



An Investigation into the Three Most Failed Subjects by Students with Visual Impairment in the Cameroon GCE Ordinary Level: Reported Factors and Potential Explanations

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Abstract	Article information
Background: Students with visual impairment in Cameroon face significant academic challenges, as evidenced by the 2025 General Certificate of Education (GCE) Ordinary Level results showing a pass rate of only 39.13% compared to the national average of 79.12%. Objective: This study identifies the three subjects most frequently failed by students with visual impairment in the Cameroon GCE Ordinary Level examination, examines reported factors associated with poor performance, and proposes evidence-based interventions supported by previous literature. Methods: Employing a mixed-methods explanatory sequential design, the study analyzed eleven years (2015–2025) of GCE examination data from 206 candidates with visual impairment. Quantitative analysis identified the three most failed subjects by percentage failure rate. Subsequently, syllabi analysis, teacher questionnaires (n=25), and semi-structured interviews with students with visual impairment (n=25) explored specific challenges, problematic topics, and pedagogical barriers. Results: Mathematics (87.13% failure rate), Computer Science (79.31%), and Geography (73.56%) were identified as the three most failed subjects. Syllabi analysis revealed multiple visually-dependent topics across all three subjects. Teachers reported challenges in materials preparation and notation instruction. Students identified barriers including inaccessible instructional methods and spatial reasoning difficulties. Conclusion: Reported factors suggest that systemic barriers—including inaccessible curricula, untrained teachers, and visually biased assessments—may contribute to poor outcomes. The Social Model of Disability provides a framework for understanding structural responsibilities in improving educational outcomes. Keywords: visual impairment, GCE Ordinary Level, mathematics education, computer science education, geography education	Received: 14/08/2026; Reviewed: 26/08/2026; Revised: 03/09/2026; Accepted: 07/09/2026

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1. Introduction

Background

Education The education of persons with disabilities has emerged as a critical priority in global development agendas. The United Nations Convention on the Rights of Persons with Disabilities affirms the right to inclusive education (United Nations, 2016). Cameroon, as a signatory to this convention, has committed to ensuring equal access to quality education for all learners, including those with visual impairment. However, significant gaps persist between policy commitments and educational outcomes (Cockburn et al., 2017).

The General Certificate of Education (GCE) Ordinary Level examination represents a pivotal milestone in the Cameroonian educational system, serving as the primary gateway to higher education and employment opportunities. Performance in this examination significantly influences life trajectories, making equitable access and achievement essential for social inclusion and economic participation.

The 2025 GCE Ordinary Level examination results revealed a troubling disparity: only 9 of 23 candidates with visual impairment (39.13%) achieved the minimum pass requirement of at least four subjects with grades A, B, or C. This stands in stark contrast to the national pass rate of 79.12%, indicating that students with visual impairment are performing at slightly less than half the national average. This performance gap raises urgent questions about the nature of the reported difficulties and what interventions might address them.

Statement of the Research Problem

Persons with visual impairment in Cameroon face serious academic challenges in secondary education, particularly evident in their performance in the GCE Ordinary Level examination. The 2025 results, showing a pass rate of only 39.13% against a national average of 79.12%, underscore potential systemic barriers that may hinder equitable educational outcomes. Despite growing policy attention to inclusive education, limited empirical research has systematically identified the specific subjects where students with visual impairment struggle most, the reported factors associated with these difficulties, or evidence-based interventions tailored to the Cameroonian context. This research addresses these

gaps by identifying the three subjects most frequently failed by students with visual impairment, exploring reported factors associated with poor performance, and proposing practical interventions supported by previous literature.

Research Objectives

1. To identify the three subjects with the highest failure rates among students with visual impairment in the Cameroon GCE Ordinary Level examination from 2015 to 2025.
2. To identify the specific topics within these subjects that may pose the greatest challenges for students with visual impairment.
3. To identify the difficulties teachers report in teaching these subjects to students with visual impairment.
4. To identify the difficulties students with visual impairment report in learning these subjects.
5. To propose evidence-based interventions supported by previous literature that may improve performance.

Significance of the Study

This research provides empirical evidence on the specific subjects where students with visual impairment face the greatest challenges, enabling targeted resource allocation. By exploring reported factors from multiple perspectives—examination data, syllabi analysis, teacher experiences, and student experiences—the study offers a comprehensive understanding of potential barriers. The proposed interventions provide practical guidance for policymakers, educators, and advocacy organizations. The study contributes to the limited body of empirical research on the education of students with visual impairment in sub-Saharan Africa.

