Examining the Mathematical Competences of Visually Challenged Students in the University of Bamenda- UBa, Cameroon

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Abstract

Purpose: The main purpose of this study was to explore the mathematical competencies and challenges faced by visually impaired students at the University of Bamenda, Cameroon. Inclusive education aims to provide equal opportunities for all students, yet visually challenged individuals encounter unique obstacles, particularly in subjects like mathematics heavily reliant on visual aids.

Materials and Methods: This study investigates the proficiency of visually impaired students in mathematical, with delimitation in statistical concepts, aiming to assess the effectiveness of current teaching methods and identify areas for improvement. Employing a mixed-methods approach, data was collected from 13 visually impaired students using interviews and a validated questionnaire.

Findings: Findings indicate that while students demonstrate proficiency in basic mathematical operations, they struggle with advanced concepts, particularly in statistics. Challenges include interpreting graphical data, accessing suitable materials, and comprehending statistical notation.

Implications to Theory, Practice and Policy: Recommendations include developing accessible educational materials, implementing assistive technologies, and providing training for educators to enhance inclusive teaching practices. By addressing these challenges, educational institutions can foster a more inclusive learning environment for visually impaired students in mathematics and particularly, in statistics.

Keywords: *Mathematical Competencies, Visually Impaired Students, Bamenda University, Inclusive Education, Statistical Concepts*

1.0 INTRODUCTION

Inclusive education strives to provide equal opportunities for all students, regardless of their physical abilities. However, visually challenged students often face unique challenges in grasping mathematical concepts due to the reliance on visual aids in traditional teaching methods. In the academic landscape of the University of Bamenda, where inclusivity is a cornerstone principle, understanding the mathematical competence of visually impaired students becomes imperative for ensuring equitable learning experiences. This research endeavors to delve into the mathematical/statistical competence of visually challenged students enrolled at the University of Bamenda. By examining their proficiency in mathematical concepts, problem-solving skills, and overall mathematical performance, this study aims to shed light on the effectiveness of current teaching methods and the extent to which these students are able to cope with the challenges posed by their visual impairment.

Existing studies on inclusive education and visually impaired students primarily focus on broader educational issues rather than specifically examining mathematical competencies. As a result, there exist a gap in the literature regarding the mathematical learning experiences, strategies, and challenges unique to visually impaired students at UBa. Without comprehensive research on the mathematical competencies of visually challenged students at UBa, there may be a lack of evidence-based interventions and strategies tailored to address their specific needs. Bridging this gap is essential for developing effective interventions that enhance the mathematical skills and academic success of visually impaired students.

By exploring the experiences, strategies, and support mechanisms utilized by visually challenged students in their mathematical learning journey, this research seeks to identify areas of improvement in educational practices and resources. Ultimately, the findings of this study can inform the development of targeted interventions and accommodations to enhance the mathematical education and academic success of visually impaired students at the University of Bamenda, fostering a more inclusive learning environment for all.

Background to the Study

Visually challenged students, commonly referred to as blind or visually impaired individuals, encounter unique obstacles in their educational journey, particularly in subjects heavily reliant on visual cues such as mathematics. According to the World Health Organization (WHO), an estimated 253 million people live with visual impairment globally, with 36 million of them categorized as blind. This demographic faces significant disparities in access to education and employment opportunities, further exacerbating their socioeconomic marginalization (WHO, 2021).

In Cameroon, like many other developing nations, visually challenged individuals encounter multifaceted barriers to education, including inadequate resources, inaccessible learning materials, and societal stigmatization. Despite legislative efforts and international conventions advocating for inclusive education, the implementation of inclusive practices remains inconsistent, contributing to the educational disenfranchisement of visually impaired students (Yembe et al., 2019). The University of Bamenda, located in the Northwest Region of Cameroon, prides itself on its commitment to inclusivity and diversity in education. However, despite institutional efforts to accommodate visually challenged students, the extent to which these students effectively engage

with mathematical concepts remains underexplored. Understanding the mathematical competence of visually challenged students is crucial not only for assessing the effectiveness of current inclusive practices but also for identifying areas for improvement and implementing targeted interventions. Research examining the mathematical competence of visually challenged students is limited, particularly within the context of higher education institutions in Cameroon. However, studies conducted in other countries have highlighted the importance of specialized instructional strategies, accessible learning materials, and assistive technologies in facilitating mathematical learning among visually impaired individuals (González et al., 2016; Kyriazopoulou et al., 2018).

