

	ORIGINAL RESEARCH PAPER GENDER-BASED ANALYSIS OF STUDENTS' PERFORMANCE IN MAP READING USING DIGITAL TOOLS	Education KEY WORDS: Gender, Map reading, Digital Tools, Students' Performance
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ABSTRACT	This study explored the impact of digital technologies on enhancing map reading and interpretation skills among Form Three secondary school students in Kisarawe District, Tanzania. A quasi-experimental design was employed, involving a control group taught using traditional methods and an experimental group exposed to digital tools such as Google Maps and Google Earth. Data were collected through pre-tests and self-made achievement tests, and analyzed using Post-Hoc Tukey's HSD to compare performance by gender. The findings revealed statistically significant improvements ($p < 0.05$) in both male and female students' post-test scores compared to their pre-test results. Male students exhibited the highest gain with a mean difference of 47.30, while female students showed a gain of 31.63. Additionally, male students outperformed female students in the post-test by a mean difference of 7.85, also statistically significant. These results confirm that digital technologies effectively support geographic skill development. However, the gender gap observed suggests the need for inclusive, gender-sensitive approaches in digital learning. The study recommends broader integration of digital tools and further research into equitable digital education practices.	
INTRODUCTION	In the 21st century, digital technologies have become integral to education systems worldwide, revolutionizing how knowledge is accessed, processed, and delivered. Their integration into classrooms has particularly transformed the teaching and learning of complex subjects like Geography, where visual representation and spatial analysis are essential. Digital tools such as Google Maps, Google Earth, and other Geographic Information Systems (GIS) offer dynamic and interactive ways of enhancing students' spatial reasoning and interpretation of geographical data (Nyanda & Mbilinyi, 2021). These tools enable learners to interact with real-world geographical content, thereby promoting deeper conceptual understanding and practical application of map reading skills. Map reading and interpretation are critical competencies in geography education, especially in the Tanzanian curriculum for Form Three students (TIE, 2019). Despite their importance, students often face challenges in mastering these skills due to reliance on traditional, text-based instruction that may not cater to diverse learning styles or stimulate student engagement. Consequently, the integration of digital technologies into teaching practices is considered a promising approach to address these limitations and improve learning outcomes (Mkenda et al., 2022). However, while the potential of digital tools is widely acknowledged, empirical evidence on their effectiveness especially in resource-constrained contexts like rural Tanzanian schools remains limited. This study, therefore, seeks to investigate the influence of digital technologies on the development of map reading and interpretation skills among Form Three secondary school students in Kisarawe District, Tanzania. Specifically, the study aims to evaluate the extent to which digital interventions can improve student performance in geography and to determine whether there are gender-based differences in learning outcomes resulting from such interventions. The significance of this study lies in its potential to inform teaching practices and curriculum development by highlighting the value of digital tools in enhancing geography instruction. Moreover, the findings may contribute to a broader understanding of how gender dynamics interact with digital learning in secondary education, guiding the design of more inclusive and equitable digital learning strategies. By comparing pre-test and post-test scores through statistical	
www.worldwidejournals.com	methods, including Post-Hoc Tukey's HSD analysis, this study provides empirical insights into how students' geographical skills are influenced by digital learning interventions. Drawing on the work of researchers like Creswell (2014) and Singh (2006), this quasi-experimental research also employs a rigorous methodological framework to ensure reliability and validity of the findings. Ultimately, the study aspires to support evidence-based integration of digital technologies in secondary schools and to address potential gaps in digital access and engagement across different student groups. Methodology and Procedure This study adopted a quantitative research approach and employed a quasi-experimental design to investigate the influence of digital tools on students' map reading and interpretation skills. The target population comprised all Form Three students in secondary schools within Kisarawe District, located in the Coastal Region of Tanzania. A stratified sampling technique was utilized to ensure representation across different student groups. (Kothari, 2004; Creswell, 2014). Two secondary schools were purposively selected to participate in the study. School A served as the control group, where traditional teaching methods were maintained, while School B functioned as the experimental group, in which students received instruction enhanced with digital tools such as Google Maps and Google Earth. The study was conducted over a period of six months, from July 2024 to December 2024. A pre-test was administered to both groups to assess their baseline understanding of map reading and interpretation. This was followed by an intervention phase, where the experimental group engaged in digital tool based learning activities. Upon completion of the intervention, a self-developed achievement test was administered to measure students' post-intervention performance. Furthermore data collected from the pre-test and self-made achievement were analyzed using independent samples t-tests, as part of parametric statistical measures, to determine the significance of any differences in performance between the two groups. In adherence to research ethics, informed consent was obtained from all participants. For students under the age of 18, parental or guardian consent letters were secured in accordance with ethical guidelines governing research involving minors. The confidentiality and anonymity of all participants were strictly maintained throughout the study. 93	