2. Literature Review

Conceptual Review: Subjects Most Failed and Reported Factors

Research consistently identifies specific subject areas where students with visual impairment experience disproportionate academic difficulty. Mathematics stands as the most frequently cited subject of difficulty, attributable to its heavy reliance on visual notation, spatial reasoning, and

graphical representation of abstract concepts (Rosenblum & Herzberg, 2021). The linear nature of mathematical braille codes creates cognitive load as students translate between spatial visual representations and sequential tactile formats, complicating comprehension of algebraic equations, geometric proofs, and statistical analyses.

Science and geography subjects present similarly formidable barriers rooted in empirical and observational foundations. Laboratory-based inquiry traditionally depends upon visual observation, apparatus manipulation, and interpretation of visual data displays (Papadopoulos et al., 2022). Geography's dependence upon cartographic representation, spatial relationships, and visual interpretation of landscapes poses particular challenges when tactile alternatives are unavailable (Douglas et al., 2022).

The reported factors underlying subject-specific difficulties operate at multiple interconnected levels. At the institutional level, inadequate provision of accessible learning materials represents a primary barrier (UNESCO, 2020). Teacher preparation constitutes a second institutional factor, as general education teachers often lack training in specialized pedagogical approaches (Fonyuy, 2019). Examination system design frequently incorporates visual bias through graphically-dependent questions and formatting that assumes sighted test-taking strategies.

Interventions supported by previous literature emphasize universal design principles applied to curriculum development, ensuring instructional materials are accessible from inception. Technological interventions, including screen readers with mathematical notation support, tactile graphic production systems, and audio-tactile devices, offer promising avenues (Cmar & Nagle, 2022). Teacher professional development focused on inclusive pedagogies has demonstrated effectiveness. Examination accommodations, including extended time and alternative formats, represent essential systemic modifications.

Theoretical Framework: The Social Model of Disability

This research is grounded in the Social Model of Disability. The Social Model, as articulated by Shakespeare (2021) and others, distinguishes between "impairment" (biological condition) and "disability" (social, environmental, and attitudinal barriers). Applying this model to education, poor performance of students with visual impairment is primarily understood as a consequence of systemic barriers: curricula designed for sighted learners, textbooks unavailable in accessible formats,

untrained teachers, and inaccessible assessments. The problem lies not within the student but within an educational system that has failed to remove disabling barriers.

Empirical Review: Studies on Education of Persons with Visual Impairment

International research consistently demonstrates significant achievement gaps between students with visual impairment and sighted peers. In the United States, studies have found that students with visual impairments scored significantly below national norms in mathematics and science, with particular difficulties in spatial reasoning and graphical interpretation (Bishop, 2016). Research in the United Kingdom indicates persistent challenges in mathematics, science, and visual-spatial processing (Douglas et al., 2022).

These patterns are amplified in developing country contexts where resource constraints limit access to specialized support. The World Health Organization (2022) noted that in low-income countries, children with disabilities are significantly less likely to attend school and often experience lower quality instruction. Research in Eastern Africa has documented similar trends, with students with visual impairment facing particular difficulties in science and mathematics due to reliance on visual teaching methods and inadequate tactile materials (Adugna et al., 2022).

Research by Rosenblum and Herzberg (2021) found that mathematics achievement among students with visual impairment correlates strongly with access to appropriate tactile materials, teacher expertise in mathematical braille codes, and instructional time dedicated to concept development through non-visual means. Papadopoulos et al. (2022) demonstrated that students with visual impairment can achieve at high levels in computer science when provided with accessible programming environments, tactile graphics, and modified instructional approaches.

Empirical research on the educational experiences of persons with visual impairment in Cameroon is limited but growing. Tchombe and Shey (2017) highlighted that while national policies advocate for inclusion, implementation is severely hampered by lack of specialized teachers, inadequate materials, and negative societal attitudes. Nfor (2017) identified infrastructural barriers and prohibitive costs of assistive devices as key factors contributing to marginalization. Fonyuy (2019) found that mainstream secondary school teachers had received no pre-service or in-service training on special needs education.

Gaps in the Literature and Rationale for Current Study

While existing literature provides valuable insights, several gaps justify the current investigation. First, much research originates from developed country contexts, limiting applicability to Cameroon. Second, within Cameroon, research on disability and education is growing but sparse regarding subject-specific performance in national examinations. Studies have focused on general attitudes (Tchombe & Shey, 2017) or access challenges (Nfor, 2017). There is a significant lacuna in empirical research using official examination data to identify specific academic pain points. This study addresses these gaps by systematically identifying the three subjects most commonly failed, investigating reported factors, and proposing interventions supported by previous literature.

