CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Surveying is a fundamental aspect of engineering and construction projects, ensuring precise measurement of land elevations, distances, and angles. Accurate surveying techniques are essential for infrastructure development, road design, and topographical mapping. Among the most commonly used instruments for precise levelling and elevation measurement are digital levelling instruments and total stations (Ghilani& Wolf, 2017). The comparative evaluation of these two methods in the context of Kwara State Polytechnic is crucial for determining their accuracy and reliability in geospatial data acquisition.

Digital levelling, also known as electronic or automatic levelling, employs highly sensitive digital bar-coded levelling staffs to record precise elevation readings. This method reduces human errors associated with traditional levelling techniques and provides higher precision in elevation determination. The equipment is particularly effective for differential levelling, which is critical in construction, geodetic, and topographical surveys (Uren & Price, 2010). Digital levels are commonly preferred for high-accuracy vertical control networks and engineering surveys due to their ability to minimize reading and interpolation errors.

On the other hand, total station equipment combines an electronic distance measurement (EDM) device with an integrated digital theodolite. This instrument allows surveyors to measure horizontal and vertical angles, distances, and elevations with high precision. Total stations are widely used in cadastral surveys, construction staking, and topographic mapping due to their ability to perform multiple surveying

functions simultaneously (Kavanagh & Glennon, 2020). The efficiency of total stations is further enhanced by their capability to store and process data digitally, reducing the need for manual calculations.

Despite their advantages, both digital levelling and total station instruments have limitations that may affect their accuracy and reliability in different field conditions. Digital levels, though highly accurate in elevation determination, are limited in measuring horizontal distances and angles. Conversely, total stations, while excellent for both angle and distance measurement, may be influenced by environmental conditions such as temperature variations, atmospheric refraction, and operator expertise (Luhmann et al., 2014). These factors highlight the need for a comparative analysis of these two instruments in a real-world setting such as Kwara State Polytechnic.

Several studies have examined the accuracy and reliability of surveying instruments in various environments. Research by Al-Omari et al. (2019) demonstrated that digital levelling provided superior accuracy in elevation measurements compared to total stations, particularly in geodetic control surveys. However, in practical construction applications, total stations were found to be more efficient due to their capability to integrate multiple surveying functions. Similarly, Ibraheem et al. (2021) compared digital levelling and total station techniques in an urban area and concluded that the total station was advantageous in terms of speed and efficiency, but digital levels remained superior in vertical precision.

Advances in surveying technology have led to the integration of GNSS (Global Navigation Satellite Systems) with total stations, further improving data acquisition capabilities. However, digital levelling remains a fundamental approach for

establishing benchmark elevations, which are critical for engineering projects (Ghilani, 2021). Therefore, understanding the strengths and weaknesses of each method within Kwara State Polytechnic's environment will help optimize surveying practices and decision-making for future developments.

This project will employ experimental data collection and statistical analysis to compare the accuracy and reliability of digital levelling and total station measurements. Key parameters such as measurement discrepancies, environmental influences, and time efficiency will be examined. By analyzing these factors, the research will provide insights into which instrument is best suited for specific surveying tasks in the area.

The comparative evaluation of digital levelling and total stations in Kwara State Polytechnic will contribute to improved surveying methodologies, ensuring accurate geospatial data collection for future infrastructural projects. The findings will also serve as a reference for surveyors, engineers, and researchers interested in adopting the most suitable equipment for different surveying needs. This project aligns with global trends in precision surveying and geospatial technology, reinforcing the importance of choosing the right tools for accurate land measurement and mapping.

1.2 Statement of Problem

Accurate and reliable elevation and distance measurements are crucial in surveying for engineering, construction, and geospatial applications. Digital leveling and total station instruments are widely used for these purposes, but their performance varies based on environmental conditions, terrain characteristics, and specific project requirements. While digital leveling provides superior accuracy in vertical measurements, it is limited in horizontal data collection. Conversely, total stations

offer a combination of angular, distance, and elevation measurements but may be affected by atmospheric conditions and operator expertise. The challenge lies in determining which of these two methods is more suitable for different surveying tasks within Kwara State Polytechnic, Kwara State, where ongoing infrastructure development requires precise geospatial data acquisition.

Despite previous research comparing these instruments, there is limited empirical data specific to Kwara State Polytechnic's environment regarding their comparative accuracy and reliability. The need for cost-effective, time-efficient, and precise surveying methods necessitates an in-depth evaluation of these two instruments in real-world applications. This project aims to bridge this knowledge gap by assessing the accuracy, efficiency, and reliability of digital leveling and total station equipment in the project area, providing insights that will aid surveyors, engineers, and policymakers in selecting the most appropriate technology for different surveying needs.

1.3 Aim of the Project

The aim of this project is to compare the accuracy, efficiency, and reliability of digital leveling and total station equipment for height measurement in part of Kwara State Polytechnic.

1.4 Objectives of the Project

1. To assess and compare the accuracy of digital leveling and total station measurements in Kwara State Polytechnic.
2. To evaluate the efficiency and reliability of both instruments under different environmental and terrain conditions.

3. To determine the most suitable instrument for precise geospatial data acquisition in the study area.

1.5 Justification of the Project

Accurate and reliable height measurement is fundamental to infrastructure development, construction, and land management. The choice of surveying equipment significantly influences data precision, project efficiency, and cost-effectiveness. Digital levelling is widely recognized for its superior vertical accuracy, making it indispensable for high-precision height determination in engineering and geodetic surveys (Ghilani& Wolf, 2017). However, it is limited in terms of horizontal measurement capabilities, necessitating the use of other instruments for comprehensive surveying tasks. On the other hand, total stations integrate electronic distance measurement (EDM) with angular observations, allowing surveyors to capture both horizontal and vertical data efficiently. While total stations provide an all-in-one solution, factors such as atmospheric variations, operator experience, and instrument calibration can affect measurement accuracy (Kavanagh & Glennon, 2020).

