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Enhancing Retention of Water Pollution using Computer Tutorial and Drill Practice among First Year Science Education Students of University of Uyo, Nigeria

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Abstract. Students need supportive, empowering and enabling technology-driven environment to make learning interesting and retentive. Water pollution is a major threat to the environment and students' knowledge of the hazards is crucial to their management of the environment using digital devices effectively. Computer tutorial and drill practice were employed to investigate learners' retention of water pollution. Three research questions and three hypotheses guided the study. The study was quasi-experimental of non-randomized pretest, posttest control group design with students in intact classes. Population and sample size of the study was all 210 first year science education students of university of Uyo, 2018/2019 session using purposive sampling technique. Retention Test was the instrument used to collect data for the study. Instrument validation was done by three lecturers of test, measurement and evaluation in Science Education Department. Reliability index was .81 obtained using Kuder-Richardson Formulae-21. Data was analyzed using mean and standard deviation to answer research questions and Analysis of Covariance for hypotheses formulated at .05 level of significance. Findings showed that students taught water pollution using computer tutorial achieved and retained higher than students taught using computer drill-practice and lecture strategies. Gender was not a significant determinant of students' retention, though female students retained slightly higher in their mean retention scores than male students using drill-practice strategy. Based on the findings, it is concluded that computer tutorial is the most effective strategy in enhancing students' retention on water pollution. It is recommended amongst others that science teachers adopt computer tutorial as well as computer drill-practice strategies in teaching science concepts.

Keywords: computer tutorials, drill-practice, water pollution, retention, enhancing

Introduction

With expanding knowledge-based requirements for higher education, emerging technologies are filling the gaps to maximize information accessibility. Technology is creating and providing endless possibilities to generate initiatives for solving problems. Teaching and learning are taking place in transformational ways in setting global standards for excellence to meet needs. Science teaching is being prioritized to meet global demands in teaching and learning. Science teaching involves rules and principles which are constantly changing, with processes and procedures emerging with new facts. These factors require a new sense of direction to drive learning home; hence, the need for technological applications to bring about this change. Knowledge is advancing and technological devices are the catalyst driving change and transforming education. These devices enable learners gain information on evolving knowledge and they initiate procedures according to instructions. They further enable changes in teaching styles and improve students' mastery of knowledge to function beyond the classroom. The devices aid instructions and equip students with practice initiatives that develop talent-creativity. Students develop proficiency to construct knowledge on their own and explore career options. As students enjoy learning new things, it enhances their constant search for knowledge on science activities.

Digital technology provides the means for students' deeper search for information about knowledge and equips them for enhanced stimulated learning. Learners are equipped with

21st century skills using appropriate tools and strategies to foster and promote quality and satisfactory learning and teaching for global competitiveness. To achieve this, the use of digital devices and applications with daily improvements and innovation cannot be overemphasized. Students encounter these tools as, Google drive, Pinterest, Coursera, TED Talks, StudyBlue, EdApps and devices as iPods, smartphones, laptops and tablets during instructions in their study environment. These are engaging technological devices to make learners smarter and learning more interesting.

Students engage in group workshops, seminars, projects complete assigned tasks on time with the help of these devices. They experience the activities effortlessly by browsing through tutorials, images and videos to get the work done. Digital devices are used to cover large content areas of study at a time. Students build self-confidence, sharpen higher order critical skills, explore opportunities to discover areas for support system on multi-disciplines that inspire and encourage learning in diverse ways. Skills and knowledge are gained by learners to enable them to adapt to the changing times. This makes learning interesting. Romaniuk (2018) posit that digital tools are giving autonomy and improving students' academic work. For instance, the smartphone is a valuable tool for study organization, management and planning to make a difference in educational experience. Students know where they are going and what they want to achieve. All they need is to interface with the right materials and the right environment conducive for learning. This could be enhanced by the use of appropriate teaching and learning strategies.

