CREATIVITY AND INNOVATION IN TEACHING: DEVELOPING MULTIMEDIA SKILLS IN A PROBLEM-BASED LEARNING INTEGRATED SCIENCE CLASSROOM IN COLLEGES OF EDUCATION IN NIGERIA

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Abstract

Teaching and learning subject content without teaching the learner basic skills that will enable the learner excel in the real job situation has been the major problem of teacher education in Nigeria. Students studying integrated science at the College of Education level need to know not only the course content/ but also should know how to create and develop multimedia instructional material in their area of specialization. Presently, traditional teaching approaches have resulted in a mismatch between what is taught to the students and what the employers need. This paper is focused on developing multimedia technology as an innovative teaching and learning strategy in a problem-based learning in an Integrated Science classroom by giving the students a multimedia project to train them in this skill set. This multimedia-oriented method, like many other problem-based learning solutions, can be used alternatively as an innovative and effective tool in a problem-based learning classroom for the acquisition of problem-solving skills among graduates of Integrated Science in Colleges of Education.

Keywords: Problem-based learning, Interactive Multimedia, Integrated Science, Teamwork, Problem-solving, Teaching.

One of the major concerns of many developing countries today is that there is a mismatch between graduates' skills acquired from tertiary institutions and the skill sets needed by the employers. Many of the current graduates of Colleges of Education are found to be lacking in creativity, communication skills, analytical and critical thinking, and problem-solving skills which are important skills required in a teacher today. As such, there is much need for Colleges of Education in Nigeria to focus on

training future graduates to be more adaptable to the needs of the schools that will employ them.

Presently, many institutions are moving towards problem-based learning as a solution to producing science-oriented graduates who are creative and can think critically, analytically, and solve problems. Since knowledge is no longer an end but a means to creating better problem solvers and encourage lifelong learning, problem-based learning is becoming increasingly popular in educational institutions as a tool to address the inadequacies of traditional teaching. These traditional approaches do not encourage science students to question what they have learnt or to associate with previously acquired knowledge (Wong, 2000). Problem-based learning is seen as an innovative measure to encourage students to "learn how to learn" via "real-life" problems (Boud & Feletti, 2004).

Teaching Integrated Science students how to develop and use multimedia technologies to create a multimedia-oriented lesson will help to develop the students' ability to become creative and critical thinkers and analyzers, as well as problem-solvers, within a multimedia-mediated problem-based learning (PBL) classroom. This learning mode is constructivist in approach whereby the students of Integrated Science participate actively in their own learning process and construct their own knowledge and skill (Babajide and Bolaji, 2003).

Multimedia, defined, is the combination of various digital media types such as text, images, sound and video, into an integrated multi-sensory interactive application or presentation to convey a message or information to an audience. In other words, multimedia means an individual or a small group using a computer to interact with information that is represented in several media, by repeatedly selecting what to see and hear next (Nkweke, 2010).

Multimedia is changing the way we communicate with each other. The way we send and receive messages is more effectively done and better comprehended. The inclusion of media elements reinforces the message and the delivery, which leads to a better learning rate. The power of multimedia lies in the fact that it is multi-sensory, stimulating the many senses of the audience. It is also interactive, enabling the end-users of the application to control the content and flow of information (Bartsch, 2009). This has introduced important changes in our educational system and impacted the way we communicate information to the learners (Nkweke, 2010)). The evolution of multimedia in science-oriented subjects like Integrated Science has made it very possible for learners to become involved in their work. With multimedia technologies, they can create multimedia applications as part of their class assignments. This would

make them active participants in their own learning process, instead of just being passive learners of the subject content.

Advantages of Using Multimedia in an Integrated Science Classroom

According to Onyegegbu (2006), using multimedia in science teaching and learning has the following advantages:

Motivation – This is important as we have learned that we must first engage the attention of our students before they are ready to learn especially in Integrated Science where the learners feel that the concepts are very difficult to understand.

