The Design and Development of a Multimedia Learning Object on the Use of Google Earth to Teach Concepts in Secondary School Geography

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Abstract

The developments in information and communication technology (ICT) that simplify the performance of disciplinary tasks has impacted positively on the teaching and learning of concepts in secondary school geography. But lack of digital skillfulness amongst secondary school teachers remains an impediment to the exploration of the benefits of ICT integration in teaching and learning of secondary school geography. The ADDIE instructional design model can be used to analyse tasks involved in use of the Google Earth digital application software to teach the concept of vegetation in secondary school geography. Guided by the cognitive theory of multimedia learning and the associated multimedia principles, the multimedia training programme for teachers on the use of the Google Earth software to teach the concept of vegetation in secondary school geography is critical, hence this paper suggested that the analysis, design and development activities of the generic ADDIE instructional design model be strategically adopted and applied in developing multimedia training objects for secondary school Geography teachers on the use of Google Earth app in teaching the concept of vegetation in secondary school Geography.

Keywords: Google earth software, Multimedia learning, Vegetation, Geography, ICT integration

The Introduction

Geography education plays a vital role in equipping students with a deep understanding of the world around them, fostering spatial thinking, and developing critical analytical skills. In today's digital age, Information and Communication Technology (ICT) offers numerous opportunities to enhance geography instruction, engage students, and facilitate meaningful learning experiences. However, many geography teachers face challenges in effectively integrating ICT into their teaching practices due to limited proficiency, insufficient training, and a lack of awareness of the available tools and resources.

ICT encompasses a wide range of technologies, including Geographic Information Systems (GIS), online mapping tools, virtual globes, interactive simulations, multimedia resources, and geospatial data sources. These tools can transform traditional geography lessons into dynamic and interactive experiences, enabling students to explore, analyze, and understand complex geographical phenomena in new and exciting ways. Additionally, ICT facilitates collaboration, data visualization, and access to real-time information, empowering students to become active participants in their learning journey.

A pilot survey of digital skills capacity of secondary school teachers in Rivers State revealed that most of the teachers do not have access to personal computers. And majority of the teachers also lack the requisite digital knowledge and skills required to apply digital devices into teaching tasks (Okoli & Wagbara, 2016). Most regretful is that they have failed to make efforts to migrate into digital citizenship; preferring to remain "non-migrants" in a world that thrives in digitalization. But the benefits that accrue from the application of digital tools in teaching of geography especially the prospects of immersing the learner in the context of learning matter with three-dimensional real life geographic objects makes it mandatory that teachers be encouraged to explore the provisions of digital resources and the associated learning affordances for the achievement of educational objectives.

One digital resource that comes handy for teaching of geography concepts is the Google Earth. Google Earth is a software application developed by Google that provides a virtual representation of the Earth. It allows users to explore the Earth's surface in the 3D environment, view maps, and manipulate geographic data. The 3D model of the Earth, which users can rotate and zoom in and out to view different parts of the world.

Also, the combination of maps and high-resolution satellite imagery to provide detailed views of locations around the world, from entire continents to individual buildings.

To harness the full potential of ICT in geography education, it is therefore essential to provide teachers with the necessary knowledge, skills, and pedagogical strategies. This requires comprehensive professional development programs specifically designed to address the integration of ICT tools and methodologies into geography instruction. By empowering teachers to leverage ICT effectively, they can create engaging learning environments that cater to diverse learning styles, foster critical thinking and problem-solving abilities, enhance students' digital literacy skills as well as overall learner achievement.

The design of instruction and the cognitive theory of multimedia learning

In the task of development of multimedia training programme for secondary school teachers on the use of Google Earth digital software to teach concepts in Geography, the generic

ADDIE instructional design (ID) model and Mayer's Cognitive theory of multimedia learning (CTML) readily comes to the fore. The ADDIE (Analysis, Design, Development, Implementation and Evaluation) instructional design (ID) model provides a guide for due analysis of the tasks that the teacher would perform, the development, implementation and the evaluation stage to ascertain that the preproduced multimedia training programme is duly equipped to accord the teacher the appropriate knowledge and skills to apply the Google Earth digital software in teaching concepts in Geography. The cognitive theory of multimedia learning provides guiding strategies for combining visual and audio sensory information as appropriate for the development and production of the multimedia training objects for the teachers.