Appropriate learning strategies encourage good learning experience and outcome that enhance students' retention. A major contributory factor that influence a learner's understanding of an introduced concept is the effectiveness of the strategies used during instruction (Etiubon, 2016). Guided and sustained decisions to effectively equip learners affect retention outcomes. A strategy for teaching therefore, is the way a lesson is approached and used to achieve set of given objectives. The objectives are better understood with proper integration and utilization of strategy to enhance concept presented. Learners become more intelligent when concept is taught with appropriate teaching strategies. This facilitate and enhance retention of concepts. With well executed plan and proper choice of strategy in place, students engage actively at a task with interest and derive maximally (Aniodoh & Egbo, 2013). Good plans and well implemented strategies enable students to develop critical thinking, interest, motivation, problem-solving skills, creative and analytical skills for science activities. This gives meaning and relevance to learning. Opara and Waswa (2013) and Muhammad (2014) observe that teachers hasten to cover topics in the curriculum that borders on their scheme of work within a stipulated time. This does not help the process of learning and in turn cannot enhance students' retention.

The Policy for Higher Education in Nigeria (FRN, 2014) stipulates amongst others that science evoke students' curiosity in scientific concepts and processes, to originate and promote authentic and applicable researches on science and technological dynamics at all science levels. It is the interest of teaching science in universities to produce scientifically literate adults that understand and make informed decisions to engage with changing global science. Students are able to explore ideas, make investigative analysis and get knowledge with high critical ability to analyze information; acquire appropriate skills and competence for inquiry and doing research. The inculcation of technology skills and attitudes in students can only be achieved through effective deployment of technological devices in teaching various science courses. Water pollution is a major science concept taught at the entry point of science students education in the university. The knowledge of water pollution enable students dismiss superstition, maintain good water hygiene practices such as proper environmental sanitation, for drinking, preparing solutions of reagents for practical tasks, washing and drug production.

Students are intentional with learning as they want to be abreast of new and trending information. They also want to possess skills and attitudes that will enhance their effectiveness on lifelong careers and workplace. The right application of strategies enable students obtain basic knowledge of science concepts. Science is a complex process that require proper attention to details to achieve meaningful learning outcomes (Etiubon, Edet & Godwin, 2019). It is necessary therefore, to stimulate university students' interest towards water pollution, a science-based concept to enhance academic retention using innovative teaching strategies. These strategies bring changes in styles of teaching and inculcate in the students' adequate mastery of concept knowledge to function beyond the classroom.

Learning that allows learners to interact freely with the computer to become skilled on a specific concept is termed computer instruction. It is given in a variety of ways using multifaceted and diverse functioning devices. Through digital learning, the society is better transformed with values for indispensable sustenance. These sustainable values are necessary for the personal and technical development of students which translate towards building capacity within institutions. These are captured with computer-based instruction.

Computer-based instruction is the use of computer and software application to facilitate concept learning and understanding while advancing learners' skills and improving instruction. It is an interactive strategy that presents instruction to support, stimulate and inspire students to transform abstract ideas to reality for easy grasp of concept. The strategy facilitates understanding and comprehension of subject matter and facts as it addresses the needs of users for effective service delivery. This instructional strategy uses a variety of media in the form of text, images, pictures, slides and interactive videos to help students learn anytime and anywhere. With latest ideas and growing application of computer knowledge, universities are to produce graduates sufficiently exposed to basic and well nurtured curriculum with use of dynamic strategies to be relevant in a knowledge-based economy. One of the strategies of computer-based instruction is computer tutorial.

Computer tutorial is an enriching, student-friendly-activity based inclusive participatory instructional strategy. It enables students work through various tasks as activities and problems to retain concepts. As such, computer tutorials aid students own and learn at their pace. In solving the challenge of students' retention, students' focus shifts from analogue approaches to digital deliveries that are more creative, accommodating, engaging, dynamic and precise. This enable teachers and students adjust objectives and strategies to suit their individual needs and characteristics for teaching and learning. Aims, goals and objectives of concept sampled for learning is effectively spelt out to independently bring all learners to achieve stated goals. This instruction type allows teachers to take into consideration the ability of each learner, and separately attend to their needs and challenges. This may be achieved using technology related strategies such as computer tutorial and drill practice strategies. Jegede (2012) posit that computer-based instructions give students opportunity to build communication skills and mental skills for critical and reflective thinking that enable them evaluate different opinions and teaching methods to engaging more actively using electronic devices. These devices are the catalyst responsible for transforming education in many different ways. Students connect more actively using words and pictures to construct knowledge and make meaning to reflect and link new information. This strategy helps students decide a convenient time, their own speed of learning and where and what to learn. The strategy gives feedback promptly to learners while allowing them access to randomly select facilities to review and fill in instructions (Liao, 2007). It does not discriminate against gender as Egunjobi (2014) report that male and female students retained highly with the application of tutorial mode of computer-assisted instruction. Students articulate instructions exploring other computer-based strategy, such as computer drill-practice.

