JOURNAL OF RESEARCH IN INDUSTRIAL TECHNOLOGY & EDUCATIONAL STUDIES (JRITES)
Homepage: http://Journals.unizik.edu.ng/index.php/jrites
e-ISSN 3122-0436
Vol 2 Issue 1 (2026) 25-31

Integration of Geographic Information System in Technical and Vocational Education and Training: The Impact on Youth Employment and Entrepreneurship in Nigeria

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Abstract: The rapid evolution of technology has emphasized the need for innovative approaches in Technical and Vocational Education and Training (TVET), particularly in the context of youth employment and entrepreneurship in Nigeria. This research explores the impact of the integration of Geographic Information Systems (GIS) into TVET program on Youth employment and Entrepreneurship in Nigeria. GIS technology with the use of ArcGIS, QGIS, Unmanned Aerial Vehicles (UAVs), Global Navigation Satellite Systems (GNSS) performs various spatial analyses and digital mapping that solves different difficult environmental problems. The aim of this study is to investigate the impact of GIS integration in TVET program on youth employment and entrepreneurship in Nigeria. Qualitative method of Research was adopted by: examining the current state of GIS implementation in Nigerian educational institutions and analyzing its effectiveness in aligning TVET outputs with labor market demands, and assess how GIS can facilitate entrepreneurial ventures among graduates. Result highlighted the Benefits, Impacts and Implementation Strategies of integration of GIS in TVET programs on Youth Employment and Entrepreneurship. The paper proposed strategic recommendations for policymakers, educational institutions, and stakeholders aimed at enhancing the GIS capacities within TVET frameworks to boost youth employment rates and foster entrepreneurial growth in Nigeria. Ultimately, this research underscores the transformative potential of GIS in revamping TVET systems, advocating for its adoption not merely as a technical tool, but as a catalyst for socio-economic development among Nigerian youth.

Key words: GIS Integration, TVET, Youth Employment, Entrepreneurship

INTRODUCTION

Nigeria, like many other African Countries, faces significant challenges in youth employment and entrepreneurship (Akanji 2005). Despite efforts to address these challenges, many young people in Nigeria struggle to find employment or start their own means of livelihood (Nwachukwu & Ogunlade 2016). In recent years, the integration of Geographic Information Systems (GIS) into Technical and Vocational Education and Training (TVET) has gained increasing recognition for its potential to enhance educational outcomes and stimulate economic development (Ogunniyi & Boaduo 2021). GIS technology, which enables the capture, analysis, and visualization of spatial data, provides invaluable tools for training youth in various sectors, including agriculture, urban planning, and environmental management. This integration is particularly critical in Nigeria, where the youth unemployment rate is alarmingly high and entrepreneurship is essential for economic growth (National Bureau of Statistics, 2022). Nwachukwu and Ogunlade (2016) analyze how high youth unemployment in Nigeria, driven by economic mismanagement and poor infrastructure, necessitates urgent entrepreneurship development. The study highlights that corruption, lack of funding, and inadequate skills hinders youth-led businesses, recommending improved vocational training, access to capital, and better infrastructure to foster economic growth.

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GIS is a powerful tool that can provide students with hands-on experience in spatial analysis and mapping, preparing them for real-world applications. The integration of GIS in TVET programs has the potential to enhance the employability and entrepreneurial skills of youths in Nigeria. However, there is a need to investigate the impact of integration of GIS into TVET programs on youth employment and entrepreneurship in Nigeria by exploring its' benefits and challenges, providing insights into the current state of GIS integration in TVET programs in Nigeria and identifying areas for improving the effectiveness (Goodchild 1990). GIS technology is widely used in various fields, such as Urban Planning, Environmental Management, Emergency response and so on. The integration of GIS in TVET programs has the potentials and capabilities of enhancing the employability and entrepreneurial skills of youth in Nigeria when they are learnt.