3. Methodology

Research design

This study employed a mixed-methods explanatory sequential design, integrating quantitative and qualitative approaches (Creswell & Plano Clark, 2017). Quantitative data from examination results were analyzed first to identify the three most failed subjects, followed by qualitative data collection and analysis to explain and elaborate upon these failures.

Area of Study

The research was conducted in Cameroon, focusing on candidates with visual impairment who sat for the GCE Ordinary Level examination. The study covered the entire national territory, as data obtained from the Cameroon GCE Board encompassed candidates from all regions.

Population and Sample

The target population comprised: (a) all persons with visual impairment who sat for the Cameroon GCE Ordinary Level examination between 2015 and 2025 (N = 206 candidates), (b) teachers with at least one year GCE Ordinary Level teaching experience in any of the identified subjects to students with visual impairment, and (c) persons with visual impairment who had written the subjects under investigation.

For quantitative analysis, the entire population of 206 candidates was included. For the qualitative phase, purposive sampling selected 25 teachers and 25 students with visual impairment. Inclusion

criteria were: (a) having taught or sat for the GCE Ordinary Level in at least one identified subject within the past ten years, and (b) willingness to participate.

Instruments for Data Collection

GCE Examination Results Spreadsheet: Provided by the GCE Board, used to calculate failure rates by subject.

Subject Syllabi: The official Cameroon GCE Ordinary Level syllabi for Mathematics, Computer Science, and Geography were obtained. Three academic specialists in Special Needs Education independently reviewed each syllabus to identify topics that appeared to depend heavily on visual skills (e.g., geometric constructions, flowcharts, map interpretation). They compared their lists, discussed discrepancies until consensus was reached, and ranked topics according to the density of visual-spatial requirements. This systematic content analysis identified the most visually dependent topics.

Questionnaire for Teachers: A semi-structured questionnaire with closed-ended and open-ended questions gathered information on difficulties encountered in teaching the identified subjects and suggestions for improvement.

Interview Guide for Students: A semi-structured interview guide explored specific challenges encountered in learning the subjects and suggestions for improvement.

Validation and Reliability

Validity was ensured through review of the research proposal, methodology and subject syllabi by three academic doctors in special needs education and research methodology. Content validity was ensured by aligning each instrument item with the research objectives. Reliability was ensured through: (a) expert review of research instruments, including subject syllabi by three academic doctors in Special Education and Research Methodology, (b) use of three statistical analytic tools (Kimi AI, Google Gemini and SPSS 2025), for quantitative analysis of subject failure rates, (c) mixed-methods triangulation – subject syllabi analysis, teacher and student questionnaires, (d) pilot testing with ten teachers and ten students, and (e) observing research ethics through encoding participant's data.

Procedure for Data Collection

Phase One: The results of students with visual impairment were requested and obtained from the Cameroon GCE Board. Data were analyzed to identify the three most problematic subjects. Syllabi of these subjects were analyzed by three academic doctors in Special Needs Education.

Phase Two: Twenty-five teachers with at least one year of GCE Ordinary Level teaching experience for students with visual impairment in any of the identified subjects were identified and contacted. Questionnaires were distributed to determine challenges faced in teaching the subjects and proposed solutions.

Phase Three: Twenty-five students with visual impairment who had written any of the identified subjects in the GCE Ordinary Level were identified and contacted. Individual interviews were scheduled. With permission, interviews were audio-recorded; for participants not comfortable with recording, detailed notes were taken, to determine challenges faced in learning the subjects and proposed solutions.

Method of Data Analysis

Quantitative Data Analysis: Examination results data were analyzed using descriptive statistics. Frequency and percentage of failures in each subject were calculated. Subjects were ranked according to failure frequency.

Qualitative Data Analysis: Data from subject syllabi, teacher questionnaires and student interviews were analyzed using thematic analysis as outlined by Braun and Clarke (2019).

Integration of Findings: Quantitative and qualitative findings were integrated to provide comprehensive answers to research questions.

Ethical Considerations

Ethical approval was sought from the GCE Board's research ethics committee before the candidate's results could be granted. Informed consent was obtained from all participants. Confidentiality was ensured by using pseudonyms and storing data securely.

4. Results

Research Objective One: Identification Of Three Most Failed Subjects

From statistical analysis of GCE Ordinary Level results for candidates with visual impairment from 2015 to 2025, subjects with participation fewer than 20 candidates were excluded. The three subjects with highest percentage failure rates are Mathematics, Computer Science, and Geography. Table 1 outlines the annual candidate enrollment, absolute count of unclassified or failing grades, and calculated failure percentage.