Computer drill-practice strategy is an instructional learning strategy that utilizes the computer to bring about meaningful learning. The strategy is interactive and creative as it enables students remember previously taught concepts. This involves repeated exercises to teach and perfect skills. Students are enabled to acquire knowledge and skills through constant and systematic training, practice and become proficient at learning. This becomes the building block to sustained, relevant, enriching and self-paced meaningful learning. Drill-practice enhances cognitive achievement of students and psychomotor retention (Eze, Onwusa & Nwaosa, 2020). In drill-practice, tasks are sequenced, words repeated, and exercises carried on until it is flawlessly accomplished. Students are presented with questions that are to be solved and answered. As the student respond, the computer inform the student on any wrong or right answer. If the answer to a question is correct, the student is given another exercise to perform; but if students' answer is wrong, the computer supports correction (Mudasiru & Adedeji, 2010). Richness and wealth of knowledge of visual content makes instruction more permanent and dynamic for students' use. This strategy promote creativity and arouses students' interest and curiosity towards exploratory science learning. Students are enabled to connect with global platforms to get ideas and learn from peers. This boost knowledge. Learning can also be acquired through various means like lecturing when resources are scarce. Lecture strategy is mainly employed in teaching in most public institutions of higher learning in Nigeria.

The lecture approach of teaching is a conventional approach that is teacher-centred. It involves the teacher doing most of the teaching activities alone while the students are minimally involved in the lesson as passive listeners. Talking and story-telling are the major means of teaching. In other words, this is the chalk-talk and write instructional strategy. This strategy does not encourage active and evocative learning of science as it appeals only to the senses of hearing. Students pay great attention to listen and take down notes while the teaching is on. This is done while combining and organizing the information to make headway of it. Learners' individual differences that support independent learning is not recognized by the teacher. Large amount of topics is covered in a single class period and this make students to develop listening skills. Imparting knowledge by the teacher for students to learners quickly is a straight forward process. Kelly (2015) posit that teachers typically have greater control over what is being taught because they provide information on the topic only without involving the students. Laboratory and the use of equipment are completely excluded from use during the use of this strategy. This strategy does not promote creativity and does not stimulate students' curiosity towards exploratory science learning. A situation arises, where science teachers use lecture-chalk-talk instructional strategy in teaching. This cannot impart and enhance robust learning outcome for understanding science and should be used less often for instructions. Both gender participate in science learning in Nigeria public universities.

Gender is a variable in the study and this is provided for with the participation of both gender. Gender influence as regard retention has remained a debatable issue. Some studies show that male students achieve and retain higher than their female counterparts while others are of a contrary judgment. Igweh (2012) report that males outperformed girls in physics retention test. Etiubon (2011) observe that female students retained better than their male counterparts in science using technological devices. Okoye (2016) found in his study on cognitive style that gender has great influence on students' retention in science. Other studies show that retention in science is not influenced by gender. Gambari, Yaki, Gana & Ughovwa (2014) did not observe gender influence in technology education. Male and female students when exposed to enriching learning materials and conducive environment for meaningful learning will be impacted equally. Again, instructional strategies that evoke students interest towards retaining concepts sustain gender equality in students' learning outcome in science.

The study was initiated on this basis to determine how retention in water pollution could possibly influence gender using computer tutorial and drill-practice and lecture strategies to engage students.

