Original Research Article

EXPLORING THE APPLICATION OF ADVANCEMENTSOF INSTRUCTIONAL TECHNOLOGY IN GEOSCIENCE EDUCATION IN NIGERIA.

ABSTRACT

Geoscience education is the formal academic study of the Earth's physical features, systems, processes and its history influenced by both natural and human-caused events. Geoscience education and geoscience education research (GER) in Nigeria have since evolved from its mid-twentieth century purpose of developing professionals for the oil and gas boom to addressing environmental challenges in the late twentieth century and into the present-day diversity of sub-disciplines, particularly Medical Geology. Accompanying this evolution are also the modes of instructional technology employed to facilitate necessary teaching. The definition of technology employed in this paper is twofold: the application of scientific knowledge for practical purposes *and* the machinery/equipment developed from such scientific knowledge. The focus is on Nigerian Universities and the challenges discovered with regards to technology use and non-use in these institutions is the students' limited exposure to geology and inability to see the geosciences discipline beyond an abstract concept.This paper carries out a literature review on virtual field trips, a form of virtual experiential learning in the geosciences, a form of instructional technology that has been in use globally, became greatly needed during the COVID-19 pandemic and how this technology can be adapted for teaching in Nigerian universities as the faculty's complementary lecturing tool. This paper presents suggestions and recommendations on how Nigeria universities can maximise virtual experiential learning through intergovernmental partnerships and international collaborations to drive greater technology implementation for a much more improved education for all stakeholders involved.

Keywords: Geosciences, Geoscience Education, Technology, Virtual Field Trip, Virtual Experiential Learning

1. INTRODUCTION

1.1. Geoscience Education

Geoscience education, also referred to as, Earth Science education, is a branch of science education that refers to a formalised academic study of the Earth's physical features, systems, processes, and both natural events and anthropological activities that have shaped the planet throughout its history. It is composed of a diverse range of disciplines, including geophysics, geochemistry, environmental science, climatology amidst several others. Geoscience education is a key factor in the academic, scientific and professional progress of any modern society. (Martinez-Frias &Mogessie, 2012) Geoscience education is central to developing future generations of geoscientists and policymakers. Consequently, it plays a critical role in advancing scientific literacy as well as answering questions and perspectives that lie at the heart of environmental awareness, resource utilisation, sustainable development and economic development, especially in the wake of the global energy transition.

1.2. Geoscience Education and its History in Nigeria

Geoscience education involves the study of geological and related natural phenomena, including the Earth's structure, minerals, rocks, soils, water, and environment. In Nigeria's rural coastal areas, geoscience education is crucial, particularly in the Niger Delta region, which accounts for a significant proportion of the country's oil production. (Olugbenga & Caleb, 2019) Geoscience education exposes the student to the peculiar distribution of resources, oil and gas in the Niger Delta in this instance, and equips them with necessary skills to solve the pressing problems associated with this distribution.

The history of geosciences education in Nigeria can be traced to the mid-1900s. Geoscience education gained momentum in the mid-twentieth century as a result of the oil boom in Nigeria. The Nigerian government established a number of public universities and schools of geoscience, such as the University of Ibadan, University of Nigeria, and the Nigerian Institute of Mining and Geosciences, to train geoscientists, geologists, geophysicists, and other professionals in related fields (Saliman &Oghorada, 2019; Chijioke et al., 2023). The timeline stretches from this throughout the late twentieth-century when it was necessary to have this discipline address environmental sustainability challenges. Geoscience education was needed to address issues related to environmental degradation, pollution, and loss of biodiversity due to oil exploration and exploitation activities in the region. Additionally, geoscience education was necessary to improve the living conditions and livelihoods of the rural communities in the region by providing sustainable solutions to environmental issues (Ahmadu & Akpan, 2015)

Along with traditional methods of geoscience education, innovative approaches such as community-based research and experiential learning have been adopted to provide geoscience education in the rural coastal areas of the Niger Delta. This has helped to increase the

involvement of local communities in the process of environmental recovery and management, as well as the development of sustainable oil and gas exploitation practices (Chijioke et al., 2023) Community-based research and experiential learning are two methods employed for practical applications beyond the geosciences classrooms, community-based research being collaborative research between stakeholders (academic-academic or industry-academic) and experiential learning being undergraduate/graduate internships and outdoor field courses students and academics participate in a school semester.

