TEACHING AND LEARNING THREATENED IN NIGERIA: INNOVATIVE RESEARCH-BASED APPROACH TO THE RESCUE.

By

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Abstract

The 21st century teaching and learning has gone beyond chalk and board, teacher-centred, and mere memorization of facts and concepts. The whole system reform is undergoing innovative teaching and learning metamorphosis. This research examined the new research findings arising from the innovative teaching and learning research project sponsored internationally by Microsoft partners in learning. The research findings identified fostering communities of learning, learning by design, the neo-Piagetian central conceptual structures, web-based inquiry science engineering, cognitive tutors, direct instruction, higher order thinking skills, and knowledge building as innovative research-based approaches to teaching and learning. Secondary data was used to obtain information. On the whole it was recommended that Nigeria government should be among the policy partners in innovative teaching and learning research as Senegal is the only Africa nation that is a member; the Government should provide the enabling environment for innovative teaching and learning to kick-start in Nigeria, among others.

Keywords: Teaching, learning and innovative research based approach

Introduction

Teaching and learning is the backbone of academic excellence. It has become highly competitive in the 21st century as a result of integrating of educational technology into classroom. This is why Aduwa-Ogiegbaen (2016) asserts that the purpose of education in the 21st century is for teachers to prepare students with broader learning experiences that will enable them fit into the world of work. The researcher further stated that preparing students for the world of work today requires that students are prepared to meaningfully and purposefully use technology and media for creativity, and innovation, communication, research, and problem-solving.

Gagne in India Study Channel (2011) states that teaching is a form of interpersonal influence aimed at changing the behavior potential of another person. It also quoted Amidon as saying that teaching is an interactive process, primarily involving class room talk which takes place between teacher and pupil and occurs during certain definable activity. India Study Channel (2011) defines teaching as a process that improves the student's seeking level more easily and it might overcome any situation as an easy way. In the same vein Smith (2016) defined teaching as the process of attending to people's needs, experiences and

feelings, and making specific interventions to help them learn particular things. On the other hand, Bingham and Conner in Malamed (2016) define learning as the transformative process of taking in information that—when internalized and mixed with what we have experienced—changes what we know and builds on what we do. It's based on input, process, and reflection. It is what changes us. Also quoting Gagne learning is a change in human disposition or capability that persists over a period of time and is not simply ascribable to processes of growth.

Today's learning is beyond memorization of facts and procedures and these are not enough for academic success. This is why OECD (2008) states that educated workers need a conceptual understanding of complex concepts, and the ability to work with them creatively to generate new ideas, new theories, new products, and new knowledge. They need to be able critically evaluate what they read, be able to express themselves clearly both verbally and in writing, and understand scientific and mathematical thinking. They need to learn integrated and usable knowledge, rather than the sets of compartmentalized and de-contextualized facts. They need to be able to take responsibility for their own continuing life-long learning. In the same vein, PISA (2006) opines that school systems are not outstandingly successful in preparing students for the kinds of abilities and skills that build the foundation for life-long learning, hence the students need the 21st century skills that can stand the test of times.

It is imperative that students of today that are sometimes referred to as digital in their approach and thinking are living in the world through the filter of digital media such as smartphones, handheld gaming devices, PDAS, laptops, tablets, game consoles, television, and other digital devices. To be abreast with these devices, teachers need to acquire many digital skills such as processing skills, spreadsheet software, database, electronic presentation skills, video conferencing skills, web navigation skills, web collaboration skills, use of portable digital devices, use of interactive whiteboard, skills in using web 2.0 technologies, among others.

Today innovation is flourishing in the world around us in rapid technological advancement and in growth of knowledge-based economies around the world. There is no doubt that education is facing several critical gaps between the world that young people experience outside the classroom and the world within, between the skills that students learn in school and those they will need later in life and between those who have access to high-quality education and tools and those who do not (Innovation Teaching and Learning Research, 2011). It further stated that it is increasingly an accepted truth that education systems must evolve to meet the needs of the students and societies they serve, changing their mission from knowledge transmission to preparation for future learning.