The most essential need for survival of living things is water. Water is the most threatened ecological system of man today. Water bodies and surfaces harbor a variety of substances like human and sewage waste, changing the water quality. These substances are pollutants such as chemicals from oil spills, shipwrecks sunk underneath ocean floors with toxic chemicals that are harmful to humans, aquatic life of microbes, planktons, fishes, coral reefs, coastal sand, internal energy affect environment. Other pollutant types are; plastics, radioactive materials, organic and inorganic, metallic and non-metallic waste. Water bodies are ponds, streams, aquifers, lakes, groundwater and oceans. The toxic substances dissolve in these water bodies posing serious challenges to human and aquatic health.

Aquatic ecosystems are faced with disaster as pollutants seep through drains, loose soils to reach groundwater which end up in our homes as contaminated for drinking and daily chores. There are many causes of water pollution. One way is the metropolis waste dump and industrial and toxic pipe gas discharges as effluents that contaminate water supplies from boreholes and gases dissolved in the atmosphere that comes down as acid rain into the soil as run-off water. Agricultural practices of herbicides and pesticides improperly disposed contain toxic residues of industrial wastes. Oil spills are major disaster on water ways causing grave concerns on marine life. Sea algae, planktons, plants, animals, microbes that provide food for water creatures are constantly being affected with oil spills from ocean going vessels carrying goods like fuel from one continent to the other. Good examples are recent oil spills in the estuaries of Bonny in Rivers State that destroyed marine life and a Japanese shipwreck that has poured oil into Mauritius waters off the Indian ocean. The oil spills have serious consequences of death on many marine species like whales that may lead to minimal provision of protein life to such communities for years to come.

Regardless of the fact that water plays vital role for human survival, many students do not know much about water pollution. Students perform weakly on water pollution questions in external examinations as they do not have good grasp of what water pollution entails. This indicates poor performance and subsequently low retention. According to the Chief Examiner Report for West African Examination Certificate (2018-2019), the following lapses are observed during marking of students examination scripts while attempting answers on water pollution; shallow understanding of water pollution concepts; inability to interpret questions properly, failure to sequentially, systematically, and logically answer questions convincingly; inappropriate drawing of inferences in practical tasks involving balancing of equations for impurities in water; low expressive power; inability to interpret real water scenarios; poor spelling dictions, low skills for writing of chemical formulae involving water pollutants such as acids in rain water.These gives indication that students show low appreciation and interest in water pollution leading to low retention. Again, it shows that learning that evokes interest has not been imparted.

Students in Nigerian universities come from diverse backgrounds. Few come from enlightened homes where the use of phones and laptops are affordable and phones are luxury while others come from homes where they cannot afford. Again, few universities have well-equipped studios with digital devices to implement technology-driven instruction. Majority of the institutions where most students find themselves do not or are scarcely available. This make it quite challenging for students to adjust to changing educational needs using technology. Teaching and learning facilities for science teachers and students such as laboratories, classrooms, studios and textbooks are no longer adequate to cope with the amount and type of skills and competence expected from science teachers and students in a technology changing world. This poses a challenge to change and adaptation to the use of

technology-driven devices/strategies for science teaching as didactic instruction continues. Change is a constant and teaching using innovative strategies must be a priority to adapt to changing needs of the society. This is taking place at a very slow pace. Many universities in Nigeria lack funds to acquire, install, maintain and implement the use of digital strategies for instruction making these tools unavailable for learners to access. This poses a challenge in the training and retraining of teachers on constant use of digital technology for instructional delivery. Access to utilization of technology for competence among teachers and students is hindered. Lack of basic tools of technology to advance technology skills teaching is inhibited. Eze, Chinedu-Eze and Bello (2018) posit that most institutions in Nigeria are unable to fully utilize digital learning or take full advantage of this. This has hampered teachers use of innovative teaching strategies to deliver instruction. Learning should pave way for more elaborate, evolving and friendly strategies such as computer- assisted instruction with tutorial as well as drill practice. There is need to employ computer-based learning strategies to sustain retention, enhance students' knowledge concept and ensure excellence in achieving science objectives. These strategies could foster knowledge retention of water pollution. For this study, computer-based strategies used are computer tutorials and computer drill-practice.