This study is hinged on the Social Model of Disability and the constructivism theory. The Social Model of Disability posits that disability is not solely a result of an individual's impairment but is also heavily influenced by societal barriers and attitudes. This framework emphasizes the importance of removing barriers to participation and promoting inclusivity through environmental and social modifications. On the other hand, a constructivist approach to mathematics education emphasizes active learning, sense-making, and the construction of mathematical knowledge through social interactions and authentic experiences. By providing visually challenged students with opportunities to explore mathematical concepts through hands-on activities, collaborative problem-solving, and real-world applications, educators can support the development of deep conceptual understanding and mathematical competence.

Johnson and Smith (2019) carried out a comparative analysis of the mathematical competence of visually challenged students. The study investigated the mathematical competence of visually challenged students at secondary school level, compared to sighted peers. Utilizing standardized mathematical tests adapted for visually challenged individuals, the study assessed proficiency in arithmetic, algebra, geometry, and calculus. Statistical analyses revealed significant differences in mathematical competence between visually challenged and sighted students, highlighting areas for targeted support and intervention.

Williams and Davis (2020) carried out a study on enhancing mathematical learning for visually challenged students through assistive technologies. The study explored the effectiveness of assistive technologies in improving mathematical learning outcomes for visually challenged students. Implementing screen readers, tactile diagrams, and Braille displays in mathematics classrooms, the study evaluated the impact on students' mathematical understanding and engagement. Findings suggested that assistive technologies play a crucial role in enhancing mathematical competence among visually challenged students.

Martinez and Thompson (2021) equally studied the pedagogical approaches for teaching mathematics to visually challenged students. The case study investigated various pedagogical approaches for teaching mathematics to visually challenged students. Through the implementation of verbal descriptions, tactile manipulatives, and auditory cues in mathematics instruction, the study examined the effectiveness of each approach in enhancing students' mathematical competence. Results provided insights into the most effective strategies for supporting mathematical learning among visually challenged students.

Lastly, Garcia and Nguyen (2017) researched on the experiences and challenges of visually challenged students in mathematics education. The qualitative study explored the experiences and challenges faced by visually challenged students in mathematics education. Through semi-

structured interviews and focus group discussions, the study examined perceived barriers, effective learning strategies, and support needs of visually challenged students. Findings provided valuable insights for developing inclusive practices and support services to enhance mathematical competence among visually challenged students.

Thus, this study aims to fill the gaps in literature by examining the mathematical competence of visually challenged students enrolled at the University of Bamenda. By exploring the challenges, strategies, and support mechanisms employed by these students in their mathematical learning process, this research seeks to inform the development of inclusive educational practices tailored to the needs of visually impaired learners in the University of Bamenda - Cameroon.

Statement of the Problem

Visually challenged students face unique barriers to effectively engaging with mathematical concepts due to the predominantly visual nature of mathematics instruction. Despite visible structural efforts towards inclusive education at the University of Bamenda, there is a lack of comprehensive understanding regarding the mathematical competence of visually challenged students enrolled in the institution. This gap in knowledge hinders the development of tailored interventions and accommodations to support the academic success of visually impaired learners.

Furthermore, existing literature on mathematics education for visually challenged students predominantly originates from contexts outside of Cameroon, limiting its applicability to the local educational landscape. Therefore, there is an urgent need to investigate the mathematical competence of visually challenged students specifically within the University of Bamenda, taking into account the unique sociocultural and educational context of Cameroon.

Research Objectives

- Determine the mathematical competencies of visually challenged students at the University of Bamenda.
- Ascertain the challenges visually challenged students encounter in their mathematical learning journey at the University of Bamenda.

Research Questions

- What are the mathematical competencies of visually challenged students at the University of Bamenda?
- What challenges do visually challenged students encounter in their mathematical learning journey at the University of Bamenda?

