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Science Teaching and Learning Using Animation and Simulation Strategies in Nigerian

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Abstract- The use of only traditional teaching methods in science class in this 21st century of rapid development in ICT subject students to learn scientific concepts passively. This paper therefore, is an attempt to examine the teaching and learning of science using animation and simulation strategies and determined if there is any significant difference in the performance of students exposed to traditional method only and those exposed to animation and simulation strategies incorporated into traditional teaching methods. Empirical studies revealed successes in the use of animation and simulation all over the world with a lot of benefits as these strategies encourage active learning and sustains students' interest thereby enhancing their academic performances. With the availability of simulation courseware and software online, teaching and learning of science can now become active, enhance students' performance and interest in science. It is recommended that with the creation and availability of virtual laboratories, simulation courseware and software on internet, science teachers should direct students in the learning of science with animation and simulation strategies and conduct laboratory experiments online in a safe and interactive manner where they can observe, explore, recreate, and receive immediate feedback about real objects, phenomena, and processes that would otherwise be too complex, time-consuming, or dangerous.

Indexed Terms- Animation, Science, simulation, traditional teaching methods, virtual lab.

I. INTRODUCTION

There is a rapid development in the world today and every Nation strives to meet up with the requirement needed. The federal government of Nigeria has called for advancement to socioeconomic development in various ways. One of which is the introduction of information, communication and technology (ICT) at all levels of education. In order to actualize this, a lot of curriculum reforms were put in place. According to Obioma (2006) there is plan to digitalize the science, technology and mathematics (STM) Curricula which implies the automating digital templates for teaching and learning or where expertise is not locally available; domesticating existing digital templates from elsewhere to ensure that they are compliant with extant and establishing relevant digital infrastructure to drive the application of the automated curricula (Obioma 2006).

Over the years, traditional teaching methods which include lecture method, demonstration method, laboratory method, assignment method and project method are being used in teaching science. These methods do not encourage active learning and students learn passively thereby killing the interest of students in science subjects. Consequently, poor academic achievement of students in sciences and poor enrolment ratio had been much pronounced in recent times as observed by Ajah (2004). This is supported by West African Examination Council (WAEC) Chief Examiner's report. Arong and Ogbadu (2010) outlined some factors contributing to the decline in quality of education. They include lack of instructional materials, inadequate library facilities, teachers' methodology and students' attitude towards learning. Most scientific concepts are generally found to be abstract in nature thereby needs to be simplified through an alternative strategy that will engage the students actively, arouse and sustain their interest in the subject. Therefore, this study is an attempt to portray an alternative way to enhance the teaching and learning of science by the use of simulation strategy.

II. SCIENCE AND AIMS OF TEACHING SCIENCE IN NIGERIAN SCHOOLS

According to Cornelius Bernardus Van Nie (1897-1985), U. S. microbiologist in his definition of science said "In essence, science is a perpetual search for an intelligent and integrated comprehension of the world we live in." The field of science is viewed from two perspectives which are pure and applied science. Pure science is the discipline of science that focuses on theories of science and predictions that help understand the world better. On the other hand, applied science is the discipline of science that utilizes scientific information to develop practical solutions to human problems.

According to Adolphus Telima (2019), **t**he purposes of science education in Nigeria are generally drawn from the national goals and philosophy of education as contained in the National Policy on Education (NPE). For instance, the goals of education in Nigeria include: Development of the individual into a morally sound, patriotic and effective citizen …. and social abilities and competencies as equipment for the individual to live in and contribute to the development of the society (FRN 2013, p.2). According to the national policy text, the goals of science education are to:

i. Cultivate inquiring, knowing and rational mind for the conduct of a good life and democracy;
ii. Produce scientists for national development;
iii. Service studies in technology and the cause of technological development; and
iv. Provide knowledge and understanding of the complexity of the physical world, the forms and the conduct of life. (FRN 2004, p.29).

III. IMPORTANCE OF SCIENCE

Science is valued by society because the application of scientific knowledge helps to satisfy many basic human needs and improve living standards. Finding a cure for cancer and a clean form of energy are just two topical examples. Similarly, science is often justified to the public as driving economic growth, which is seen as a return-on-investment for public funding. During the past few decades, however, another goal of science has emerged: to find a way to rationally use natural resources to guarantee their continuity and the continuity of humanity itself; an Endeavour that is currently referred to as "sustainability" .Science is linked to personal health and longer life expectancies, technological advancement, economic profits, and/or sustainability—in order to secure funding and gain social acceptance. They point out that most of the tools, technologies and medicines we use today are products or by-products of research, from pens to rockets and from aspirin to organ transplantation.