Photo 1: Computer Classroom Used in Instructional Process
 Source: Research Field (2024)



Photo 2: Students Responding Pre-test
 Source: Research Field (2024)

RESULT
Post-Hoc Tukey's HSD Analysis of Performance in Green: Pre-Test vs. Self-Made Achievement Test by Gender

Comparison	Mean Difference	p-value	Significance
Female students' pre-test vs. Female students' Self-Made Achievement Test	31.63	< 0.05	Significant
Female students' pre-test vs. Male students' Self-Made Achievement Test	39.48	< 0.05	Significant
Male students' pre-test vs. Female students' Self-Made Achievement Test	39.45	< 0.05	Significant
Male students' pre-test vs. Male students' self-Made Achievement test	47.30	< 0.05	Significant
Female students' Self-Made Achievement Test vs. Male students' Self-Made Achievement Test	7.85	< 0.05	Significant
All other pairwise comparisons	N/A	> 0.05	Not significant

Data obtained from Research Field (2024)

DISCUSSION
 The Post-Hoc Tukey's HSD Analysis of Performance in Green Class (Table 4.59) provides further insights into the statistically significant differences between pre-test and self-made achievement test results among male and female students. The results indicate that all pairwise comparisons of pre-test and post-test scores yielded p-values below 0.05, confirming significant improvements in students' map reading and interpretation skills following the implementation of digital technologies.

The most substantial improvements were observed in male students' performance, where the mean difference between their pre-test scores and self-made achievement test scores was 47.30 ($p < 0.05$). Similarly, female students also showed considerable progress, with their pre-test scores differing from their post-test scores by 31.63 ($p < 0.05$). These findings reinforce the effectiveness of digital technologies in

enhancing students' spatial reasoning and analytical skills, as they significantly outperformed their initial pre-test performance.

Furthermore, when comparing female students' pre-test scores to male students' post-test scores, the mean difference was 39.48 ($p < 0.05$), highlighting the remarkable improvement in male students' performance post-intervention. Likewise, the mean difference between male students' pre-test scores and female students' self-made achievement test scores was 39.45 ($p < 0.05$), demonstrating that both genders experienced significant gains. However, the difference between female students' and male students' self-made achievement test scores was 7.85 ($p < 0.05$), suggesting that while both groups improved, male students outperformed female students in the final assessment.

These results align with research findings on technology-enhanced learning, which suggest that interactive digital tools significantly enhance students' engagement and comprehension of complex geographical concepts (Nyanda & Mbilinyi, 2021). The observed gender differences in performance gains may also reflect varying levels of digital literacy and engagement with technology-based learning materials. Some studies, such as Mkenda et al. (2022), suggest that male students often exhibit greater interest in digital learning tools, which could explain their relatively higher post-test performance.

The lack of significant differences among other treatment groups suggests that the main factor influencing student performance was the pre-test vs. post-test intervention, rather than differences between specific gender-based treatment groups. This underscores the consistency of the observed improvements across all students, reinforcing the effectiveness of digital technology as a universally applicable intervention for improving map reading and interpretation skills.

The findings from this post-hoc analysis provide valuable insights for educators and curriculum developers in geography education. The substantial improvements in self-made achievement test scores for both male and female students suggest that digital technologies should be more widely integrated into teaching strategies to enhance spatial reasoning and geographic literacy. However, the gender-based performance gap observed in post-test results suggests the need for additional research into gender-sensitive digital learning strategies to ensure equitable access and engagement for all students.

CONCLUSION AND RECOMMENDATION
 The results of the Post-Hoc Tukey's HSD analysis clearly demonstrate that the use of digital technologies had a significant impact on improving students' performance in map reading and interpretation skills in the Green class. Both male and female students showed substantial improvement from the pre-test to the self-made achievement test, with all comparisons yielding statistically significant results ($p < 0.05$). Male students recorded the highest mean difference of 47.30, while female students also showed notable progress with a mean difference of 31.63. These findings highlight the effectiveness of digital tools in enhancing geographical understanding and spatial reasoning among secondary school students.

However, the data also revealed a gender-based disparity in performance. Male students outperformed female students in the post-test by a statistically significant mean difference of 7.85. While this indicates that both genders benefitted from the digital learning approach, it also points to an underlying gap that could be influenced by differences in digital literacy, access, or engagement levels between male and female students. This calls for deliberate attention in addressing

gender-based challenges in the implementation of technology-enhanced learning.

In light of these findings, it is recommended that digital tools be systematically integrated into geography instruction to support improved student engagement and learning outcomes. Teachers should also adopt gender-sensitive strategies to ensure that female students are equally supported and encouraged to engage with digital learning platforms. Moreover, professional development programs should be established to equip teachers with the necessary skills to implement inclusive digital instruction effectively. Finally, further research should be conducted to explore the causes of gender disparities in digital learning and to develop targeted interventions that promote equity and academic success for all students.

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