The Google Earth digital software

The Google Earth digital app is a type of digital globe that finds application in complex tasks like land management, visualization of landscapes as well as disaster management. These geography related tasks present the Google Earth as a cogent instructional tool for learning of geography subject matter in institutional settings (MacEachran & Kraack, 1997). The Google Earth technology applies the principle of visualization to "link science, technology, computer science and applied visual art in designing systems that can translate huge amounts of quantitative data into digital graphic images. (Yair, et al., 2003:44). It utilises visual communication and the process of observation to facilitate teaching and learning of concepts in Geography and Cartography (Yair et al, 2003:44). And the most important reason for instructional application of the Google app in Geography is the three-dimensional visualization capacity (Schroth et al, 2015) However, challenges of didactic application of Google Earth as observed by Osaci-Costache et. al, (2024) include: Poor internet connectivity, lack of personal computers in the respective faculty and students' reluctance. But the advantages include: high landscape visualization capacity, facilitation of the understanding of geography concepts and the free access to students

Task analysis: Task analysis is the deeper level of job analysis that is undertaken to identify the basic skills and knowledge required to perform a job (Jonassen et al., 1999). The process of task analysis is systematic and it leads to identification of the instructional content that should equip the task performer with the knowledge, skills and attitudinal (KSA) abilities required to perform the tasks effectively. In the words of Lee and Owen (2004) "task analysis is undertaken in response to the question; what do you need to know to perform your job well?

Task analysis therefore reveals the elements of knowledge required for competent performance of job tasks. These elements of knowledge present as facts, concepts, processes, procedures and principles. They require the use of different types of media objects for effective communication of the content to the task performer. A factual element of knowledge can be communicated with still photograph while the process and procedural knowledge require video media. But the element of knowledge of a principle is elucidated with simulated visuals while the conceptual knowledge matter requires the provision of audio narratives that explains the accompanying visual objects.

Justification

In the rapidly advancing digital era, there is a pressing need to equip geography teachers with the necessary skills and knowledge to effectively integrate Information and Communication Technology (ICT) into their teaching practices. While ICT offers immense potential to enhance geography education, many teachers lack the proficiency and training to harness its full benefits (Jones et al 2023). This knowledge gap hinders teachers from effectively utilizing digital tools, resources, and platforms to create engaging and interactive learning experiences for students. Therefore, the problem is to design a comprehensive training program that equips geography teachers with the necessary ICT skills, strategies, and pedagogical approaches to effectively incorporate technology into their geography lessons, fostering students' understanding, engagement, and critical thinking in the subject matter.

Furthermore, the rapid advancement of technology and the constant emergence of new digital tools present an ongoing challenge for geography teachers to stay updated and adapt their teaching methodologies accordingly (Liu et al., 2021). Consequently, teachers face difficulty in navigating the ever-evolving digital landscape and struggle to effectively leverage ICT to enhance student learning outcomes in geography.

And so, there is the need to design and implement a comprehensive training program that addresses the specific needs of geography teachers in utilizing ICT tools, resources, and platforms effectively. This program aims to equip teachers with the necessary knowledge, skills and pedagogical strategies to integrate ICT resources into their geography lessons in order to foster students' engagement, critical thinking, and the acquisition of geographical knowledge (Jones et al., 2023; Kim & Lee, 2022). By addressing this problem, the training program seeks to bridge the existing gap and empower geography teachers to leverage the potential of ICT for enriching geography education in the digital age. The study shall design and develop a multimedia training object to equip secondary education teachers with the

knowledge and skill to apply the Google Earth software in teaching the concept of vegetation and the vegetation types in Nigeria.

The study hereby constitutes a procedural guide for trainers and developers of professional development training programmes for teachers on the application of digital resources in the performance of instructional tasks.

Aim and objectives

The study shall equip teachers with the knowledge and skill to utilize Google Earth to explore and visualize Nigeria's vegetation patterns for enhancement of geography students' understanding of the vegetation types that abound in the different regions of the country.

In teaching the pattern and types of vegetation in Nigeria to secondary school students, the teacher shall enable he students to:

1) Identify the different types of vegetation in Nigeria
2) Ascertain the geographical regions where various vegetation patterns abound
3) Utilise google map to explore and visualize the vegetation patterns in Nigeria.
4) Gain awareness of the value of each vegetation type to the nation

Objectives of the training program

To perform the stated instructional tasks, the preproduced multimedia learning object would equip the teacher with the capacity to:

1) Identify relevant digital devices for ICT integrated teaching/learning
2) Set up a multimedia projection system
3) Boot a computer system
4) Undertake screen clicks to:
    - Open Google Earth app
    - Zoom into the vegetation patterns of any country
    - Add vegetation data.
1) Explain the concepts of vegetation density, vegetation pattern and vegetation type.