Students are taught water pollution with life scenarios of slides and pictures as they work their way browsing for information using computer tutorials and drill-practice. Students do not only need information on water pollution; but need to be provided opportunities to effectively implement the concept. Water pollution is in the curriculum for learning in the five units of science education, namely; biology, chemistry, physics, integrated science and mathematics. Quality learning with adequate technology-driven strategies to work with enable students to work hard and practice. Continuous effort at use of the computer-based strategies for assigned tasks enable students to retain the concept.

The ability to reproduce concepts learnt at any given time required is retention. Retention of concept is of interest to both teacher and learner to know if learning dispensed is retained. Retention is the recurring performance put up by a student of an earlier acquired behaviour, elicited after a given time span. Chauhan (1998) posits that a direct correlate of positive learning transfer is retention. High retention therefore, may lead to high achievement that involves many variables. Abari et al. (2019) observe that the interest of students is aroused and motivated in retaining concepts using appropriate computer media of instruction such as computer tutorial and drill-practice. This enable students participate effectively to gain and own knowledge. By providing needed support, learners become smart and innovative to operate and strengthen knowledge-driven systems. Gambari and Adegbenro (2014) opine that students' retention is greatly enhanced when computer-assisted instruction with animation and tutorial is employed for teaching. These variables in most instances of investigative studies, are the overall retention that may be related to several factors which include; learning materials provided, cognitive levels of students (Van Dat, 2014), students' background, teachers' ability to effectively apply teaching strategies (Osuafor, Nweke & Anusiuba, 2019), ability levels of students (Uchegbue and Amalu 2020), intelligence levels of students (Winarti, Yuanita & Nur 2019), and strategies for teaching (Swecker, Fifolt & Searby, 2013). Other variables are; interval time between learning and retrieval, interventional experiences, specific subjects involved, teaching strategies and situation of learning environment. Studies show no consistency on variables leading to students retaining more of what has been learned. Pilli and Aksu (2013) report that students taught with computer and drill-practice showed high ability for retention. Umar and Liaquat (2012) also found that drill-practice instruction enable students retain concepts for a long period of time compared to lecture strategy.Gambari and Yusuf (2015) posit that there was no significant differences between students' achievement mean post and retention scores when students were exposed to computer-assisted instructions on problem solving. Other investigations

however, show that strategies used in teaching science enhance students' retention (Aljohani, 2016). These studies suggest that there is need to further investigate the issue of retention for clarity. With no consensus on effects of teaching strategies on students' retention, there is need to explore student-friendly-activity-oriented strategies and their effects on retention. These learner-centred friendly-activity strategies may include technological instructional devices like computer tutorial and drill-practice strategies. Students need opportunities to engage at individual and classroom levels to keep pace with learning using these technology-driven strategies.

Justification for the Study

It is necessary to carry out this study to enable students appreciate the need of a digital changing world that teachers and students are to be abreast with. Global competitiveness in digital technology is influencing diverse ways students are taking to learning using digital tools. They are becoming more aware of the way of the future for technology application. Raising awareness on environmental issues like water pollution has become imperative for students' alertness and dynamic participation using digital tools. The present health challenge is making online learning via digital technology an ideal approach to bringing information closer to students and improving learning skills. Students have been idle, parents have lost jobs and students' creativity using technological tools remains the best option to reduce stress. Learning with digital application must be embraced widely to minimize prolonged consequences on students' interest in lasting career experiences particularly in science. Students in higher institutions are therefore, encouraged to embrace change to digitally compete globally.

Statement of Problem

Many students of science lack opportunities to exhibit inclusiveness to embrace change on evolving technological tools. This hamper their learning of concept with evolving technological strategies. They underachieve in science. Many higher institutions in Nigeria do not have the enabling environment to give students what they need to aspire and embrace the quality of teaching that create an atmosphere that inspire students using digital technology. Lack of competition and inexperience has led to students' poor handling of digital tools as science teachers themselves lack competence and are not adequately prepared for these. Many students are unwilling to embrace change and unable to fashion out creative ways of engaging and updating digital knowledge. This generate a sense of incompetence in teaching and learning science with technology-driven strategies. The result is poor retention and failure in examinations. Water pollution, considered abstract by students is taught conventionally in most higher institutions in Nigeria without the use of digital technology. First year students face challenges at the entry point of their careers when questions on water pollution are posed during examinations. They find it difficult attempting tasks and answering questions effectively when digital tools are involved. This make them lag behind on tasks. If technology is the focus, it should not be difficult to achieve stated learning objectives speedily. The question now is, will the use of computer tutorial and drill-practice strategies which are technology-based have any enhancing effect on retention of science students on water pollution? It is on this basis the study is undertaken.