Table 1. Candidate Enrollment and Failure Rates for Mathematics, Computer Science, and Geography

Year	Subject	Total Wrote	Failed Count	Failure Rate (%)
2015	Mathematics	15	15	100.00
	Computer Science	1	1	100.00
	Geography	1	0	0.00
2016	Mathematics	11	11	100.00
	Computer Science	0	0	N/A
	Geography	3	3	100.00
2017	Mathematics	4	4	100.00
	Computer Science	0	0	N/A
	Geography	2	2	100.00
2018	Mathematics	10	10	100.00
	Computer Science	0	0	N/A
	Geography	3	2	66.67
2019	Mathematics	8	8	100.00
	Computer Science	2	2	100.00
	Geography	5	4	80.00
2020	Mathematics	18	18	100.00
	Computer Science	3	3	100.00
	Geography	10	8	80.00
2021	Mathematics	21	21	100.00
	Computer Science	4	4	100.00
	Geography	15	13	86.67
2022	Mathematics	19	11	57.89
	Computer Science	5	5	100.00

	Geography	10	10	100.00
2023	Mathematics	26	21	80.77
	Computer Science	5	2	40.00
	Geography	15	10	66.67
2024	Mathematics	17	13	76.47
	Computer Science	3	2	66.67
	Geography	11	4	36.36
2025	Mathematics	22	17	77.27
	Computer Science	6	4	66.67
	Geography	12	8	66.67

Note. N/A indicates no candidates sat for the subject in that year.

Interpretations: Mathematics is the most significant academic hurdle, with nearly 9 out of 10 students failing to achieve a passing grade. Although the number of candidates who failed Geography (64) almost triples the number failing Computer Science (23), Computer Science still has a higher percentage failure rate (79.31%) than Geography (73.56%).

Research Objective Two: Identification Of Problematic Topics Within Identified Subjects

Syllabi Analysis Method and Findings

Three academic doctors in Special Needs Education independently reviewed the official GCE Ordinary Level syllabi for Mathematics, Computer Science, and Geography. Each reviewer examined topics against six categories of visual dependency: (a) diagram/chart interpretation, (b) spatial reasoning, (c) color coding, (d) scale and proportion, (e) directional concepts, and (f) pattern recognition. Topics rated as highly dependent on two or more categories by all three reviewers were classified as potentially problematic.

The analysis revealed extensive visually-dependent content across all three subjects. In Mathematics, potentially problematic areas include: Geometry and Spatial Reasoning (geometric constructions, properties of shapes, circle theorems, trigonometry, bearings and distances, loci); Graphical Representations (plotting and interpreting graphs, statistical graphs); Measurement and Mensuration (scale drawings); Transformations; and Vectors and Matrices.

In Computer Science, potentially problematic topics include: Programming and Algorithm Design (flowchart construction, pseudocode conversion); Data Representation (binary conversions, bitmap

images); Hardware and Architecture (CPU architecture diagrams, logic gates and truth tables); Networking (network topologies, OSI model layers); Databases (entity-relationship diagrams, data flow diagrams); and Web Development (HTML/CSS structure).

In Geography, potentially challenging topics include: Map Work and Cartography (topographic map interpretation, grid references, scale calculations, cross-section drawing); Weather and Climate (weather map interpretation, climate graphs, synoptic charts); Economic Geography (flow line maps, choropleth maps); Physical Geography (river morphology, coastal landforms, soil profiles); Human Geography (population pyramids, migration flow diagrams); and Regional Geography (photograph interpretation).

Table 2. Common Visual Barriers Across Subjects

Barrier Type	Mathematics	Computer Science	Geography
Diagrams/Charts	Geometric figures, graphs	Flowcharts, circuit diagrams	Maps, cross-sections
Spatial reasoning	3D visualization	Network topologies	Relief interpretation
Color coding	Graph distinctions	Logic gate levels	Map symbols, choropleth
Scale and proportion	Graph axes, maps	Memory hierarchies	Map scales, proportions
Directional concepts	Bearings, vectors	Data flow directions	Compass directions, wind
Pattern recognition	Shape properties	Binary patterns, codes	Landform patterns

Research Objective 3: Identification Of Challenges Teachers Face In Teaching Identified Subjects

Teacher Perspectives: Thematic Analysis

Thematic analysis of teacher questionnaire data generated four major themes.