IV. ANIMATION AND SIMULATION IN SCIENCE TEACHING

Animation is the method of creating an illusion of any movement by using rapid display images of 3-D or 2-D artwork. The effect of this becomes an optical motion or illusion because of persistence visions. It involves the technique of photographing successive drawings or positions of puppets or models to create an illusion of movement when the film is shown as a sequence. Educational animations are animations produced for the specific purpose of fostering learning. The popularity of using animations to help learners understand and remember information has greatly increased since the advent of powerful graphics-oriented computers. This technology allows animations to be produced much more easily and cheaply than in former years. Previously, traditional animation required specialized labour-intensive techniques that were both time-consuming and expensive. In contrast, software is now available that makes it possible for individual educators to author their own animations without the need for specialist expertise. Teachers are no longer limited to relying on static graphics but can readily convert them into educational animations. Abstract concepts can be made real to learners using animation.

For instance, movement of particles of matter at different states can best be demonstrated with manipulation of various variables using animation strategy. Peristaltic movement of food through the esophagus can equally be explained with animation. Boyle's law and Charles law tried to establish the relationship between the volume and temperature, volume and pressure due to the rapid or slow movement particles randomly, students end up in memorizing these laws thereby encouraging rote learning which ought to be discouraged in science learning. With simulation, the perticles would be made visible and the collisions of particles would be observed like in a real life.

V. SIMULATION

Simulations are instructional scenarios where the learner is placed in a "world" defined by the teacher. Simulation is an imitation or replication from the real thing. They represent a reality within which students interact. The teacher controls the parameters of this "world" and uses it to achieve the desired instructional results. Students experience the reality of the scenario and gather meaning from it. A simulation is a form of experiential learning. It is a strategy that fits well with the principles of Student-Centred and constructivist learning and teaching. Simulations take a number of forms. They may contain elements of a game arole-play, or an activity that acts as a metaphor.

Simulations are characterized by their non-linear nature and by then controlled ambiguity within which students must make decisions. The inventiveness and commitment of the participants usually determines the success of a simulation. It promote the use of critical and evaluative thinking. Because they are ambiguous or open-ended, they encourage students to contemplate the implications of a scenario. The situation feels real and thus leads to more engaging interaction by learners. Simulations promote concept attainment through experiential practice. They help students understand the nuances of a concept. Students often find them more deeply engaging than other activities, as they experience the activity first-hand, rather than hearing about it or seeing it.

Also, simulations help students appreciate more deeply the management of the environment, politics, community and culture. For example, by participating in a resource distribution activity, students might gain an understanding of inequity in society. Simulations can reinforce other skills indirectly, such as debating, a method associated with some large-scale simulations, and research skills. The issues of simulations are resources and times are required to develop a quality learning experience. Assessment of student learning through simulation is often more complex than with other methods.

Simulation games are used for diverse reasons which range from reinforcing interest, enthusiasm and motivation, presenting information and principles, placing learners into situations where they can express their positions, ideas, opinions or facts they have earlier learned; or skills needed later. Simulation games are argued to be an excellent supplement to standard lecture. As evidence, both computerized and non-computer-based simulation games have shown significant growth in education (Lean, Moizer, Towler, and Abbey, 2006; Dobbins, Boehlie, Erickson and Taylor, 1995, Rils 1995; Gentry 1990). Some of the key benefits of simulation games as teaching and learning strategy identified are that they can help learners to obtain genuine information; develop intellectual and social skills; understand how certain concepts are structured and worked in the 'real' world. It can also assist in learning from their mates and understand the teachers better and clearer. Furthermore, it encourages creative expression, problem solving, in complex situations and experiential/active learning; provides immediate and conceptualized feedback; adapt to the level of individual while providing support; and thus learner-centered. Computer simulations are computer-generated dynamic models that present theoretical or simplified models of real-world components, phenomena, or processes. They can include animations, visualizations, and interactive laboratory experiences (*Randy L. Bell and Lara K. Smetana (2012*).