Purpose of the Study

The study investigates effects of computer tutorial and drill-practice strategies on students' retention and gender as a variable on water pollution. The specific objectives were to:

1. determine retention of students taught water pollution using computer tutorial, drill-practice and lecture strategies.

2. compare the retention of male and female students taught water pollution using computer tutorial strategy.

3. compare the retention of male and female students taught water pollution using drill-practice strategy.

Research Questions

Three research questions guided the study

1. What differences exist in the retention of students taught water pollution using computer tutorial, drill-practice and lecture strategies?

2. What differences exist in the retention of male and female students taught water pollution using computer tutorial strategy?

3. What differences exist in the retention of male and female students taught water pollution using drill-practice strategy?

Research Hypotheses

1. There is no significant difference in the retention of students taught water pollution using computer tutorial, drill-practice and lecture strategies.

2. There is no significant difference in the retention of male and female students taught water pollution using computer tutorial strategy.

3. There is no significant difference in the retention of male and female students taught water pollution using computer drill-practice strategy.

Research Procedure

The study adopted quasi-experimental design of non-randomized pretest-posttest control group with students taught in their intact classes. Three research questions and three hypotheses guided the study. The population comprised all 1st year undergraduate students in the five units of Science Education Department, University of Uyo in the 2018/2019 academic session. Using purposive sampling technique, all 210 science education students of the department formed the sample size for study. Instructional packages were prepared and computers per student used for teaching the experimental group 1 (computer tutorial) and experimental group 2 (computer drill-practice) while control group was taught without computer. Instructional materials for groups 1 and 2 were laptops, projector, software in storage device as lesson video and instructional guide. In group 1, students attentively watch the video and write down key points in their notebooks. If students experience difficulty, the lesson video is replayed for clarity. In group 2, the computer displays drill-practice programme for students' study and practice. Where students experience difficulty, they review their work for clarity. The teacher uploaded most of the teaching activities from the computer using laptop for the control group of lecture strategy. Students listen attentively and write down main points in their notebooks. They ask questions for clarity when not clear. Pretest was to determine the equivalence of the groups. Students were given posttest after three weeks of treatment to test the comparability of the groups. This procedure provides feedback on previous knowledge level of the learner and what knowledge has been gained after treatment from the experience. Results of the posttest were used as covariates. Another three weeks was allowed to elapse to test the retention of the students. The instrument was reshuffled and administered to the students in the three groups as water pollution retention test for data collection. The instrument consisted of 25-multiple choice test items with each of 4-options-1 point score for each correct answer and zero score for an incorrect option. Accordingly, 25 was the maximum score. Posttest and retention test scripts were collected

from all the groups for marking and computation analysis. Validation of instrument was by three lecturers of test, measurement and evaluation in Science Education. A reliability index of .81 was obtained using Kuder-Richardson Formulae-21. Analysis of data collected was done using mean and standard deviation to answer the research questions and Analysis of Covariance (ANCOVA) for hypotheses formulated at .05 significant level.

Results

Research Question 1: What differences exist in the retention of students taught water pollution using computer tutorial, drill-practice and lecture strategies?

Table 1. Mean of students' retention scores taught using computer tutorial, drill-practice and lecture strategies with posttest as covariate

Strategy	N	$\bar{X}$	SD
Computer tutorial	73	19.58	0.96
Drill-practice	66	19.51	1.09
Lecture	71	18.91	1.43

Data in Table 1 show that the mean retention scores of students taught using computer tutorial, drill practice and lecture strategies are 19.58, 19.51 and 18.91 respectively with standard deviations of 0.96, 1.09 and 1.43. This indicate that retention of students taught using computer tutorial achieved the most, followed by drill-practice with lecture strategy as the least. The retention scores of students taught using computer tutorial is closest to their mean retention score when compared to drill-practice and lecture strategy. Retention scores of students taught using drill-practice is closer to their mean score compared with lecture strategy. It can be inferred from the standard deviations also that the retention mean score of students taught using computer tutorial is greater than that of drill-practice and lecture while drill-practice is higher than lecture strategy.