Learning styles addressed – Multimedia allows Integrated Science teachers to address various learning styles in the classroom. Students can see, hear, and imagine what things feel like as multimedia is used to bring a subject to life.

Technology standards addressed – Technology is an important aspect of life today. Students must be ready to compete in a highly technological world especially in using them in teaching and learning.

Access to limitless resources for teaching and learning – Teachers are no longer limited to textbooks as vast amounts of knowledge and teaching ideas may be explored especially in integrated science which covers all aspects of science.

Student centered learning – Students will show accountability for learning when collaborative activities or project based learning is implemented through technology, hence the need to allow them create the software themselves.

Problem-solving - The Need to Develop multimedia Lesson in the Integrated Science Classroom

The move towards using problem-based learning in Nigerian Colleges of Education has resulted in a shift in the curriculum model. The focus is moving from content towards problems to provide a more realistic approach to learning and to create a teaching methodology which emphasizes real world challenges, higher order thinking skills, multi-disciplinary learning, independent learning, teamwork and communication skills via a problem-based learning environment (Tan, 2000). However, this model can be further strengthened with the inclusion of multimedia technology into this problem-based learning environment to enhance the students' learning experience. This reinforced model is illustrated in Figure 1.

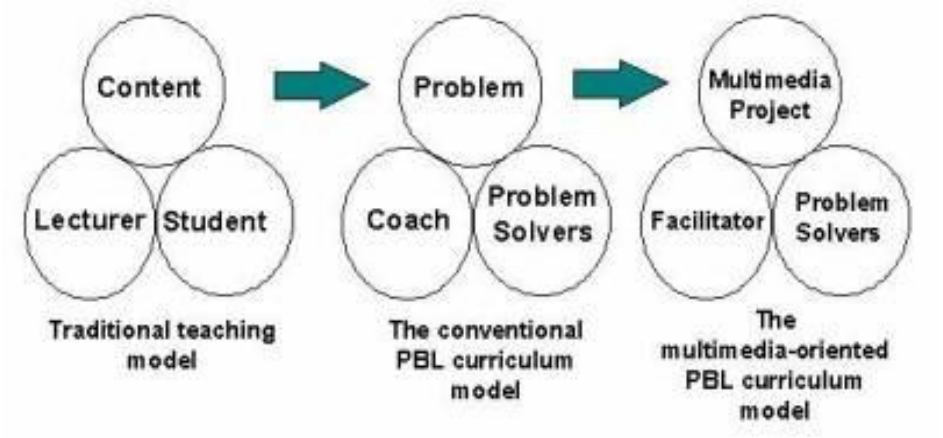

Figure 1. The multimedia-oriented Problem-Based Learning curriculum model (Tan, 2000).

With the use of multimedia, students can utilise the knowledge presented to them by the lecturer, and represent them in a more meaningful way, using different media elements. These media elements can be converted into digital form and modified and customised for the lesson. By incorporating digital media elements into the project, the students are able to learn better since they use multiple sensory modalities, which would make them more motivated to pay more attention to the information presented and better retain the information.

Creating multimedia is both challenging and exciting. Fortunately, there are many multimedia technologies that are available for developers to create these innovative and interactive multimedia applications (Vaughan, 2010). These technologies include Adobe Photoshop and Premier to create and edit graphics and video files respectively, SoundForge and 3D Studio Max to create or edit sound and animation files, respectively. They can also use an authoring tool such as Macromedia Director or Authorware to integrate and synchronise all these media elements into one final application, add interactive features, and package the application into a distributable format for the end-user. Another advantage of creating multimedia in the classroom setting is that when students create multimedia, they tend to do this in a group environment. By working in a group, the students will have to learn to work cooperatively and collaboratively, using their group skills and a variety of activities to accomplish the project's overall objectives.

As stated by Dike (2008), Student-created multimedia are beneficial, because they often involve substantial work, open-ended assignments, lesson-based activities, and knowledge and experiences that the students draw from a wide variety of sources.