In a simulated environment, time duration for an activity can be changed by speeding up or slowing down the process, abstract concepts can be made concrete and tacit behaviors visible. The teacher can focus students' attention on learning objectives when real-world environments are simplified, causality of events is clearly explained, and unnecessary cognitive tasks are reduced through a simulation. The use of ICT packages have increasingly brought instructional digital technologies into the science classroom. Teachers can now have greater access to computers, internet, wireless laptop, computer projectors, and interactive whiteboards than ever before. These resources can be used to enhance science teaching and learning. Computer simulations make these types of interactive, authentic, meaningful learning opportunities possible. Learners can observe, explore, recreate, and receive immediate feedback about real objects, phenomena, and processes that would otherwise be too complex, time-consuming, or dangerous (*Randy L. Bell and Lara K. Smetana (2008)* Many of these simulations can be accessed online (some for a free, like at *www.ExploreLearning.com* and www.pbs.org/wgbh/aso/tryit).

Here are some science simulations packages and web sites

- u Learning Science: A vast collection of animations, simulations, and web-based resources for all subject areas *(*www.learningscience.org/index.htm*)*
- u Visual Elements: A visual representation of the Periodic Table *(www.chemsoc.org/viselements)*
- u Virtual Chemistry Lab: A fully stocked virtual chemistry lab *(www.chemcollective.org/vlab/vlab.php)*
- u OhmZone: A virtual circuit board (*www.article19.com/shockwave/oz.htm)*
- u Physics Education Technology: A collection of interactive simulations of physical phenomena *(www.colorado.edu/physics/phet/web-pages/index.html)*
- u Cell Biology Animations: A collection of animations for a variety of topics, from DNA replication to photosynthesis *(www.johnkyrk.com/index.html)*
- u Interactive Human Body: An interactive exploration of the human organs, muscles, skeleton, and nervous systems *(www.bbc.co.uk/science/humanbody/body/interactives/_02/index.shtml?skeleton)*
- Other more complex simulations with large underlying databases (like Starry Night) are available as commercial software.

VI. EMPIRICAL REVIEW ON THE USE OF SIMULATION IN SCIENCE TEACHING

Researchers studying the use of simulations in the classroom have reported positive findings overall. The literature indicates that simulations can be effective in developing content knowledge and process skills, as well as in promoting more complicated goals such as inquiry and conceptual change (*Randy L. Bell and Lara K. Smetana (2012*).

Gains in student understanding and achievement have been reported in general science process skills and across specific subject areas, including physics, chemistry, biology, and Earth and space science (Kulik 2002). Although conventional instructional materials such as textbooks present two-dimensional representations, simulations can offer three-dimensional manipulative that bring the subject matter to life. Visualization results in the development of mental constructs that allow one to think about, describe, and explain objects, phenomena, and processes in a more true-to-life form. These are just the habits of mind scientists rely upon in their daily work. For example, after comparing simulated and hands-on dissection labs, Akpan and Andre (2000) concluded, "The flexibility of these kinds of environments makes learning right and wrong answers less important than learning to solve problems and make decisions.

A study conducted by Geban, Askar, and Ozkan (1992) investigated the effects of a computer-simulated experiment on chemistry achievement and process skills. The researchers found greater student achievement with simulated labs than with hands-on labs.

A study by Mintz (1993) found that students were successful in designing, implementing, and analyzing the results of three ecological problems, noting improvement even as the inquiry tasks became increasingly complex. Students also began employing more formal analytical strategies, rather than relying on trial and error.

Trundle and Bell (2005) described students' conceptual understandings about lunar concepts before and after instruction with planetarium simulations. Results indicated that students learned more about moon shapes and sequences, as well as causes of moon phases, by using the computer simulations than by making actual nightly observations and studying nature alone. The ability to make many more observation using the program, the ease of making and testing predictions, and the consistency and accuracy of student measurements contributed to the dramatic improvements in student understanding.

The past 20 years of research indicates that students' misconceptions in science are prevalent and tenacious. Thus, the process of conceptual change is an ongoing challenge in science education. Computer simulations have demonstrated the potential to facilitate this process by highlighting students' misconceptions and presenting plausible scientific conceptions. For instance, using computerized interactive laboratory simulations, learners can confront their beliefs by working with real data, experiencing discrepant events preselected by the program, or forming and testing multiple hypotheses of their own (Gorsky and Finegold 1992; Tao and Gunstone 1999; Trundle and Bell 2005).