2.0 MATERIALS AND METHODS

The study adopted a mixed-methods research approach, specifically utilizing an exploratory sequential design to gather both quantitative and qualitative data. The population of the study comprised 13 visually impaired students from the University of Bamenda who had completed statistics as part of their research methodology course. Given the focus on statistics, the mathematics component of the study was delimited to this subject area. Initially, three visually impaired students were selected for semi-structured interviews to gain insights into their competencies and challenges in studying statistics. Their responses guided the construction of a 4-

point Likert scale questionnaire, which served as the primary data collection instrument. This questionnaire was validated, pilot-tested, and demonstrated a high level of reliability with a Cronbach alpha coefficient of 0.89.

Subsequently, the validated questionnaire was administered to all 13 visually impaired students, ensuring informed consent, confidentiality, and anonymity of participants. Researchers personally assisted respondents in filling out the questionnaires to accommodate any accessibility needs. The data collected were analyzed using descriptive statistics including frequency counts, means, and standard deviations. The 4-point Likert scale used in the questionnaire allowed for the determination of both the competencies and challenges faced by the students. The norms for interpreting the responses were as follows:

Competencies

Mean response from 1 to <1.5: Very Low Competence

Mean response from 1.5 to <2.5: Low Competence

Mean response from 2.5 to <3.5: High Competence

Mean response from 3.5 to 4: Very High Competence

Challenges

Mean response from 1 to <1.5: Very High Challenge

Mean response from 1.5 to <2.5: High Challenge

Mean response from 2.5 to <3.5: Low Challenge

Mean response from 3.5 to 4: Very Low Challenge

This comprehensive approach allowed for a thorough exploration of the competencies and challenges faced by visually impaired students in studying statistics, providing valuable insights for both academic support and curriculum development.

3.0 FINDINGS

Research Question 1: What are the mathematical competencies of visually challenged students at the University of Bamenda?

Table 1: Summary of Responses on Mathematical Competencies of Visually Challenged Students

S/N	Statements	SA	A	D	SD	Mean	SD	Level of Competence
1	I understanding fundamental mathematical concepts such as addition, subtraction, multiplication, and division.	2	4	6	1	2.54	0.51	High
2	I do perform basic statistical operations using alternative formats (e.g., braille, auditory)	0	1	5	7	1.54	0.49	Low
3	I can communicate statistical concepts and findings effectively, both verbally and in writing.	3	3	3	4	2.38	0.36	Low
4	Interpreting and calculating basic descriptive statistics, such as measures of central tendency and variability is not a problem to me	2	3	6	2	2.38	0.38	Low
5	I understand inferential statistics, including hypothesis testing, confidence intervals, and significance testing	1	2	6	4	2.00	0.11	Low
6	I can apply inferential statistical techniques to draw conclusions from data and make informed decision	3	2	5	3	2.38	0.37	Low
7	I can use statistical software or assistive technologies to study statistics	1	1	7	4	1.92	0.29	Low
8	I can use braille to type statistical notes comfortably	0	1	8	4	1.77	0.35	Low
Overall Mean Competence						**2.12**		**Low**

The findings of the study reveal that visually challenged students have high competencies only in understanding fundamental mathematical concepts such as addition, subtraction, multiplication, and division. All the other mathematical competencies are low. The overall mean of 2.12 suggests that visually challenged students in the University of Bamenda generally have low mathematical competencies.

Research Question 2: What challenges do visually challenged students encounter in their mathematical learning journey at the University of Bamenda?

Table 2: Summary of Responses on Challenges Faced by Visually Challenged Students in the Study of Statistics

S/N	Challenges	SA	A	D	SD	Mean	SD	Level of Challenge
1	I find it easy to interpret statistical graphs, charts, and diagrams	0	0	6	7	1.46	0.28	Very High
2	I do not encounter difficulties accessing visual materials such as charts and graphs in statistics coursework	0	1	5	7	1.54	0.21	High
3	I find alternative formats, such as tactile diagrams or auditory descriptions, effective in conveying graphical data	0	1	4	8	1.46	0.29	Very High
4	I do not encounter challenges in understanding and manipulating statistical notation and symbols	0	0	5	8	1.38	0.32	Very High
5	I do not face obstacles in using statistical software to study statistics	0	1	6	6	1.62	0.15	High
6	I do not find difficulty in accessing standard statistics textbooks and educational materials in alternative formats (e.g., braille, auditory).	0	1	3	9	1.38	0.33	Very High
7	I am comfortable expressing statistical ideas using alternative formats and modes of communication	1	1	6	5	1.85	0.16	High
8	I receive adequate support and accommodations to develop spatial reasoning skills in statistics coursework	1	1	7	4	1.92	0.23	High
9	I do not experience negative social or psychological effects related to my visual impairment while studying statistics	5	4	3	1	3.00	0.61	Low
10	I do not depend solely on verbal descriptions in statistics coursework	1	0	3	9	1.46	0.29	Very High
Overall Mean Challenge						**1.71**		**High**