The ability of an integrated science student to create and develop multimedia of plant cells, human anatomy, reproductive organs of plants and animals, etc, will serve as an added advantage to both what the student is to learn and what the student will be after graduation as a science teacher. Multimedia-oriented lessons are a way for students to achieve high self-esteem, to increase their ability to function as self-directed learners, to learn to think effectively, and to practice problem-solving and decision-making in integrated science.

Therefore, developing and using multimedia in the teaching and learning environment enables students to become critical thinkers, problem-solvers, more apt to seek information, and more motivated in their learning processes. Multimedia is slowly gaining ground as a way for students to represent the knowledge that they acquire in class and to construct their own interpretation of the information acquired. It also fosters collaborative and cooperative learning between and among students, thus better preparing them with a skill set for real-life work situations in integrated science.

Structuring of Interactive Multimedia Class in Integrated Science

An integrated science class can be structured toward creating a problem-based learning classroom environment for the students in a multimedia design context in order to harness their abilities to use and appreciate media effectively when representing various pieces of information to convey a message to the class. Thus, by designing a multimedia application that is multi-sensory and interactive, the students are challenged to learn more about integrated science concepts and to develop their abilities to analyse and draw conclusions from it. Some of the goals for a multimedia project that were adapted from Agnew (2010) for use in the class include the following:

Higher-order thinking skills: Here the students are required to present their information appropriately and effectively. They are also required to select the appropriate media and to use them effectively in conveying their lesson. Example, in teaching plant cells, microscope can be used to enlarge the cells, create the enlarged cells into slides which will be used in teaching the topic through an overhead projector or an electronic interactive white board.

Group and interpersonal skills: This goal requires that the students work successfully in a group and with members of their groups in class and interacting with people outside of the classroom environment. This is especially true when the students have to use multimedia, since multimedia is better used in a small class situation especially in a science-oriented subject.

Content and discipline: This requirement enables the student to learn significant facts and concepts in the multimedia discipline as well as integrated science topics. The students can also familiarise themselves with the vocabulary of multimedia and integrated science, its terms and interpretations.

Technical skills: No multimedia is complete without the use of multimedia software technology. Here the students will learn about creating multimedia software and acquire skills on how to use them in teaching integrated science. These interactive links will work alongside the display of integrated science lessons in multimedia form, using text, graphics, sound, video and animations in an effective manner.

With the above creative and innovative skills, a graduate of integrated science in Nigerian College of Education will be better equipped with not only the knowledge of the course, but also with the ability to create instructional materials (multimedia) for teaching process. This includes deciding on the multimedia hardware and software, what is involved in creating a multimedia for each lesson, how media elements are gathered and modified, the creation of the presentation interface, and the use of interactivity in a multimedia presentation.

Introducing Multimedia Development Strategy in an Integrated Science Class

As science educators, we know how important critical thinking and new technology skills are in the scientific community. The ability to question and make sense of the world around us is a skill we value highly in the scientific world. We recognize that if our students are going to become the next scientific innovators and responsible citizens, they need, more than ever, skills to gather and evaluate data, make informed decisions, and communicate their ideas to others. As with scientific literacy, media literacy and other 21st century skills are grounded in inquiry, critical thinking, evaluation and communication. We also understand that our students are growing up in a world increasingly saturated with information and media messages. Students will need to become media literate and well versed in the many modes of communication that surround them if they are to sort through this information. There is no better place to learn these skills than in the science-oriented classroom.

Although multimedia as a tool cannot replace hands-on learning, it can enhance and strengthen the impact of activities in the field and in the integrated science classroom. Lecturers can use new information tools, such as podcasts, blogs, and streaming video and audio, to engage students and effectively demonstrate integrated science concepts as well as to reinforce media literacy technologies.