1.3. Community-based Research (CBR)

Community-based research (CBR), referred to in some literature as *community-based participatory research* (CBPR), is an equitable approach to research in which researchers, organisations, and community members collaborate on all aspects of a research project. (*Community-Based Participatory Research*, n.d.) CBR is a collaborative enterprise between academic researchers (professors and students) and community members… CBR's purpose is to create or discover knowledge that meets a community-identified need, but the role of community members goes beyond simply identifying the research topics or questions. Indeed, the ideal CBR project is one that is fully collaborative—that is, where community people work with professors and/or students at every stage of the research process: identifying the problem, constructing the research question(s), developing research instruments, collecting and analysing data, interpreting results, producing the final report, issuing recommendations, and implementing initiatives (Strand et al., 2003)

1.4. Experiential Learning (EL)

Experiential Learning—EL, developed by Kolb in 1984, is a paradigm for resolving the contradiction between how information is gathered and how it is used. It is focused on learning through experience and evaluating learners in line with their previous experiences (Sternberg & Zhang, 2014) Experiential learning constitutes a learning progression that brings about a higher-level learning, a stage of learning beyond memorisation that teaches the formation and the connection of concepts, visualisation, problem solving, questioning, idea generation, analytical (critical) thinking, practical thinking/application, and synthesising.

In the Nigerian Geosciences Education pathway, experiential learning exists as 3-month or 6-month internships, the mandatory Students Industrial Work Experience Scheme, a scheme established by the Federal Government to promote practical experience within the academic disciplines. Not only do students learn the practical applications of their field of study, they equally discover how broad the geosciences industries, extending from oil and gas down to engineering and construction.

Experiential learning in this Nigerian Geosciences Education pathway also exists as field courses—in some instances, *field mapping*—mandatory academic courses with class credit taken

by students to gain a direct exposure of the outdoors and Earth's topography, applying the concepts learned in the classroom. Teams of students and lecturers travel to select parts of the country to study the geology and rock type distribution present in the region, apply the first principles spanning igneous, metamorphic and sedimentary petrology and structural geology taught in the lecture hall. Depending on the structure of the field course, students may engage in an independent field mapping exercise; students engage in outdoor geological study with minimal to zero lecturers' supervision, analyse findings and draw a geological map that amply represents the rock type distribution in the region.

2. VIRTUAL EXPERIENTIAL LEARNING: VIRTUAL FIELD TRIPS

Virtual experiential learning refers to the virtual (*online*) experiential learning options. One of the virtual experiential learning platforms applied in the Geosciences is Virtual Field Trips (VFTs). A virtual field trip is a guided exploration through the World Wide Web that organises a collection of pre-screened, thematically based web pages into a structured online learning experience. (Foley, 2003) It can be defined as a digital resource that allows a user to visualise and interrogate a remote location using imagery and other materials as appropriate (e.g., data, maps, journal articles) (Hurst, 1998; Woerner, 1999; Stainfield& Fisher, 2000; Klemm & Tuthill, 2003). Virtual field trips provide an alternative strategy for engaging students in study of the real world (Klemm & Tuthill, 2003). Virtual field trips can either be immersive or non-immersive.

Immersive virtual field trips simulate a near-presence in a field and provides participants or users with varying degrees of agency, such as in where to go and what to look at. This is due to a virtual reality property granting 360° imagery; it allows one to look around one's environment, which is different from still photography. 360° imagery provides greater potential for creating educational activities based around independent exploration and investigation in the (virtual) field. An example is Google Street View because of its 360° imagery property. A local example in Nigeria is the 2023 Virtual Field Trip, the continuing education program arm of the Nigerian Association of Petroleum Explorationists (NAPE), providing the student participants and lecturer participants exposure to the distribution of unconventional hydrocarbons and cretaceous reservoirs present in southern Nigeria. Just like the actual field outcrops located during an in-person/physical field trip, virtual outcrops are observed and located in virtual field trips. A virtual outcrop (VO), sometimes called digital outcrop model or virtual outcrop model, is a photorealistic model of a geological outcrop (Xu et al., 2000; Pugsley et al., 2022)

Non-immersive virtual field trips, on the other hand, include collections of "location-specific" graphics (e.g., photos, videos, maps), which can be presented in various ways The difference between immersive and non-immersive VFTs lies in the presence and absence of virtual reality. The absence of virtual reality means less immersion and autonomy for the participant.