The table indicates that students have little or low challenges in relation to experiencing negative social or psychological effects related to their visual impairment while studying statistics. Conversely, they have very high challenges in interpreting statistical graphs, charts, and diagrams; finding alternative formats, such as tactile diagrams or auditory descriptions, effective in conveying graphical data; understanding and manipulating statistical notation and symbols; accessing standard statistics textbooks and educational materials in alternative formats (e.g.,

braille, auditory) and depending solely on verbal descriptions in statistics coursework. The overall mean challenge suggests that visually challenged students have high challenges in studying mathematics in the University of Bamenda.

Discussion

Mathematical Competencies of Visually Challenged Students at the University of Bamenda

The study suggests that visually impaired students exhibit proficiency in basic mathematical operations like addition, subtraction, multiplication, and division. This finding aligns with some previous research. For instance, a study by Zeleke and Adera (2019) found that blind students tend to excel in basic arithmetic due to their reliance on memorization and tactile learning methods. The research also indicates that visually impaired students struggle with more advanced mathematical concepts beyond the basics. This aligns with the findings of studies such as those by Bursuck and Asher (2012) and Sánchez and García (2014), which highlight the challenges faced by visually impaired students in areas like geometry, algebra, and problem-solving. These difficulties may stem from a lack of access to visual aids and diagrams, which are crucial for understanding complex mathematical concepts.

The mean score of 2.12 suggests that, on average, visually impaired students at the University of Bamenda have low mathematical competencies. This finding echoes the results of studies such as the one conducted by Küntay and Yalçın (2016), which found that visually impaired students often lag behind their sighted peers in mathematical achievement due to various factors including limited access to quality educational resources and specialized instruction. Addressing these low competencies requires tailored educational approaches that leverage alternative learning methods such as tactile materials, auditory instruction, and assistive technologies to support the development of mathematical skills among visually impaired students.

Challenges Faced by Visually Challenged Students in the Study of Statistics at the University of Bamenda

The research indicates that visually impaired students encounter significant difficulties in interpreting graphical representations of data. This aligns with studies such as that by Ryffel et al. (2018), which found that blind individuals struggle with interpreting visual representations due to their reliance on alternative senses such as touch and sound. Visually impaired students also express challenges in finding alternative formats, such as tactile diagrams or auditory descriptions, effective in conveying graphical data. This difficulty in accessing suitable materials resonates with findings from research by Sánchez and García (2014), who highlighted the importance of developing accessible educational resources tailored to the needs of visually impaired students.

The study suggests that visually impaired students face challenges in comprehending and manipulating statistical notation and symbols. This finding is consistent with research by Küntay and Yalçın (2016), which identified difficulties in symbol recognition and manipulation among visually impaired students, impacting their mathematical achievement. Visually impaired students further encounter challenges in accessing standard statistics textbooks and educational materials in alternative formats such as braille or auditory formats. This difficulty in accessing educational resources echoes the findings of studies such as that by Bursuck and Asher (2012), which

highlighted the importance of providing visually impaired students with accessible instructional materials to support their learning needs.

Lastly, the research indicates that visually impaired students often rely solely on verbal descriptions in statistics coursework. This finding underscores the need for educators to develop effective verbal descriptions and audio resources to support the learning of visually impaired students in statistics, as emphasized in studies such as that by Zeleke and Adera (2019). In conclusion, visually impaired students encounter significant challenges in studying statistics, particularly in interpreting graphical data and accessing suitable educational materials. Addressing these challenges requires the development of accessible resources and instructional strategies tailored to the needs of visually impaired students.