Teaching has moved out of chalk and board to more complex knowledge integration. Linn, Clark, and Slotta (2003) opine that knowledge integration has four ways in which teaching can promote knowledge integration through:

i. Teaching needs to make science accessible. This is to facilitate that students can restructure, rethink, compare, critique, and analyze both new ideas and their established views. Making science accessible also means designing science content, but not necessarily simplifying the language or topic. It begins with the choice of good inquiry question, which should not be too broad but motivate students to study alternatives.
ii. Teaching should make thinking visible. This concerns the thinking of both the teachers and the students. The teacher should model scientific thinking to help students understand how problems are solved. For example, by means of simulations and visualization, the students should be prompted to report on their ideas, critique and analyze their progress, and reflect on the nature of science.
iii. Teaching should enable students to learn from others. When students learn from each other they encounter a broad range of views that help them develop personal criteria for decisions, and make their solutions comprehensible to others.

iv. Teaching should promote autonomy and life- long learning by engaging students in complex projects in which they practice critiquing, comparing, revising, rethinking, and reviewing their ideas. This helps them to contrast solutions, test potential connections, and solve novel, complex problems.

In order to make knowledge integration functional,Web-based Inquiry Science Engineering(WISE) was developed. WISE, according to Slotta (2004) is an internet-based platform for middle and high school science activities where students work collaboratively on inquiry projects, making use of information from the web. Linn et al (2003) added that Web-based Inquiry Science Engineering (WISE) projects are created by design teams that include teachers, technologists, pedagogy researchers, curriculum designers, as well as experts from science agency and museums. Linn et al (2006) further said WISE modules guide students with an inquiry map and use embedded assessments. This inquiry map guides students to articulate their ideas, test predictions, reflect on their progress, monitor and give feedback on each other's work.

Broek (2012) in OECD Education working papers No. 79 identified fostering communities of learning, learning by design, the neo-piagetian central conceptual structures, web-based inquiry science engineering, cognitive tutors, direct instruction, higher order thinking skills, and knowledge building as innovative research-based approaches to teaching and learning.

Innovative Research-Based Approaches to Teaching and Learning

Fostering Communities of Learning

To make learning more interesting and meaningful students should be allowed to have stake in determining what to learn and how to learn. This is why Mintrop (2004), Shulman and Sherin (2004) state that fostering communities of learning is a constructivist teaching model that emphasizes democratic, student-centred, and inquiry-based instruction oriented toward the development of higher-order understanding by means of complex, authentic tasks, collaborative scientific research, and reciprocal teaching. Fostering communities learning (FCL) emphasizes that the role of the teacher is to guide the students' discovery process towards the upper bounds of their zone of development (Brown, 1994). This role is apt because the teacher must guide the students' learning adventures with a good judgment of when to intervene and when to let students solve problems on their own.

Brown (1992) maintains that in practice, FLC principles of (individual responsibility, multiple zones of proximal development, ritual, familiar participant structures, community discourse, seeding, migration, and appropriate of ideas) learning by integrating the roles of students-as-learners and students-as-teachers with peer tutoring, cross-age tutoring, and techniques like so-called jigsaw puzzles. The aim of these activities according to Brown is that students act as self-reflective, critical teachers and practice plausible reasoning, explanation, analogy and comprehensive-monitoring during reciprocal teaching. The aim is also that students become co-investigators of their own learning, who feel in charge of their learning, as well as making students to create a deep disciplinary understanding. Brown (1994) further maintained that Fostering communities learning (FCL) emphasizes that the role of the teacher is to guide the students' discovery process towards the upper bounds of their zone of development. This role is apt because the teacher must guide the students' learning adventures with a good judgment of when to intervene and when to let students solve problems on their own.

In the same vein, Brown and Campione (1994) opine that FCL gives students much room for discovery and individual majoring, but at the same time the teacher intentionally directs activities towards relevant content and engineers the curriculum. Broek (2012) states that FCL is a constructivist approach in which teachers help students to discover important curricular concepts framed by the students' own ideas and questions. The researcher concluded that learning routines centre on learning by discovery and research, and prominently feature collaborative learning such as by reciprocal student-student teaching.

Learning by Design

Georgia Institute of Technology (n.d) defines learning by design as a project-based inquiry to science aimed at the middle school grades-6th through 8th. It is aimed at students to learn science content deeply and at the same time develop the skills and understanding needed to undertake solution of complex, ill-structured problems. In the same vein Kolodner, Crismond, Gray, Holbrook and Puntembakar (1998) and Kolodner (1992) opine that learning by design is an inquiry-based science learning programme with a focus on learning flexible transfer to new situations. It is also a case-based reasoning theory (Kolondner, 1992). Kolondner (1992) assumes that case-based reasoning is that reasoners naturally use their own experiences when they deal with unknown or uncertain information during problem solving. In such situations, reasoners try to recall similar previous experiences to find a way of interpreting the situation at hand. He assumed that previous experiences can help predict the effects of possible solutions and warn of potential problems.