Statement of the Problem

Unemployment and Entrepreneurship are significant challenges among youths in many Countries in Africa especially in Nigeria. Despite efforts to address these challenges, many young people struggle to find employment or start their own businesses. However, the effectiveness of TVET in addressing youth unemployment and entrepreneurship is often limited by the lack of integration of modern technologies, such as Geographic Information System (GIS), Artificial Intelligence, Global Navigation Satellite System (GNSS) and so on. GIS has the potential to enhance the employability and entrepreneurial skills of TVET graduates, but its integration in TVET programs is often hindered by several challenges. According to Obidile et al. (2020), the lack of GIS integration in TVET programs can limit the ability of graduates to compete in the job market. Additionally, Ahmed & Bello (2022) found that the lack of GIS skills among TVET graduates can hinder their ability to start and grow successful businesses. Therefore, this study investigates the impact of GIS integration in TVET on youth employment and entrepreneurship in Nigeria by exploring its' benefits, challenges and identifying strategies for improving the effectiveness of GIS integration in TVET.

Research Questions

RQ1: What are the benefits of GIS integration in TVET programs.

RQ2: How does GIS integration in TVET programs impact youth employment and entrepreneurial outcomes?

RQ3: What strategies can be used to improve the effectiveness of GIS integration in TVET programs?

RQ4: What recommendations can be made to policymakers, educators, and industry stakeholders to support the integration of GIS in TVET programs and promote youth employment and entrepreneurship?

LITERATURE REVIEW

GIS skills are highly valued in the job market, making TVET graduates more employable, such GIS Skills include Spatial mapping, Database modeling, Database design, etc (Obidile et al. 2020). Additionally, GIS provides students with hands-on experience in spatial analysis and mapping, preparing them for real-world application. According to study by the African Development Bank (2023) found that TVET graduates with GIS skills had better job prospects and higher employment rates compared to those without. According to UNESCO-UNEVOC (2023), GIS can provide entrepreneurs with the tools and skills they need to succeed in the business world. A study by Ahmed & Bello (2022) found that GIS integration in TVET programs in Nigeria improved student outcomes and increased employability then another study by UNESCO-UNEVOC (2023) found that GIS integration in TVET programs in Africa improved entrepreneurship skills and increased business start-ups.

This study reviewed at least 10 scholarly articles, industry reports, and policy documents which provided a comprehensive understanding of the benefits of the integration of Geographic Information System into the TVET program/curricula especially its impact on the employment of youths and the entrepreneurship skills gained that will foster economic growth and development as well as increase the standard of living among young people in Nigeria.

Geographic Information Systems (GIS) in TVET

Geographic Information System (GIS) is a technology that enables the capture, storage, manipulation, analysis, and visualization of spatial and geographic data (Goodchild, 1990). It integrates various data sources, such as satellite imagery, aerial photography, remote sensing data, and field

surveys, to provide insights into spatial relationships, patterns, and trends. It connects data to a map, enabling users to visualize, interpret, and understand patterns and relationships. GIS is widely used in land administration, environmental management, urban planning, disaster response, and many other fields (Abdullahi et al. 2020).

Remote Sensing in TVET

Remote sensing is the process of obtaining information about objects or areas from a distance, typically using satellite or aerial imagery. It involves collecting data through sensors that capture the electromagnetic spectrum.