Lecturers can also engage students with digital media tools, such as photo-sharing, video-publishing and map-making programs, to give them opportunities to

demonstrate their mastery of a concept in integrated science and simultaneously reinforce their literacy skills by having them create their own content.
According to Babajide and Bolaji (2003), the development and use of multimedia resources as part of a core science curriculum can:

1. Visually demonstrate scientific ideas and concepts.
2. Instil a sense of wonder and excitement in students about the world around them.
3. Present local, relevant case studies.
4. Provide examples of real people practicing science.
5. Generate student interest in science careers.
6. Promote 21st century skills, including critical thinking, problem solving and communication skills.
7. Provide a common experience shared by all students

As Lecturers adapt teaching strategies to better replicate the tools used by the scientific community, they should enhance students' ability to envision themselves within it and nurture the skills they will need to be active participants in their own lifelong teaching and learning career.

Steps for Introducing Multimedia Development Strategy in an Integrated Science Class

Planning the development: The first stage in a multimedia development process is to come up with a scheme of work, example: the characteristics of living things. This scheme of work will define the scope of the final multimedia application (pictures, slides, video, etc), the targeted student (junior secondary) and the presentation (Microsoft PowerPoint). After introducing the general lesson objective to the class by the Lecturer, the students have to submit a lesson proposal outlining their topic of choice from the scheme of work and the team members and their specific functions. Upon the groups' lesson plan approval by the Lecturer, the team then will have to create a storyboard (lesson note). In their storyboard (lesson note), the group will outline the specific interfaces of each screen, the media elements to be used and the information that is to accompany the screen design. They also have to outline the type of interactivity that they are going to use in each screen and their navigational structure. Each screen of the application will be sketched and the entire storyboard will be submitted on paper.

It is also at this stage that the groups elect their group leader. The group leader would be responsible for providing the direction and objectives for the final presentation and to moderate any disagreements that may arise from the group's discussions. The groups will meet and discuss their presentation outside of class times. After, each group will give a short presentation and a brief summary of their lesson in the class.

Acquiring the resources: At this stage of the multimedia project development, materials have to be gathered from the application's sources to be used as information. To be able to assemble the various media elements for the final multimedia development, the groups have to collect materials from the various sources of their topics. These materials range from brochures to product information, to photographs taken at the respective sites showing living things, to video footage shot at the sites themselves. The media materials assembled are usually in analogue format. This means that they are collected in their raw state and not yet ready to be processed in the computer. The collection of materials at this stage is critical because the groups have to make sure that they have enough materials for use in their multimedia presentations. Therefore, their brainstorming and planning stage prior to this provides them with their direction and objectives for the lesson. The acquisition of the materials thus requires the groups to visit the sites of their topics, and collect materials on the topic.

Converting the media elements to digital: After all the materials have been collected and assembled in their raw analogue state, they have to be converted into a standard digital format in order for the computer to be able to process them. This would entail using scanners to convert images and graphics, and digitising any analogue video footage into digital movie clips. These files are then saved as appropriate media formats and stored in the computer for presentation. For example, images are scanned and stored as JPEG (Joint Photography Experts Group), GIF (Graphic Interchange Format), or BMP (Windows Bitmap) files, and digital movie clips are stored as AVI (Audio Video Interleave) or MOV (Quicktime Movie) files.

Editing or creating media: Once the media elements have been digitised and stored in the computer, they can then be edited or modified in software packages (powerpoint). In these packages, the media elements are modified to include special effects and filters to further enhance its look and perspective. Many chose to use Adobe Photoshop for this purpose. Adobe Photoshop is a sophisticated image-editing tool that is popularly used to modify and edit digital images. Other media elements like animations are digitally created in animation software like Macromedia Flash and 3D packages like Kinetix 3D Studio Max.

Multimedia authoring: Authoring is the stage where all the media elements that have been created or modified and stored digitally in the computer are brought together into one final application and integrated into a cohesive presentation for the purpose of conveying a specific message to the audience. It is also at this stage that elements of interactivity and navigation are incorporated to involve the user in the application and to create a multi-sensory experience.