Overall, the research shows that interaction with computer simulations resulted in measurable achievement gains and indicates that simulations are equally, if not more, effective than traditional methods. Access to multiple representations of phenomena, the ability to manipulate the environment, ease of posing and testing multiple hypotheses, and ability to control variables are consistently cited in the research as contributing to the effectiveness of computer simulations.

Other noted benefits to consider when comparing instructional approaches include cost and time efficiency, student enthusiasm, high engagement, and on-task behavior while working with simulations. Effectiveness, however, varies based on design features, support measures, and sequencing of simulation activities within the curriculum (Bayraktar 2002; Kulik 2002).

VII. GUIDELINES FOR BEST PRACTICE OF SIMULATION

Effective uses of computer simulations in the science classroom are abundant and as varied as the teachers who use them. Technologies like computer simulations are tools to support learning. As with any other educational tool, the effectiveness of computer simulations is limited by the ways in which they are used. Certainly, instructional strategies proven to support meaningful learning should be adhered to when using computer simulations or any other digital technologies. Students should be actively engaged in the acquisition of knowledge and encouraged to take responsibility for their own learning; Content should be placed in the context of the real world and connected to their own lives.

In order to maximize the potential of computer simulations to enhance meaningful science learning, *Randy L. Bell and Lara K. Smetana (2012*) proposed guidelines, representing a synthesis of the recommendations from science educators, researchers, and developers.

VIII. GUIDELINES FOR USING SIMULATION IN SCIENCE TEACHING

(1) Use Computer Simulations to Supplement, not Replace, other Instructional Modes**.**

Computer simulations should be used in conjunction with hands-on labs and activities that also address the concepts targeted by the simulation. Indeed, one study has indicated that simulations used in isolation were ineffective (Hsu and Thomas2002). When preceding a hands-on activity, a simulation may familiarize students with a concept under a focused environment.

For example, chemistry students might become familiar with titration virtually (using a titration simulator like the one created by Yue-Ling Wong at *www.wfu.edu/~ylwong/chem/titrationsimulator/index.html*) before doing a hands-on titration lab.

When an interactive simulation is used as a follow-up, students can continue investigations of questions and manipulations of variables that would otherwise be impossible under the constraints of the lab equipment or class schedule.

(2) Keep Instruction Student Centered. By exposing complex concepts and abstract phenomena, computer simulations offer the opportunity to engage students in higher-level thinking and challenge them to struggle with new ideas. Lessons involving computer simulations should remain student-centered and inquiry-based to ensure that learning is focused on meaningful understandings, not rote memorization. Depending on your instructional objectives and classroom arrangement, the student groupings and computer setups will vary. You may choose to integrate simulations such as Stellarium (a free

opensource virtual planetarium available at *www.stellarium.org*) into your lectures as a teacher-led demonstration, or students may work in a lab setting individually or in small groups with programs such as Net Frog (an interactive virtual dissection)

When simulations are teacher led, students should be actively engaged through questioning, prediction generation and testing, and conclusion drawing (Soderberg 2003). Connections made to their own lives make the learning more authentic and meaningful. Closure to the lesson is as important for simulated activities as for conventional activities; have students restate their understandings and consider real world applications. When students work with simulations individually or in small groups, discussion and collaboration among teachers and peers should be fostered. Regardless of the implementation you choose, students should be prompted to form and test their own hypotheses and justify their decisions. By encouraging reflection on their actions and decision-making, you can help expose student misconceptions, allowing for conceptual change and development. Students can then begin to monitor and take responsibility for their own learning.

(3) Point out the Limitations of Simulations
Since simulations are simplified models of the real world. Although it is necessary for students to accept the simulated environment as an intelligible and plausible representation of reality, it is also critical that students realize the differences between the simulation and reality.

Without understanding a model's limitations, students may form misconceptions. For instance, it is important to stress that protons, neutrons, and electrons are not actually red, blue, and yellow as they may be in a simulated model of the atom. Attention should also be given to scale and timeframe when they are altered for the sake of simplification. For instance, students should understand that, in reality, volcanoes take hundreds of years to form, not a matter of seconds (as it appears in a simulation. A discussion of why scientists use models and the role they have in scientific inquiry would be a valuable component of any lesson involving simulations (Harrison and deJong 2005).