Applications GIS and Remote Sensing on TVET programs

1. **Environmental Monitoring and Management**: GIS and remote sensing can be used to teach students about environmental issues, including land use changes, deforestation, and urbanization. Vocational programs in environmental science can utilize these tools to analyze real-time data and develop sustainable management practices.
2. **Agricultural Training**: In agricultural TVET programs, GIS can help students understand spatial data related to soil health, crop distribution, and resource management. Remote sensing technologies can assist in monitoring crop health and managing irrigation more effectively.
3. **Urban Planning and Infrastructure Development**: GIS is crucial in urban planning courses, teaching students how to analyze geographical data for infrastructure projects. Skills in spatial analysis and modeling can prepare them for careers in city planning and civil engineering.
4. **Disaster Management and Mitigation**: TVET programs can incorporate GIS and remote sensing to teach disaster risk management. Students can learn how to analyze data for effective emergency response strategies in natural and artificial disasters such as floods, hurricanes, earthquakes, road accidents, fire outbreaks, pollution etc.
5. **Transportation and Logistics**: In transportation management programs, GIS can be utilized to optimize routes, manage logistics, and enhance transportation networks. Students can learn to analyze spatial relationships that affect traffic patterns and infrastructure.
6. **Health Services**: GIS can be used in health services training to map health resource distributions, analyze Public Health data and plan Community Health interventions.
7. **Tourism and Hospitality**: GIS applications can enhance tourism management education by teaching students how to map attractions, plan tours, and analyze visitor patterns to improve services.
8. **GIS Mapping in Business:** Businesses ranging from entrepreneurial start-ups to multinationals rely on analyses of data from operations to make better decisions more quickly, gain efficiencies, reduce risk and cut costs. GIS technology incorporates geospatial and demographic data and business analytics. As a result, it changes how organizations in the private, nonprofit and public sectors make vital decisions.

Current State of GIS Implementation in Nigerian Educational Institutions

Geographic Information Systems (GIS) have gradually made their way into Nigerian educational institutions, particularly in departments related to Surveying and Geoinformatics, Geography, Environmental Science, Urban Planning, and Agricultural Studies. However, the level of implementation varies significantly across institutions. Some Universities have integrated GIS into their curricula, offering specialized courses and training programs, while others have limited access to the necessary software and hardware, resulting in a skills gap among graduates. The following are current State of Nigeria in Educational Institutions:

1. **Curriculum Integration**: A number of Nigerian Universities now offer Degree programs that include GIS as part of their coursework. However, the depth and scope of GIS education vary, with some institutions providing hands-on training while others focus primarily on theoretical concepts.
2. **Research and Development**: Some institutions engage in GIS-related research, with projects addressing local issues such as urban planning, disaster management, and Environmental Monitoring. This research often collaborates with Governmental and Non-Governmental Organizations, enhancing practical skills in Students.

3. **Partnerships**: Educational institutions are increasingly collaborating with private sectors and international organizations to bolster GIS technology training. These partnerships often facilitate the sharing of resources, enhancing both software accessibility and real-world applications.
4. **Challenges**: Despite these advancements, several challenges hamper effective GIS implementation these include inadequate infrastructural deficits, limited access to up-to-date GIS software, insufficient training for educators, limited access to technology and lack of funding (Nwachukwu & Ogunlade 2016).

BENEFITS OF GIS INTEGRATION IN TVET PROGRAM

Benefits on Youth Employment

Technical and Vocational Education and Training (TVET) is crucial in bridging skills gaps in the Nigerian labor market (Ahmed, & Bello 2022). The integration of GIS into TVET programs helps to align educational outputs with the skills demanded by employers in the following ways:

1. **Skills Development**: GIS training equips students with valuable analytical and problem-solving skills applicable in various sectors-urban planning, agriculture, transportation, and environmental management. This makes graduates more attractive to employers who often cite skill shortages.
2. **Industry Relevance**: By tailoring GIS curricula to the needs of the labor market, educational institutions can produce graduates with competencies that meet current demand. For instance, sectors such as construction and urban planning increasingly require GIS capabilities for project management and decision-making.
3. **Workforce Readiness**: Graduates with GIS skills are better prepared for employment or entrepreneurship since they possess technical know-how that is increasingly sought after in the job market.