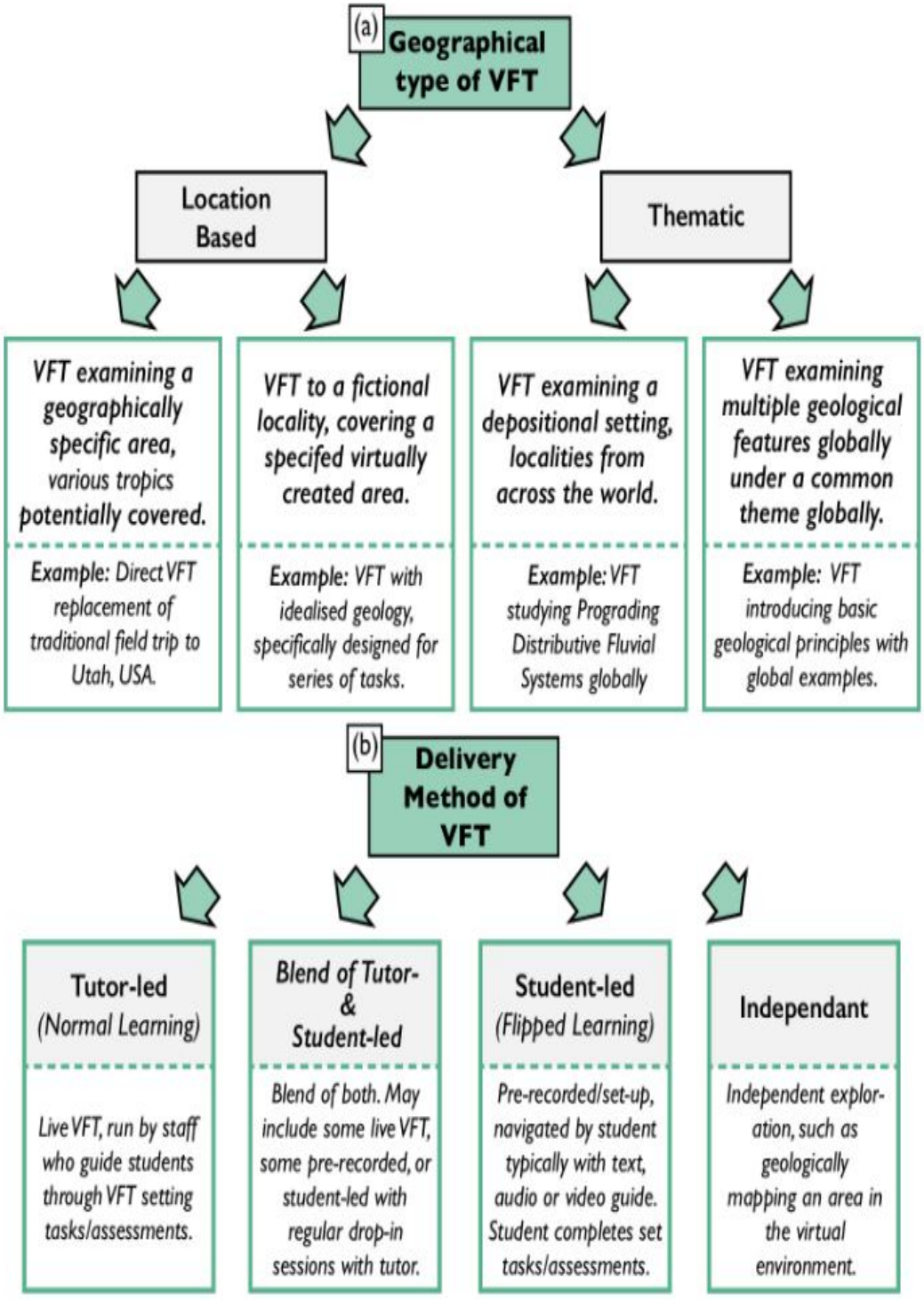

Figure 1. Outline of types and delivery methods of VFTs. (a) Types of VFT separated between location-based trips to a specific locality and thematic trips spanning global localities with a common theme. (b) Delivery method of VFT divided into tutor-led VFTs and student-led VFTs as well as the blended spectrum between. (Credits: Pugsley et al., 2022)

3. CONCLUSION/RECOMMENDATIONS

Conclusively, Nigerian Universities would benefit greatly from the adaptation of virtual field trips in introductory geosciences courses. This paper recommends the following be considered:

1. Intergovernmental/international collaborations between technology firms and Nigerian universities
2. Revision of the geosciences curriculum in universities to include virtual field courses and auxiliary courses on programming and computation to facilitate greater understanding
3. Geosciences computational labs be set up in universities to successfully host a virtual field trip.

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