Discussion

Teacher's duty: Use Google Earth to teach the concept of vegetation patterns in secondary school geography.

Teaching tasks performed with Google map:

1) Set up a multimedia projection system with Google app installed in the computer
2) Open the Google Earth app, search for the map of Nigeria and zoom into the different vegetation regions.
3) Add vegetation data layer to visualize vegetation patterns

4) Explore different vegetation regions of Nigeria. Analyse the vegetation patterns by density and type of vegetation, and explain with appropriate narrative for learner understanding.
5) Use tools and features for measuring distance and time animations to facilitate enhanced learner insight into Nigeria's vegetation patterns

Required materials.

1) Multimedia projector and projection screen
2) Computer system with internet connection and Google Earth installed.
3) Digitized map of Nigeria
4) Hand out with key information on Nigeria's vegetation

Evaluation

To evaluate students' achievement the teacher would require them to:

1) Explain the concept of vegetation.
2) Use Google Earth to locate the regions of the three major types of vegetation in Nigeria
3) Draw the map of Nigeria, showing the vegetation belts
4) Discuss the economic values of the different types of vegetation to Nigeria.

Conceptual clarifications

Vegetation refers to a group of plants growing together in a particular habitat, possessing certain general physical appearance which arise from different sources of plants ( ). The three major types of vegetation found in Nigeria are:

1) Forest vegetation
2) Savana vegetation
3) Montane vegetation

Table 1: Table of Different geographical regions of Nigeria and the prevalent vegetation types

S/N	Vegetation Type	Region	State
01	Tropical rain forest	Southern part of Nigeria	Cross River, Rivers, parts of Ondo, Edo and Delta
02	Guinee Savana	Central part of Nigeria	Benue, Kogi, Niger, Taraba and Plateau
03	Sudan Savana	Northern Nigeria	Sokoto, Kebbi, Katsina, part of Zanfara, Jigawa and Yobe
04	Sahel Savana	Extreme Northern Nigeria	Part of Borno, Yobe and Sokoto
05	Mangrove swamp	Coastal area of Niger Delta	Bayelsa, Delta, Rivers

Table 2. Table of tasks, content type elements, knowledge requirements and media

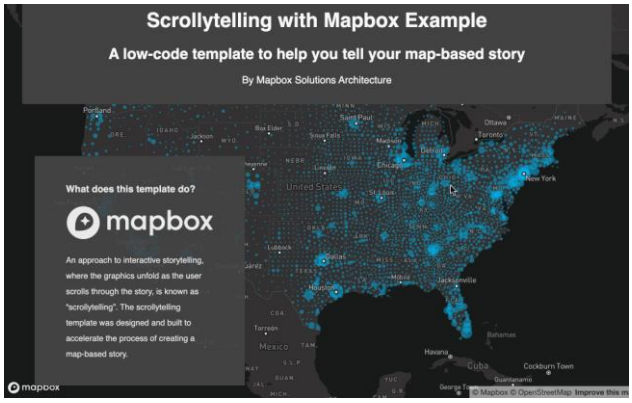
S/N	TASKS/SUB TASKS	CONTENT TYPE ELEMENTS	KNOWLEDGE REQUIREMENTS	MEDIA FORMATS
01	Set up multimedia projection system. Identify devices and components. Set up the screen with Cables and linkages	Procedural Factual Factual Procedural Procedural	Laptop Multimedia projector Screen Zoom, Focus, Electric power sourcing Screen/Projector set up	Still picture Still picture Still picture Still picture Video Video Video
02	Boot computer Open Google map Search for map of Nigeria Zoom into different vegetation regions	Factual/Process Procedural Procedural Process Procedural	Location of switch/Booting process Screen clicks to open Google map Screen clicks to zoom into Nigeria and vegetation regions	Still picture Video Video screen capture Video screen capture
03	Add vegetation data to visualize vegetation patterns	Procedural	Screen clicks to add vegetation data	Video (Screen capture)
04	Explore different vegetation regions of Nigeria	Procedural	Screen clicks to explore Nigeria's vegetation regions	,,
05	Analysis of vegetation patterns by density and types	Conceptual	Attributes of vegetation pattern, density and types	,,
06	Use of tools of Google map	Principles	Attributes of the tools of Google map	Animations
07	Values of different vegetation types	Analytical	Economic values and benefits of different vegetation types	Still pictures and videos