Learning by design gives students the experience of doing science, asking questions and investigating, and applying what they have learnt to meet their goal. In this approach to learning, students learn key concepts more deeply than in a conventional classroom because they are applying these concepts. It also creates a connection between the student's own experiences, science, and the world around them. It motivates the students to learn by making the classroom more engaging. Students also learn life skills such as how to work as a team, how to make critical decisions (Georgia Institute of Technology, n.d)

Neo-Piagetian Central Conceptual Structures

Central conceptual structures are described by Case and Okamoto (1996) as networks of sematic nodes and relations that represent children's core knowledge. They believed that central conceptual structures transform during development from simple to increasingly complex forms, and influence knowledge acquisition by constituting upper limits of the child's processing capacities. Griffin (2004) believes that central conceptual knowledge structures define which concepts are central to performance. These should be taught, especially to children who may not have opportunities to acquire them on their own.

Central conceptual structures suggest that instructional designs should focus on knowledge that is central to competent performance, and make use of models of the manner in which learners typically construct knowledge over the course of development. Moreover, instruction should take into account that some children may not have had the necessary everyday experiences to develop crucial central conceptual structures, and should build on the precursor forms of understanding that students demonstrate at earlier ages (Broek, 2012).

Web-based Inquiry Science Environment (WISE)

In order to make knowledge integration functional, WISE was developed. WISE, according to Slotta (2004) is an internet-based platform for middle and high school science activities where students work collaboratively on inquiry projects, making use of information from the web. Linn et al (2003) added that Web-based Inquiry Science Engineering (WISE) projects are created by design teams that include teachers, technologists, pedagogy researchers, curriculum designers, as well as experts from science agency and museums. Linn eta al (2006) further said WISE modules guide students with an inquiry map and use embedded assessments. This inquiry map guides students to articulate their ideas, test predictions, reflect on their progress, monitor and give feedback on each other's work.

WISE projects can also incorporate Java applets, flash models, fora to facilitate online discussions, data collection, drawing, argument creation, resource sharing, branching, concept mapping and other built-in components. On the whole, Linn et al (2002) reveal that there are four ways in which teaching can promote knowledge integration. Teaching needs to make science accessible, makes teaching visible, enables students to learn from others and promotes autonomy and lifelong learning by engaging students in complex projects

in which they practice critiquing, comparing, revising, rethinking, and reviewing their ideas. This helps them to contrast solutions, test potential connections, and solve novel, complex problems.

Cognitive Tutors

Cognitive tutor is like a robot teaching technique to replace teacher in a learning environment. Supporting this claim, Lepper and Malone cited in Koedinger and Aleven (2007) opine that cognitive is high in interactive level and works similarly to a human tutor in supporting students. Anderson (1995) maintained that it is software that has the capability to observe and watch students solve problems while they are on the computer. He further stated that cognitive tutor (CT) is an A1-based system that uses real-time to guide students through a mathematics problem.

Cognitive tutor allows students to work independently without any interruptions if they are in correct path. This software provides step-to-step in-depth and explicit feedback instead of having the student to wait until he/she gets to the final solution to the problem (Koedinger & Aleven, 2007). In the same vein, Koedinger and Corbett (2006) emphasized that cognitive tutors accomplish two of the principal tasks characteristic of human tutoring, which is monitoring the student's performance and providing context-specific individual instruction, and monitoring the student's learning and selecting appropriate problem-solving activities. Broek (2012) summed up to say that cognitive tutors are intelligent software programmes that provide students with scaffolding, feedback, and assistance, adapted to the individual students' needs. The programmes are based on models of typical learning trajectories and typical misconceptions, which describe learning paths of successive sub-goals and production-rules.

Direct Instruction Teaching Method

It is generally believed that direct instruction involves interaction between the students and teacher in the teaching learning process. However the term encompasses a wide variety of fundamental teaching techniques and potential instructional scenarios like presenting a video or film to students could be considered a form of direct instruction even though the teacher is not actively instructing students, the content and presentation of material was determined by the teacher. The Glossary of Education Reform (n.d) refers to direct instruction as instructional approaches that are structured, sequenced, and led by teachers, and the presentation of academic content to students, such as in a lecture or demonstration.

Wikipedia (n.d) defines direct instruction as a general term for the explicit teaching of a skill-set using lectures or demonstrations of the material to students. Direct instruction relies on a systematic curriculum design, delivered by implementation of a prescribed behavioural script on the premise that all students can learn and all teachers successfully teach if given effective training in specific techniques, teachers may be evaluated based on measurable student learning.