Benefits on Youth Entrepreneurship

The potentials of GIS extend beyond traditional employment, it can be a powerful tool for entrepreneurial ventures, particularly for graduates aiming to start their businesses (Ahmed, & Bello 2022). This would be by:

1. **Identifying Business Opportunities**: GIS can help graduates identify niche markets and opportunities for various startups, especially in sectors such as real estate, logistics, environmental consulting, and agriculture. For example, a GIS-enabled agricultural startup can analyze land use and optimize crop yield.
2. **Data-Driven Decision Making**: Entrepreneurs can leverage GIS technology to perform market analysis, customer segmentation, and site selection crucial for strategic planning and resource allocation.
3. **Innovation and Development**: GIS fosters innovation by enabling students to apply geographic data to develop new products or services. This has implications for Smart City initiatives, sustainable development, and logistics optimization.
4. **Networking and Collaboration**: GIS projects often encourage collaboration among various stakeholders, including government bodies, private sectors, and Local Communities, providing graduates with networking opportunities that can enhance their entrepreneurial efforts.

IMPACTS OF GIS INTEGRATION IN TVET PROGRAM

Impact on Youth Employment

1. **Enhanced Skill Development:** Integrating Geographic Information Systems (GIS) into Technical and Vocational Education and Training (TVET) programs equips students with essential technical skills. Mastery of GIS tools enables young graduates to analyze spatial data and create informed decision-making frameworks in various fields, such as urban planning, environmental management, and transportation. **Nwachukwu & Ogunlade (2016).**
2. **Increased Job Opportunities:** As industries globally recognize the importance of spatial data and analytics in decision-making processes, the demand for GIS professionals has

surged. TVET programs that incorporate GIS can help bridge the skills gap, generating a larger pool of qualified applicants in sectors like government, agriculture, construction, and disaster management. This fosters increased employment rates among youths trained in GIS.

3. **Relevance to Industry Needs:** The integration of GIS into TVET curricula aligns educational outcomes with current labor market requirements. Employers are increasingly looking for candidates with proficiency in data visualization and spatial analysis. By preparing students with these competencies, TVET programs enhance the employability of graduates and facilitate smoother transitions to the workforce **Nwachukwu & Ogunlade (2016).**
4. **Interdisciplinary Applications:** GIS skills are transferable across various sectors, allowing youth to explore diverse career paths. Whether in environmental studies, public health, real estate, or transportation logistics, GIS opens up multiple avenues for young job seekers, which can lead to reduced unemployment rates.

Impacts on Youth Entrepreneurship

According to Okafor, E. (2019), the impact of GIS on Youth Entreprenureship are as follows:

1. Empowerment through Knowledge: GIS provides aspiring entrepreneurs with essential insights regarding market analysis, site selection, and demographic profiling. By integrating GIS into TVET, students gain the knowledge necessary to assess business locations, target audiences, and logistical challenges, empowering them to make data-driven decisions when starting their ventures. Okafor, E. (2019).

2. Innovation and Creativity: The analytical capabilities offered by GIS can inspire new business ideas and innovative approaches to existing problems. Young entrepreneurs can leverage spatial data to identify niche markets, analyze competitive landscapes, and develop creative solutions that meet local needs, thereby fostering a culture of entrepreneurship.

3. Enhanced Business Planning: GIS tools enable entrepreneurs to visualize spatial information, leading to more effective business strategies. For instance, mapping client distributions or analyzing traffic patterns can help new ventures optimize their services and marketing efforts. As a result, integrating GIS in TVET aids youth in developing robust business plans that are grounded in empirical data.

4. Facilitating Access to Resources: Through GIS, young entrepreneurs can identify and access critical resources such as suppliers, funding opportunities, and potential collaborators. This ability to visualize networks and connections increases the chances of success and sustainability for startups, ultimately contributing to economic growth and job creation Okafor, E. (2019).

IMPLEMENTATION STRATEGIES FOR THE INTEGRATION OF GIS IN TVET ON YOUTH EMPLOYMENT AND ENTREPRENEURSHIP IN NIGERIA

The integration of GIS in TVET programs has the potential to enhance the employability and entrepreneurial skills of young people in Nigeria. To achieve this goal, several implementation strategies can be employed (Korter 2023).