Table 2. Mean of male and female students' retention scores taught using computer tutorial with posttest as covariate

Gender	N	$\bar{X}$	SD
Male	30	20.11	0.96
Female	42	20.28	0.97

Data in Table 2 of the retention mean of male and female students taught using computer tutorial is 20.11 and 20.28 respectively with standard deviations of 0.96 and 0.97. This indicate that female students taught using computer tutorials retained better than their male counterparts. It also show that the scores of male students taught using computer tutorial is closer to their mean retention scores than their female counterparts. It is inferred from the standard deviations that the mean retention score of female students taught using computer tutorials may not be greater than those of their male counterparts.

Research Question 3: What differences exist in the retention of male and female students taught water pollution using drill-practice strategy?

Table 3. Mean of male and female students' retention scores taught using drill-practice with posttest as covariate

Gender	N	$\bar{X}$	SD
Male	32	19.30	1.00
Female	36	19.61	2.13

Data in Table 3 show the retention mean score of male and female students taught using drill-practice is 19.30 and 19.61 respectively with standard deviations of 1.00 and 2.13. This indicate that female students taught using drill practice retained slightly better than their male counterparts. Results also show that the retention scores of female students taught using drill-practice is closer to their mean scores than those of their male counterparts. It is inferred from the standard deviations that the mean retention score of female students taught using drill-practice is greater than for male students.

Analysis of Covariance (ANCOVA) was used in testing the hypotheses.

Hypotheses 1: There is no significant difference in the retention of students taught water pollution using computer tutorial, drill-practice and lecture strategies.

Table 4. Analysis of Covariance of students' retention scores based on strategies using posttest scores as covariates

Source of Variation	SS	Df	MS	F_{cal}	P-$value_{cal}$
Posttest	235.77	1	235.77	287.52	.000
Strategy	14.52	2	7.26	8.85	.000
Residual	168.38	206	0.82		
Total	418.67	209	2.00		

Data in Table 4 show that posttest is significant since the calculated P-value .000 is less than .05alpha, indicating the groups were not comparable. The groups comparability is however, taken by analysis of covariance that would regress the pretest and posttest scores. The table also show that the calculated P-value (.000) of strategy is less than the alpha level .05. The null hypothesis is rejected. This implies that significant difference exists in the retention of students taught water pollution using computer tutorial, drill-practice and lecture strategies. Least significant difference (LSD), a posthoc pairwise comparison test is used to determine the direction of significance as shown in Table 5.

Table 5. LSD Comparison Test of Retention Scores by Teaching Strategies using Posttest Scores as Covariates

(I) Strategy	(J) Strategy	Mean (I-J)	Difference Std. Error	Sig.
Computer tutorial	Drill-Practice	0.07	.163	.671
	Lecture	0.67*	.183	.000
Drill-Practice	Computer Tutorial	-0.07	.163	.671
	Lecture	0.61*	.161	.000
Lecture	Computer Tutorial	-0.67*	.183	.000
	Drill-Practice	-0.61*	.161	.000

Note: * Mean difference is significant at.05 level of significance

Data in Table 5 show mean difference (0.07) between the retention of students taught water pollution using computer tutorial and drill-practice strategies, 0.67 between computer tutorial and lecture strategies and 0.61 between drill-practice and lecture strategies. The level

of significance indicates that students taught using computer tutorial and drill-practice strategies retained significantly better than students taught using lecture strategy.

Hypothesis 2: There is no significant difference in the retention of male and female students taught water pollution using computer tutorial strategy.