(4) Make Content, not Technology, the Focus**.**
When it comes to computer simulations, the range of accessibility is as wide as the topics spanned. Although some simulations are extremely user friendly and self-explanatory, others require a good deal of time to become familiar with. If students are to be using them on their own, they must understand how the program operates. Otherwise, they may get bogged down with logistical issues rather than remaining focused on the educational objectives. To avoid this dilemma, you may choose to lead the class through the simulation as a demonstration, ensuring the type of student engagement described previously. Even when the program is designed for independent student use, be sure to familiarize your students with its features, discuss its limitations, model its use, and provide access to any additional domain knowledge and tools that might facilitate their work.

IX. FACTORS LIMITING THE USE OF SIMULATION IN TEACHING SCIENCE CONCEPTS

Though it is highly advantageous using digital simulation for teaching and learning science, however, there are limiting factors which are stated below.

- Digital simulations may have limited tracking ability with delayed responses.
- Digital simulations may require users to switch their attention among the different senses for various tasks. In particular, multisensory inputs can result in unintended sensations and unanticipated perceptions.
- Digital simulation environments and tasks are often overwhelming for some students. Digital simulations particularly make demands on students' metacognitive skills, and in some cases, place students in complex environments.
- If students are not getting enough guidance or they use a simulation just for simple practicing of their skills, the simulation-based learning does not necessarily lead to a positive attitude towards the learning environment.
- Creating a digital simulation for education is costly and difficult. Simulation creation does not yet have a reliable, affordable set of software tools that can assist the teacher in creating tailor-made simulation environments.

- Digital simulation systems are difficult to create and maintain, and the skills needed to do so are so far outside a single teacher's usual domain of knowledge. As a result, simulations often have little adaptability; they tend to get used once and then laid aside.
- The unavailability of the ICT facilities.
- Procrastinating attitude of teachers to upgrade their knowledge on ICT skills and their applications in teaching chemistry.
- Lack of constant electrical power supply.
- Lack of adequate ICT tools in schools.

X. BENEFITS OF ANIMATION AND SIMULATION IN SCIENCE LEARNING

- In medical field, Williams B, Abel C, Khasawneh E, Ross L and Levett-Jones T.(2016) stated that Simulation-based education is an important part of paramedic education and training. While accessing clinical placements that are adequate in quality and quantity continues to be challenging, simulation is being recognized by paramedic academics as a potential alternative. Examining students' satisfaction of simulation, particularly cross-culturally is therefore important in providing feedback to academic teaching staff and the international paramedic community.
- In engineering it is used to teach the processes involved in production, in the military used to simulate war front and in moving industry used to produce an illusion causing an inanimate object to move.
- The use of the educational animation software in schools is one of the most exciting progressions that have taken place in the education technology. It helps the students in being creative and allows them to design their own movies, comic strips, and more that is endlessly creative.
- The animation for educational purposes also makes a class lively, let the students absorb knowledge faster, encourage a child to explore a subject with full enthusiasm.
- Improve Students' Presentation Skill
- The animation is one of the best ways to encourage the students to put bigger and better efforts into their project works or presentations, slides show creations, or visual concept's explanations. Animation, being visually appealing helps to connect with audiences and helps the students learn a great skill for the future
- The practice provided by simulation training builds up confidence and hence satisfaction, as students would feel more competent to handle real-life situations in the future.
- Students can gain confidence; they are more comfortable in making their own decisions.
- Student-teachers are helped in a variety of ways through simulated training. It helps in developing self-confidence among them.
- This technique helps in linking theory with practice of teaching.
- Student are given an opportunity to study and analyze critical teaching problems.
- Simulated training provides feedback to student teachers to modify their behavior.
- It helps in developing social skills like social manners and etiquettes among the students.
- Simulation creates interest and enhances active participation
- As a result of role-playing, it helps in the development of critical-thinking in student-teachers.

Nevertheless, simulation in chemistry instruction has some limitations since it requires the supervision by training personnel which are generally not available or not devoted to their duties.

- Simulation attempts to portray the real situations in a simple way, which in general, are very complex and difficult.