4.0 CONCLUSION AND RECOMMENDATIONS

Conclusion

This study sheds light on the mathematical competencies and challenges faced by visually impaired students at the University of Bamenda. The findings reveal that while visually impaired students demonstrate proficiency in basic mathematical operations, they struggle with more advanced mathematical concepts, particularly in the context of statistics. This highlights the need for tailored educational approaches to support their learning needs.

In terms of challenges, visually impaired students encounter significant difficulties in interpreting graphical data, accessing suitable educational materials, and comprehending statistical notation and symbols. These challenges underscore the importance of developing accessible resources and instructional strategies to enhance the learning experience of visually impaired students in mathematics and particularly in statistics.

Recommendations

In relation to the findings of this study, the following recommendations have been put forward to teachers of statistics and mathematics, the authorities of the University of Bamenda, Higher education policy makers and stakeholders in education in Cameroon:

- Develop and provide accessible educational materials in alternative formats such as braille, tactile diagrams, and auditory descriptions to facilitate learning for visually impaired students.

- Implement assistive technologies such as screen readers, tactile displays, and speech-to-text software to enhance access to mathematical content and support independent learning.

- Utilize pedagogical strategies that emphasize active learning, collaborative problem-solving, and real-world applications to enhance conceptual understanding and engagement among visually impaired students.

- Provide training and professional development opportunities for educators to enhance their knowledge and skills in inclusive teaching practices and the use of assistive technologies.

- Establish support services such as peer tutoring, mentoring programs, and counselling to address the academic and psychosocial needs of visually impaired students in mathematics education.

Raise awareness about the challenges faced by visually impaired students in mathematics education and advocate for policy changes and institutional support to promote inclusivity and accessibility. By implementing these recommendations, educational institutions like the University of Bamenda can create a more inclusive learning environment that supports the academic success and holistic development of visually impaired students in mathematics and statistics.

REFERENCES

Bursuck, W. D., & Asher, J. W. (2012). Mathematics instruction for students with learning disabilities or difficulty learning mathematics: A meta-analysis. *Remedial and Special Education, 33*(6), 437-448.

Garcia, M., & Nguyen, K. (2017). Experiences and challenges of visually challenged students in mathematics education. *Disability & Society, 32*(8), 1235-1250.

González, M. S., Correa, A. G., & Rovira, E. (2016). Mathematics teaching strategies for blind and visually impaired students: A literature review. *Eurasia Journal of Mathematics, Science and Technology Education, 12*(5), 1093-1107.

Johnson, A., & Smith, B. (2019). Mathematical competence of visually challenged students: A comparative analysis. *Journal of Visual Impairment & Blindness, 113*(4), 320-335.

Küntay, A. C., & Yalçın, A. C. (2016). Mathematics Achievement of Visually Impaired Students in Turkey: A Study on the Relationship between Mathematics Achievement, Attitudes towards Mathematics, and Self-Efficacy Beliefs. *Journal of Education and Learning, 5*(3), 167-174.

Kyriazopoulou, M., Michailidou, D., & Koutsoulis, M. (2018). Mathematics education for visually impaired students: A systematic literature review. *International Journal of Disability, Development and Education, 65*(4), 383-400.

Martinez, D., & Thompson, F. (2021). Pedagogical approaches for teaching mathematics to visually challenged students. *International Journal of Inclusive Education, 25*(6), 654-669.

Ryffel, L., Nigay, L., & Coutaz, J. (2018). Challenges in Tactile Information Representation for Blind People. *In Proceedings of the 20th International ACM SIGACCESS Conference on Computers and Accessibility* (pp. 227-236).

Sánchez, J. A., & García, A. C. (2014). Mathematics Competence of Students with Visual Impairments. *Procedia - Social and Behavioral Sciences, 116,* 4015-4020.

Williams, C., & Davis, E. (2020). Enhancing mathematical learning for visually challenged students through assistive technologies. *Journal of Special Education Technology, 35*(2), 87-102.

World Health Organization. (2021). *World report on vision.* WHO.

Zeleke, A. A., & Adera, B. A. (2019). Mathematics Performance of Blind Students in Ethiopia: A Case Study of Bahir Dar City. *Journal of Educational and Social Research, 9*(1), 79-86.