Adams and Engelmann (1996) state that the basic assumptions of direct instruction are that students can process information that is given to them and abstract features from examples, students generalize on the basis of similarities of features of different examples in logical way, what students learn is consistent with the teaching they receive, and students' memory and features abstraction capacity improves with practice. The content of direct instruction is organized around general ideas and skills that enable students to later go beyond the items taught and apply their learning in new situations. This includes basic skills as well as higher-order thinking skills such as cognitive strategies to solve problems (Stein, Carnine & Dixon, 1998)

Higher Order Thinking Skills (HOTS)

For learning to be more meaningful, students should go beyond mere memorization of facts and concepts. This is why Thomas and Thorne (2009) stated that higher order thinking is thinking on a level that is higher than memorizing facts or telling something back to someone exactly the way it was told to you. Higher order thinking according to them is taking thinking to higher level than restating the solutions as facts and

concepts, categorize them, manipulate them, put them together in new or novel ways, and apply them as new solutions are sought to new problems.

Wikipedia (2018) quoting Anderson and Krathwohl stated that higher order thinking involves the learning of complex judgmental skills such as critical thinking and problem solving. HOTS is more difficult to learn or teach but also more valuable because such skills are more likely to be usable in novel situations. In the same vein, Pogrow (1995) defined HOTS as a compensatory programme for educationally disadvantaged students in grades 4 to8 that teaches general thinking skills through Socratic dialogue. The approach is based on the assumption that thinking requirements of content-learning increase strongly after grade 3, so that students who lack practice of sophisticated thinking and an understanding of understanding inevitably fall behind.

Pogrow (1995) added that the purpose of HOTS is to help the disadvantaged students develop complex thinking skills so that they can better follow regular classes. He concluded that one of the key premises of HOTS is that most students fall behind not because they are not bright enough but because they lack the socio-cultural experiences that develop meta-cognitive skills, for example, because their parents do not engage them in argumentative discussions that are necessary to develop sophisticated reasoning skills.

Knowledge Building (KB)

For learning to have a long lasting legacy, stake holders in education must rob minds to achieve the desired results. Scardamalia and Bereiter (2003) refer knowledge building as a process of creating new cognitive artifacts as a result of common goals, group discussions, and synthesis of ideas. These pursuits should advance the current understanding of individuals within a group, at a level beyond their initial level of knowledge, and should be directed towards advancing the understanding of what is known about that topic or idea.

In the same vein, Bereiter, Scardamalia, Cassells and Hewitt (1997) stated that knowledge building is a deep constructivism that involves making a collective inquiry into a specific topic, and coming to a deeper understanding through interactive questioning, dialogue, and continuing improvement of ideas. The teacher becomes a guide, rather than a director, and allows students to take over a significant portion of the responsibility of their own learning, including planning, execution and evaluation. In sum Scardamalia (2002) identified the following as principles of knowledge building: In the classroom as a knowledge building community, learners are concerned with understanding, based on their real problems in the real world; students' ideas are regarded as improvable objects; in the classroom, the diversity of ideas raised by students is necessary; through a sustained improvement of ideas and understanding, students create higher level concepts; students themselves find their way in order to advance; students' contribution to improving their collective knowledge in the classroom is the primary purpose of the KB classroom; all individuals are invited to contribute to the knowledge advancement in the classroom; a goal of for knowledge building communities is to have individuals and organisations actively working to provide a reciprocal advance of their knowledge; students contribute to collective knowledge building; all members, including the teacher, sustain inquiry as a natural approach to support their understanding; students are engaged in discourse to share with each other, and to improve the knowledge advancement in the classroom; and students take a global view of their understanding, then decide how to approach their assessments. They create and engage in assessments in a variety of ways.

Conclusion

Today's school is moving from the old order of chalk and board, teacher-centred learning. Preparing students for the world of work today requires that students are prepared to meaningfully and purposefully use technology and media for creativity, and innovation, communication, research, and problem-solving. The challenge of teaching today include digital divide, inadequate technology funding, over reliance on teacher-

centred teaching approaches, lack of skills in the use of technologies, inadequate infrastructure and teachers' fear of being replaced by technological gadgets like robot.

It is in literature that many innovative approaches are now taking the centre stage in teaching and learning processes. These include fostering communities of learning, learning by design, the neo-Piagetian central conceptual structures, web-based inquiry science engineering, cognitive tutors, direct instruction, higher order thinking skills, and knowledge building as innovative research-based approaches to learning and teaching.

Recommendations

From the research findings and conclusion drawn, the following recommendations are made:

i. Nigeria government should be among the policy partners in innovative teaching and learning research. Senegal is the only Africa nation that is a member.
ii. The Government should provide the enabling environment for innovative teaching and learning to kick-start in Nigeria.
iii. Teachers should be trained in the use of new technology in teaching and learning.

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