Strategy 1: Curriculum Development

i. Develop GIS-related courses: Develop courses that incorporate GIS technology and applications in various fields, such as urban planning, environmental management, and emergency response.
ii. Integrate GIS into existing courses: Integrate GIS into existing courses, such as geography, environmental science, and computer science.
iii. Develop online courses and resources: Develop online courses and resources to provide students with flexible learning opportunities.

Strategy 2: Instructor Training

i. Provide training and support: Provide training and support for instructors to develop their skills in using GIS technology and applications.
ii. Workshops and Conferences: Organize workshops and conferences to provide instructors with opportunities to share best practices and learn from each other.

iii. Mentorship programs: Establish mentorship programs to pair experienced instructors with new instructors.

Strategy 3: Industry Partnerships

i. Collaborate with industry partners: Collaborate with industry partners to provide students with practical experience with GIS technology and applications.
ii. Internships and job placements: Provide internships and job placements for students to gain hands-on experience with GIS technology and applications.
iii. Industry advisory boards: Establish industry advisory boards to provide guidance on the development of GIS-related courses and programs.

Strategy 4: Infrastructure Development

i. Develop GIS labs and facilities: Develop GIS labs and facilities to provide Students with hands-on experience with GIS technology and applications.
ii. Software and hardware: Provide software and hardware to support the use of GIS technology and applications.
iii. Internet connectivity: Ensure internet connectivity to support online learning and access to GIS resources.

Strategy 5: Monitoring and Evaluation

i. Develop evaluation frameworks: Develop evaluation frameworks to assess the effectiveness of GIS integration in TVET programs.
ii. Conduct regular assessments: Conduct regular assessments to identify areas for improvement and provide feedback to instructors and students.
iii. Use data to inform decision-making: Use data to inform decision-making and improve the effectiveness of GIS integration in TVET programs.

CONCLUSION

The integration of Geographic Information Systems (GIS) in Technical and Vocational Education and Training (TVET) programs presents significant potential to enhance youth employment and foster entrepreneurship. By equipping Students with GIS skills, TVET institutions can significantly boost their employability in various Sectors, ranging from Environmental Management to Urban Planning and beyond. Furthermore, empowering students with entrepreneurial skills through GIS applications creates a new generation of innovators capable of responding to local and global challenges. It is imperative for Educational Institutions, Government bodies, and industry stakeholders to collaborate in fostering an ecosystem that supports the integration of GIS technology into TVET programs. This collaboration is critical for ensuring that youth are not only prepared for existing job markets but are also equipped to create new opportunities for themselves and the Society.

RECOMMENDATIONS

To address the above problem the following recommendations are proposed:

1. **Curriculum Development**: TVET institutions should develop and integrate specialized GIS modules into their existing curricula. These modules should cover technical skills, real-world applications, and emerging trends in GIS technology to ensure that students are equipped with up-to-date knowledge.
2. **Industry Partnerships**: The government should create policies that will enable the local businesses and industries to collaborate and create internship and apprenticeship opportunities for students. This would not only enhance the practical skills of students but also pave the way for employment after graduation.
3. **Community Engagement**: Students of TVET programs should be encouraged to use GIS in solving Community / Local problems.
4. **Public Awareness and Advocacy**: Awareness campaigns should be made by the Government and Tertiary Institution Management, highlighting the importance of modern geospatial technologies in sustainable land management and environmental conservation.

5. **Entrepreneurship Training**: The National Board for Technical Education should integrate entrepreneurship training within the GIS curriculum to empower students to start their ventures leveraging GIS technology.
6. **Continuous Professional Development**: The Government should initiate training programs for instructors on the latest GIS technologies and teaching methodologies. Continuous professional development ensures that educators remain relevant and can effectively teach and inspire students.
7. **Government Support**: Governments should offer grants or incentives to institutions that successfully integrate innovative GIS technologies. Advocacy for policies that support the inclusion of GIS training in TVET programs can lead to increased funding and resources.

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