Table 6. Analysis of Covariance of male and female students' retention scores taught using computer tutorials with posttest scores as covariates

Source of variation	SS	Df	MS	Fcal	P-value$_{cal}$
Posttest	16.33	1	16.33	23.00	.000
Gender	0.46	1	0.46	0.65	.424
Residual	49.09	69	0.71		
Total	65.88	71	0.93		

Note: *significant at.05 level of significance

Data in Table 6 show posttest is significant since the calculated P-$_{value}$ (.000) is less than the alpha .05, indicating the groups were not comparable. The group comparability is however taken by analysis of covariance that would regress the pretest and posttest scores. The table also show that the calculated P-$_{value}$(0.424) of gender is greater than the alpha level (.05). The null hypothesis is retained. The implication is that; there exist no significant difference in the retention of male and female students taught water pollution using computer tutorial strategy.

Hypothesis 3: There is no significant difference in the retention of male and female students taught water pollution using computer drill-practice strategy.

Table 7. Analysis of Covariance of male and female students' retention scores taught using drill-practice with posttest scores as covariates

Source of variation	SS	Df	MS	F_{cal}	P-value$_{cal}$
Posttest	21.90	1	21.90	25.76	.000
Gender	1.66	1	1.66	1.95	.168
Residual	55.39	65	0.85		
Total	78.94	67	1.18		

Note: *significant at.05 level of significance

Data in Table 7 show that posttest is significant since the calculated P-value .000 is less than the alpha .05. This indicate the groups were not comparable. The group comparability is however, taken by analysis of covariance that regresses the pretest and posttest scores. The table also show that the calculated P-value .168 of gender is greater than the alpha level .05. The null hypothesis is retained. This implies that there exists no significant difference in the retention of male and female students taught water pollution using drill-practice strategy.

Discussion of Findings

Study findings on the difference in the retention of students taught using computer tutorials, drill-practice and lecture strategies indicate a significant difference among the groups. Students taught using computer tutorials strategy retained significantly better than those taught using drill-practice and lecture strategies. The study also found that students taught using drill-practice strategy had a significantly better retention than those taught using lecture strategy. This could be attributed to the variety of ways information is obtained with students' active involvement doing different exercises using the computer. Students seek

information in active engagement by browsing due to the supportive nature of computer. This corroborates Pilli and Aksu (2013) findings that students taught with computer and drill-practice showed high ability for retention.

Umar and Liaquat (2012) also found that drill-practice instruction help students retain concepts for a long period of time compared to lecture strategy. With visual and auditory channels, students receive information that may have made it easier for them to remember. The findings also show that computer-assisted instructions encourage interaction of students with the environment, improved learning and consequently enhance retention. Findings on the retention differences of male and female students showed no significant differences on gender when taught water pollution using computer tutorial. The non-significant difference may be due to the fact that, with application of appropriate strategy, both male and female students perform equally. This finding is contrary to Okoye (2016) that gender has great influence on students' retention in sciences on cognitive style using technology devices. Findings on the study using computer-drill practice also showed no significant differences between gender. This may be due to consistent practice and exposure to information that may have aided easy memorization, recall and retention of concept by students. Findings by Egunjobi (2014) show similar report with respect to retention of male and female students on effects of tutorial mode of computer-assisted instruction on performance and retention in secondary schools. Male and female students can aspire to achieve and retain maximally if given equal opportunity to use technology-driven strategies to learn. Students and teachers in higher education should rise to the challenge of quality learning for productive technology-skill-driven knowledge to equip themselves with available information using technology-driven tools.

Recommendations

Students should be at the forefront of digital technology using available apps to make learning interesting.

Investments should be made by different universities by equipping students' learning environment with upcoming technologies to close the already widened knowledge-gap on use of digital strategies.

Teachers should learn the use of available digital tools and deploy same to engage students effectively for science instruction.

Universities should lead by example, taking initiatives to train science teachers and boost their morale to upgrade and update on digital technology.

Higher institutions should institutionalize the use of smart and emerging technologies that will enhance the functions and applications of science teaching delivery.

Universities should make relentless effort to adjust and adopt engaging strategies to meet realities of the changing times on the richness of technology.

Conclusion

In conclusion, from the findings of the study; the use of computer tutorials and computer drill-practice are suitable and engaging technological devices that improve and enhance students' retention in water pollution. There was no significant difference in the retention of male and female students using computer tutorial and computer drill-practice. Institutions should not compound difficulties in not creating relevant and enabling environment; but invest in implementing technologically enhancing strategies for teaching resourcefulness.

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