Macromedia Director is chosen to be the primary authoring tool for most science-oriented subjects. Director is currently the de facto authoring tool for creating

interactive multimedia applications such as plants, animals, interactive applications, and multimedia presentations.

Packaging for delivery: Multimedia applications inevitably have large file sizes. Therefore, they cannot be accommodated by floppy disks, but by multimedia-capable optical storage devices. Packaging involves the physical packaging of the application and saving it onto an optical storage device. Thus, as the final step in their multimedia project development, students have to create a standalone application and "burn" their application onto a CD-ROM. A standalone application is a self-executing file that, when clicked, can be played back on an end-user's computer without a helper software programme (i.e., the authoring tool, or Director, in this case).

Assessment criteria: At the end of the class presentation by all groups, the groups submit their final developed multimedia on CD-ROM together with a copy of their storyboard (lesson note) and lesson topic. According to Teo and Wong, (2000), the students will be assessed on the following criteria:

Originality: How original or creative is their concept?

Critical thinking: How well are they able to convert their concept of their topic on the storyboard (lesson note) into the final CD application? Was it well thought out?

Use of media: How successful were they in their use of media elements to represent their ideas?

Presentation: How well was the material presented?

Cohesion of application: How consistent were the digital materials used with the message to be conveyed.

Team work: How did the team work together to produce the application? Did everyone perform their specific functions?

Conclusion

This paper has presented and discussed how to introduce multimedia skills in a problem-based learning integrated science classroom in Colleges of Education in Nigeria in order to equip students with high-order thinking and problem-solving skills and to enable them to experience an IT-oriented learning situation. For a student of integrated science in a College of Education, it is not learning the course content that matters most but developing perfect teaching skills that can enable them to impact the integrated science content to their would be students after graduation. Hence, to conclude that by integrating multimedia into the teaching and learning process, the conventional PBL curriculum model is reinforced and strengthened and a multimedia-oriented PBL curriculum model can be instituted.

The introduction of multimedia in integrated science will enable the students to exercise their creative and critical thinking skills in solving teaching and learning problems, work collaboratively to gain team-based experience, and to face the real-life situation of problem-solving wherever they may be employed to teach integrated science. The role of the lecturer, on the other hand, changes from the "sage on the stage" to a "guide on the side," assisting the students in the construction of their knowledge and skill.

As such, the use of multimedia technology and project are innovative and effective teaching and learning strategies because they motivate the students in their learning process and help them to acquire good problem-solving skills. As evidenced by this project, students become very active participants in their learning process instead of being passive learners, and will be able to use various digital media elements to accomplish their class work.

Recommendations

Based on the conclusion of the paper, the following recommendations are hereby offered:

1. Integrated science lecturers in Nigerian Colleges of Education should be trained and equipped with multimedia facilities because a general science course like integrated science requires such media that touches all the sense of learning.
2. Government both state and federal should procure MM devices and distribute to all the Colleges of Education in Nigeria.
3. The integrated science lecturers should de-emphasize the use of "chalk-talk" method of instructional delivery since that method is obsolete and bearing in mind that we are now in information technology age.
4. Integrated science lecturers should frequently use MM during instructional development, especially when it is inevitable.
5. Government at all level should provide Colleges of Education with electrical power supply or stand-by generators to aid the use of MM equipment.
6. Integrated science lecturers should be innovative and use modern MM equipment during instructional delivery in order to motivate students' interest in learning, support and reinforce learning, accommodate individual learner's peculiarities, increase students' access to learning, provide students with multiple channels of communication, encourage mastery learning and develop a skill that will make them good teachers in the present IT age.
7. Occasionally, the College authorities should invite specialists (educational technologists, instructional material technicians, computer experts, etc.) to assist the integrated science lecturers on how to develop and use MM packages that are relevant to the subject.

8. The integrated science lecturers should organize fieldtrips for students to visit places where MM equipment are available so that they can learn from the experts on how to develop and use such devices in the process of teaching and learning.

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