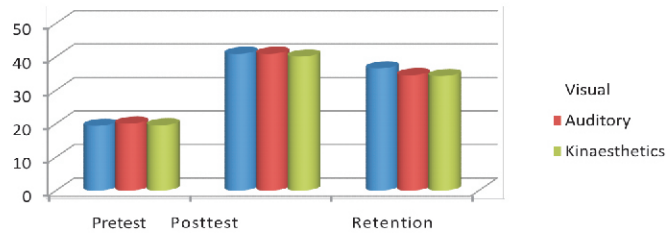

Figure 3: Performances of Physics Students Taught Using VPAI based on their learning styles

Hypothesis One: There is no significant difference in the mean achievement and retention scores of Physics students taught using APAI based on learning style (visual, auditory or kinaesthetics).

Table 6: Multivariate Analysis of Covariance of Posttest and Retention Test Mean Scores of Physics Students Taught Using Audio Podcast Augmented Instruction based o n Learning Style

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	0.017	0.306	4	140	0.873
Wilks' lambda	0.983	0.303 ^{NS}	4	138	0.875
Hotelling's trace	0.018	0.300	4	136	0.877
Roy's largest root	0.018	0.613	2	70	0.545

NS = not significant at 0.05 level

Table 6 shows the Multivariate effect of Learning Style on Posttest and retention test mean scores of Physics students taught using APAI. The table reveals that when dependent variables (posttest and retention test score) are combined and pretest controlled, there was no statistically significant difference among the Physics students taught using APAI based on their learning style , $F(4, 138) = 0.303$, $p > 0.05$, Wilkis' $\lambda = 0.983$. The results of the analysis indicates that this hypothesis should be retained on the basis that the multivariate effect of learning style was not statistically significant on the posttest and retention test mean score when combined. On this basis, hypothesis one was not rejected.

Hypothesis Two: There is no significant difference in the mean achievement and retention scores of physics students taught using EPAI based on learning style (visual, auditory or kinaesthetics).

Table 7: Multivariate Analysis of Covariance of Posttest and Retention Test Mean Scores of Physics Students Taught Using Enhanced Podcast Augmented Instruction based on Learning Style

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	0.017	0.387	4	176	0.818
Wilks' lambda	0.983	0.383 NS	4	174	0.820
Hotelling's trace	0.018	0.380	4	172	0.823
Roy's largest root	0.016	0.697b	2	88	0.501

NS = not significant at 0.05 level

Table 7 shows the Multivariate Effect of Learning Style on Posttest and retention test mean scores of Physics students taught using EPAI. The table reveals that when dependent variables (posttest and retention test score) are combined and pretest controlled, there was no statistically significant difference among the Physics students taught using EPAI based on their learning style, $F(4, 174) = 0.383$, $p > 0.05$, Wilkis' $\lambda = 0.983$. The results of the analysis indicate that this hypothesis should be retained on the basis that the multivariate effect of learning style was not statistically significant on the posttest and retention test mean score (when combined) of students taught using EPAI. On this basis, hypothesis two was not rejected.

Hypothesis Three: There is no significant difference in the mean achievement and retention scores of Physics students taught using VPAI based on learning style (visual, auditory or kinaesthetics).

Table 8: Multivariate Analysis of Covariance of Posttest and Retention Test Mean Scores of Physics Students Taught Using Video Podcast Augmented Instruction based on Learning Style

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	0.047	1.296	4	216	0.273
Wilks' lambda	0.954	1.287 NS	4	214	0.276
Hotelling's trace	0.048	1.278	4	212	0.280
Roy's largest root	0.036	1.917	2	108	0.152

NS = not significant at 0.05 level

Table 8 shows the Multivariate Effect of Learning Style on Posttest and retention test mean scores of Physics students taught using VPAI. The table reveals that when dependent variables (posttest and retention test scores) are combined and pretest controlled, there was no statistically significant difference among the Physics students taught using VPAI based on their learning style, $F(4, 214) = 1.287$, $p > 0.05$, Wilkis' $\lambda = 0.954$. The results of the analysis indicate that this hypothesis should be retained on the basis that the multivariate effect of learning style was not statistically significant on the combined posttest and retention test mean score of students taught using VPAI. On this basis, hypothesis three was therefore not rejected.

Discussion of Findings

The findings that emanated from this study revealed that there was no significant difference in the cognitive learning outcomes of Physics students exposed to APAI, EPAI or VPAI based on learning styles (visual, auditory or kinaesthetic). The finding shows that all the students taught using Podcast Augmented Instruction benefited from the lessons (be it audio, enhanced or video podcast) irrespective of their learning styles. This result is in line with the findings of Rahmat (2000), who stated that learning through computer animation; utilizing systematic theory and

development design were able to bring positive effects on students, irrespective of the different learning style and degree of achievement. It is also in line with the findings of Yilmaz-Soylu and Akkoyunlu (2009) that the type of the learning style was not significantly effective on students' achievement in different learning environments. This is contrary to the findings of Tulbure (2012), who reported that a strong relationship exist between learning styles, teaching strategies and academic achievement. Talbure reported that significant differences between the two categories of students have emerged in relation with the most effective teaching strategies corresponding to each learning style category. This is contrary to the findings of *Garton et al. (2000) and* Pouratashi *et al. (*2008) that l*earning style appeared to be the most accurate predictors of student retention of content.* This is also contrary to the views of Fleming and Baume (2006) who stated that information accessed using strategies that aligned with students' learning preferences is likely to be understood better, motivating and lead to metacognition. Hence, this is an indication that learning style is not the only factor responsible for maximum benefit in different learning environments.

Conclusion

The paper has critically examined technological advancement in education with specific emphasis on three modes of podcast (audio, enhanced and video) in relation to learning styles. The study revealed no significant difference in the achievement and retention of students taught Physics concepts using APAI, EPAI and VPAI based on learning styles. This shows that the Physics contents taught using different modes of PAI were well received and retained by the students irrespective of their learning styles. The use of Podcast Augmented Instructions had significant effects on students' achievements and retention in Physics irrespective of its mode (audio, enhanced or video). Podcast Augmented Instruction gives equal opportunities for learning and content retention to Physics students, irrespective of students' learning styles.

In practical oriented courses like Physics, it is obvious that the use of audio or enhanced podcast without visuals could not actually deliver the message clearly. Hence, there is need for visual aids in form of video podcast (vodcast) or realia that will show or demonstrate the concepts for the students to practice. Podcast Augmented Instruction gives equal opportunities for content learning and retention to students irrespective of their learning styles. The use of different modes of Podcasts to augment classroom lectures is effective for teaching and welcomed by the Physics students,

Recommendations

Based on the findings that emanated from this study, it is recommended that

1. The use of podcast (audio, enhanced and video) for teaching should be encouraged in our institutions of learning.

2. Educators should be encouraged to be in the fore front of the digital struggle, to win our students over from the journey of no-return into social media world which impedes them from being able to focus and pay attention to their studies.

3. The use of Podcasts should be encouraged so as to promote ubiquitous learning (U-learning) especially for abstract or practical related topics in science courses.

4. Students should be encouraged to subscribe to any mode of Physics Podcast as augmented instructions irrespective of their learning styles

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