XI. VIRTUAL SCIENCE LABORATORY (VSL)

Virtual Science laboratory (VSL) is a web based system designed to help students conduct laboratory experiments in a safe and interactive manner. Virtual science labs and interactive simulations can create new and unique online learning opportunities for students. These labs are also ideal for struggling learners and those with disabilities. With the growing needs companies are exploring ways to address the rigor of learning and accessibility for online science course and online science labs (VanderMolen Julia, 2019). Exploring Virtual Science LabsHigher education facilities are offering students more online courses for many reasons (Allen & Seaman, 2014). Chandler, Park, Levin, and Morse (2013) suggest that a single form of learning is not enough and combining hands-on activities with online learning would be the most effective learning method. Technology is now becoming an even more useful tool for teachers and students. The idea of using new technology to encourage and engage students with practical tasks is not new. Moreover, online learning has become more advanced and the onset of online labs offers schools and teachers convenience and savings, reducing the time and expense that purchasing, maintaining, and preparing lab materials requires (VanderMolen Julia, 2019).

XII. EXPLORING VIRTUAL SCIENCE LABS

- Carolina Biological Supply Company. This Company provides digital opportunities for online science classes the mission of Carolina Biological is "to provide educators the finest products and services that help students of all ages learn and understand science" (Carolina Biological, 2019). Carolina Biological is a source for science kits (including individual kits for lab experiments), living and preserved specimens, multimedia, books, microscopes, and apparatus. Within the company, there is a distance learning division. Carolina Distance Learning offers science lab kits with the same rigor, relevance and results as traditional labs, giving students a successful science experience in their own homes. Their website has eight different subjects with more than 200 labs to choose from to build a completely customized kit for every course (S. McGurk, personal communication, June 26, 2019)
- The eScience Labs. eScience Labs provides authentic lab experiences for online undergraduate science courses. The labs provide comprehensive hands-on science kits to support online and traditional courses in need of a laboratory component. The labs are developed and written by Ph.D. level educators and scientists. Additionally, each eScience Labs kit includes hands-on materials, a full color digital lab manual, safety equipment, Learning Management System Integration and a series of online Learning Tools. Kits can be shipped directly to students for them to perform experiments at home The price of the lab is comparable to what students would have to pay for lab manuals and materials.
- Hands-on Labs. This is the pioneer and leading provider of online science learning, is changing the way education is created, delivered and consumed regardless of location, time zone, or device" (R. Barbieri, personal communication, July 11th, 2019). Hands-On-Labs (HOLs) Inc provides LabPaq™ which are mail-order kits. The LabPaq™ are designed to provide a laboratory experience for students enrolled in online science courses. HOLs utilizes a platform called the HOLcloud™. HOLcloud™ integrates with the following learning management systems: Blackboard, Canvas, Moodle, and Edmodo order to directly provide the student with both the knowledge-based content and lesson experiments. Additionally, the HOLcloud allows students to input their research and findings directly whereby a lab report is generated as a final product or assessment. Moreover, the program provides quizzes, competency reviews, and auto-grading capabilities which add to the uniqueness of the HOLcloud and the company's learning delivery method.

The Online Learning Consortium also offers a professional development resource for those interested in enhancing their online science courses with the Online Science Labs Mastery Series. In this series, participants will engage with fellow colleagues and learn about methods to design, prepare, and integrate labs and assessment methods. Included is a review of several different online labs options and strategies for integrating them into your online science curriculum.

Whether you have students explore the local hardware store with a list of laboratory equipment needed or you utilize one of the options mentioned, the future of online science learning and online science labs is making strides to keep up with the growing demand for digital learning options

CONCLUSION

Computer simulations and animations have the potential of enhancing teaching - learning situations. They allow teachersto bring even the most abstract concepts to real life for students and incorporate otherwise impossible or impractical experiences into daily instructions. When used with conventional teaching methods in conjunction with the guidelines presented here, your students will be engaged in inquiry, further develop their knowledge and conceptual understanding of the content, gain meaningful practice with scientific process skills, and confront their misconceptions. In Addition, they will acquire the attitudes of a scientist such as curiosity, objectivity, openness, perseverance and critical thinking.

RECOMMENDATION

The following recommendations are made based on the study:
. Further studies should be carried out on the design of software on animation and simulation for science science teaching.