Previous studies have compared the accuracy of digital levelling and total station equipment, but findings often vary based on environmental conditions, terrain characteristics, and application scope. Research by Al-Omari et al. (2019) found that digital levelling outperformed total stations in elevation accuracy, whereas total stations were more efficient in large-scale mapping and construction staking. However, there is limited research focusing on the specific conditions of Kwara State Polytechnic, where terrain variations, atmospheric influences, and infrastructural needs may impact surveying accuracy.

1.6 Scope of the Project

This study focuses on the comparative evaluation of digital leveling and total station equipment in height measurement. It examines the accuracy, efficiency, and reliability of both instruments in measuring elevationunder different environmental and terrain conditions. The project will involve field data collection, measurement analysis, and statistical evaluation to determine discrepancies and performance variations between the two methods. Key parameters such as precision, ease of use, time efficiency, and external influencing factors will be assessed. The findings will be applicable to surveying, engineering, and construction projects, providing insights for selecting the most suitable equipment for specific geospatial tasks within the study area.

1.7 Personnel

The project was assigned to and was successfully carried by the personnel listed below under the supervision of the project supervisor.

NAME	MATRIC. NO.	POSITION
Ogunsuyi Babatunde Sunday	HND/23/SGI/FT/0118	Author
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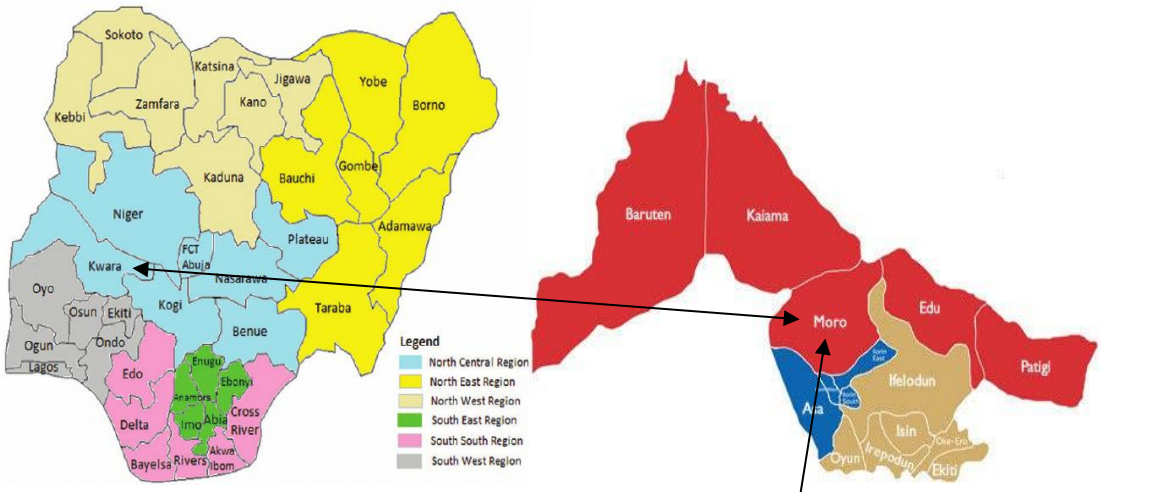
Adeleye Sheriffdeen Olawale	HND/23/SGI/FT/0081	Member
Abdul Qudus Shukurah Temitope	HND/23/SGI/FT/0083	Member
Ganiyu Akeem Abiodun	HND/23/SGI/FT/0076	Member
Jimoh Halimah Titilayo	HND/22/SGI/FT/082	Member

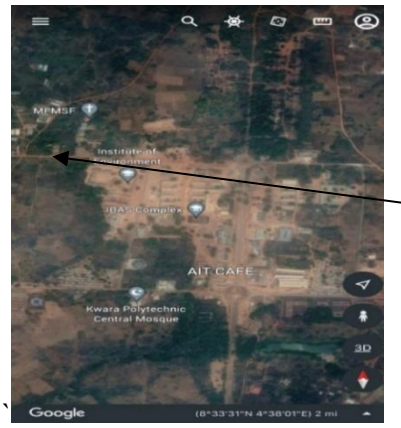
1.8 Study Area

Kwara State Polytechnic is a significant provider of technical and vocational education and is situated in Ilorin, Nigeria. Spread across a wide area, it is roughly located at latitude 8.4791° N and longitude 4.5418° E.The institution's terrain consists of both flat and slightly undulating areas, making it suitable for studying height measurement techniques. With a mix of built-up structures and open spaces, Kwara Polytechnic provides a practical environment for evaluating digital leveling and total station accuracy.

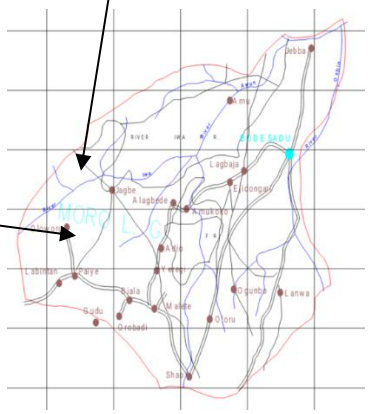


Map of Nigeria

Map of Kwara State



Google Imagery of the Study Area



Map of Moro L.G.A

***Figure 1.10**: Study Area Map*