Development of the multimedia learning object

The development stage of the multimedia learning object presents in two phases. The first phase involves certain pen and paper design activities which culminates into the storyboard or the production script. The second phase is the actual production activities which is the conversion of the design blueprints into the multimedia learning object. The respective clips of media objects are gathered and stored as thumbnails in the production library within the template of the particular multimedia development software in use. Then the thumbnails of media objects that represent the do steps of sub tasks are arranged in the sequence of the procedural performance of the particular task or function of the job position. This is the rough stage. Then follows the storyboard or production script. The storyboard/production script

provides proper durations of the respective clips of media objects for effective communication of content and elimination of design errors that may constitute extraneous cognitive loads.

The production script for exploring vegetation with Google Earth

Video clip	Audio	Duration
A video of introductory text of learning objectives	Background narration	2 minutes
A visual text of interactive maps 	Audio narration to display vegetation zones	3 minutes
A sill picture of a vegetation region 	Narrated audio background of various vegetation regions like tropical rainforest	3 minutes
A video of vegetation identification	Background voice of narrative and descriptions	2 minutes
Visual text on the impact of climate on vegetation distribution	Narrating how climate influence vegetation zones	3 minutes

Program editing

Program editing fuses all required clips of media objects as outlined in the design and production script and presents same as soft copy in a digital memory object or a compact disk as preproduced multimedia object of learning/training.

Pilot implementation/evaluation

A pilot implementation and evaluation of the learning object is undertaken by applying the preproduced multimedia object to a sample of secondary school geography teachers as professional development training program. The ICT integration training programme for secondary school Geography teachers on the use of Google Earth to teach concepts in secondary school geography.

Post production editing

The post production editing task is a multimedia production function that mends any errors revealed at the pilot implementation/evaluation stage. Such errors may present as follows:

1) Inability of the generality of the learners to answer a given question
2) Inability of most learners to present a common diagram appropriately
3) General misconception of a given concept by most of the students.

A review of content presentation in the learning object then reveals the errors in design that led to inadequacies in communication of content to the learners or undue cognitive load arising from poor design of the learning matter. The correction of such errors necessitates the post production editing task to enable the production of the final version of the multimedia learning object.

However, the sample of geography teachers with whom this multimedia learning object was evaluated actually proved that the programme was designed and developed to achieve the target objectives. They were able to:

1) Identify the digital devices required for the lesson
2) Boot the computer system
3) Open the Google Earth software
4) Zoom into the vegetation patterns of the specific country
5) Add vegetation data
6) Explain the concept of vegetation density, vegetation pattern and vegetation type

But the teachers found it challenging to set up the multimedia projection system. However, a technical assistant was readily on hand to facilitate this aspect of the teaching function.

Although the teacher is expected to be conversant with the procedure to set up the multimedia projection system, this is actually the function of the technical personnel that oversees the activities of the computer laboratory.

Conclusion

Secondary school teachers' inability to apply the Google Earth digital app in teaching concepts in Geography in this digital age has become an issue of concern. But the preproduced multimedia training object on Google Earth app readily equips geography teachers with the capacity to use the digital app to teach geography concepts effectively. A critical success factor of the multimedia training object is the task analysis function in the analysis stage of the ADDIE instructional design model used to develop the training programme.

This stage analyses the tasks involved in use of Google Earth app to teach the concepts in secondary school geography. It identifies the requisite knowledge that facilitate effective technology-based teaching, as well as the media objects to communicate the elements of knowledge to the trainees. And with proper design of the criterion elements of knowledge, using applicable learning principles, the trainer able to produce engaging multimedia learning objects that enables the teachers to imbibe the target knowledge and skills. The teachers also develop the capacity to apply the Google Earth digital app in teaching requisite concepts in secondary school geography as evidenced in the teaching of the concept of vegetation

Suggestions

It is hereby suggested that;

1. The analysis, design and development activities of the generic ADDIE instructional design model be strategically adopted and applied in developing multimedia training objects for secondary school Geography teachers.
2. The use of Google Earth digital app in teaching the concept of vegetation in secondary school geography should be encouraged.

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