It is recommended that with the creation and availability of virtual laboratories, simulation courseware and software on internet, science teachers should direct students learn science with animation and simulation strategies and conduct laboratory experiments online in a safe and interactive manner where they can observe, explore, recreate, and receive immediate feedback about real objects, phenomena, and processes that would otherwise be too complex, time-consuming, or dangerous.

It is suggested that teachers should employ ICT particularly animation and simulation in teaching science. ICT and other teachers should be taken on board in all schools on priority basis and should be given special training. It is strongly recommended that the infrastructure of the schools should be designed in such a way that ICT could be used successfully.

The government, parents teachers associations and private organizations should help equip the schools with ICT facilities.

REFERENCES

[1] Adolphus Telima (2019). The Aims and Purposes of Science Education: Social-Scientific Issues in the Science Curriculum in Nigeria. American Research Journal of Humanities & Social Science (ARJHSS) E-ISSN: 2378-702X Volume-02, Issue-07, pp-21-29

[2] Bell, R. L., & Smetana, L. K. (2008). Using computer simulations to enhance science teaching and learning. *National Science Teachers Association, 3*, 23–32.

[3] *Randy L. Bell and Lara K. Smetana (2012)* Using Computer Simulations to Enhance Science Teaching and Learning. International Journal of Science Education 34(9) J5

[4] Cann A. J. (2016). Increasing student engagement with practical classes through online pre-lab quizzes. Journal of Biological Education, 50(1), 101-112. doi:10.1080/00219266.2014.986182

[5] Gardner, A., Duprez, W., Stauffer, S., Ayu Kencana Ungu, D., Clauson-Kaas, F., & SpringerLink (Online service). (2019). Labster virtual lab experiments: Basic biochemistry. Berlin, Heidelberg: Springer Berlin Heidelberg.

[6] Geban O., Askar P., & Özkan I,. (1992). Effects of Computer Simulations and Problem-Solving Approaches on High School Students, The Journal of Educational Research, 86:1, 5-10, DOI: 10.1080/00220671.1992.9941821

[7] Hussain I. & Suleman Q. (2017). Article Effects of Information and Communication Technology (ICT) on Students' Academic Achievement and Retention in Chemistry at Secondary Level. Article DOI: 10.22555/joeed. v4i1.1058 Vol. 4 No. 1

[8] Jones, N. (2018). The virtual lab. Nature, 562(7725), S5-S7. doi:10.1038/d41586-018-06831-1

[9] Kleinert, R., Heiermann, N., Plum, P. S.,Wahba, R., Chang, D., Maus, M., . . . Stippel, D. L. (2015). Web-based immersive virtual patient simulators: Positive effect on clinical reasoning in medical education. Journal of Medical Internet Research, 17(11), e263.

[10] Kulik, L. (2002). The impact of social background on gender-role ideology. *Journal of Family Issues*, *23*, 53–73.

[11] Lean, J., Moizer, M., Towler, C. A. (2006). Active Learning in Higher Education, *Journal of Simulation and games,* 7(3), pp227-242.

[12] Mintz R (19193) Computer Simulations as A Learning Tool." All Answers Ltd. ukessays.com, November 2018. Web. 23 February 2020. <https://www.ukessays.com/essays/education/computer-simulations-as-a-learning-tool-education-essay.php?vref=1>.

[13] Obioma GO (2005) Emerging issues in mathematics education in Nigeria with emphasis on the strategies for effective teaching and learning of word problems and algebraic expression. J. issues Math. 8 (1), A Publication of the Mathematics Panel of the STAN, 1-8

[14] *Randy L. Bell and Lara K. Smetana (2012)* Using Computer Simulations to Enhance Science Teaching and Learning. International Journal of Science Education 34(9)

[15] Sowunmi, V. O. and Aladejana, F. O. (2013). Effect of Simulation Games and Computer Assisted Instruction on Performance in Primary Science in Lagos State Nigeria. *West East Journal of Social Sciences.* 2 (2), 117-122

[16] VanderMolen J, (2019). Exploring Virtual Science Labs Available at https://onlinelearningconsortium.org/exploring-virtual-science-labs/

[17] Williams B, Abel C, Khasawneh E, Ross L & -Jones T. (2016) Simulation experiences of paramedic students: a cross-cultural examination. Adv Med Educ Pract. X; 7:181–186. [PMC free article] [PubMed] [Google Scholar]