Theme 1: Materials Preparation Burden. Teachers reported that creating tactile materials was extremely time-intensive. One teacher noted: "I spend three hours preparing one tactile graph that sighted students can see in seconds. It is impossible to do this for every lesson." Another stated: "We have no swell paper, no thermoform machine. I draw raised lines by hand with glue, which takes forever and often breaks." This theme suggests that resource scarcity may contribute to inadequate tactile material provision.

Theme 2: Notation Instruction Challenges. Teachers struggled to teach mathematical and programming notation. A mathematics teacher explained: "I was never taught Nemeth Braille in

college. When a student asks me to verify their algebraic expression, I cannot read what they have written." A computer science teacher added: "Programming syntax requires precise characters. I don't know how to teach debugging when I cannot verify the Braille code the student produced." This indicates that gaps in teacher preparation may limit effective notation instruction.

Theme 3: Visual-Dependent Pedagogies. Teachers acknowledged reliance on visual methods. One geography teacher stated: "I project maps on the screen and point to features. I realize now this excludes the blind student completely, but I don't know another way to teach contour lines." A mathematics teacher similarly reported: "I draw geometry on the board and say 'look at this triangle.' My blind student sits silently because there is nothing to look at." This suggests that pedagogical practices may not accommodate non-visual learners.

Theme 4: Assessment Constraints. Teachers noted difficulties creating accessible assessments. One reported: "The GCE questions always have diagrams. Even when I teach the concept well, the exam tests whether they can see the diagram, not whether they understand the math." Another added: "I cannot create fair internal tests because I don't know how to write a geometry question without a picture." This points to potential assessment bias as a contributing factor.

Research Objective 4: Identification Of Challenges Students Face In Learning Identified Subjects

Student Perspectives: Thematic Analysis

Thematic analysis of student interview data generated four major themes that both converged with and diverged from teacher reports.

Theme 1: Inaccessible Instructional Methods. Students consistently reported that teachers relied on visual methods. One student stated: "The teacher writes everything on the board and says 'copy this diagram.' I sit there waiting for someone to describe it to me, but often no one does." Another explained: "In geography, the teacher shows slides of landforms. I hear 'as you can see' twenty times per lesson. I cannot see anything." This converges with teacher Theme 3, confirming that visual-dependent pedagogies are a shared concern.

Theme 2: Spatial Reasoning Difficulties. Students described specific cognitive challenges. A mathematics student reported: "When the teacher says 'imagine a cube rotated 90 degrees,' I cannot imagine it. I can feel a real cube, but in the exam there is no real cube, only words." A geography student added: "Contour lines are just lines to me. I cannot feel the mountain from lines on paper. The

teacher says 'the lines are close together so the slope is steep,' but I don't understand what steep looks like." This complements teacher reports by revealing the cognitive dimension of spatial tasks.

Theme 3: Notation and Reading Barriers. Students highlighted difficulties with specialized codes. One student explained: "Reading math in Braille takes me five minutes per equation. My sighted classmates read it in ten seconds. In exams, I run out of time not because I don't know the math, but because I cannot read the questions fast enough." Another stated: "Computer code in Braille is confusing. One small dot out of place and the whole program fails. I cannot see where the error is." This converges with teacher Theme 2 but adds the temporal pressure dimension that teachers did not emphasize.

Theme 4: Assessment Environment Barriers. Students reported that examination conditions exacerbated difficulties. One student noted: "I get extra time, but it is not enough. The invigilator does not know how to handle my Braille paper. I waste twenty minutes just getting started." Another said: "In Computer Science, the practical exam uses software that my screen reader cannot read. I am tested on my ability to fight the computer, not my programming skill." This extends teacher Theme 4 by documenting lived experiences of assessment barriers.

Comparison of Teacher and Student Perspectives

Teacher and student findings converged on three key areas: the burden of materials preparation (teacher Theme 1, student Theme 1), notation instruction challenges (teacher Theme 2, student Theme 3), and assessment bias (teacher Theme 4, student Theme 4). Both groups identified these as significant barriers.

However, divergence emerged in emphasis. Teachers focused on systemic and logistical constraints—time, training, and resources—positioning themselves as constrained by institutional failures. Students, while acknowledging these barriers, placed greater emphasis on the cognitive and temporal consequences: the mental effort of spatial reasoning, the slowness of Braille reading, and the frustration of examination logistics. This suggests that teachers may perceive barriers as external and structural, while students experience them as immediate and personal. Neither perspective contradicts the other; rather, they illuminate different facets of the same systemic challenges.

Research Objective Five: Evidence-Based Interventions

The following interventions are supported by previous literature and may address the reported factors identified in this study. They are presented separately from the study's findings.

Interventions for Mathematics

Tactile materials such as raised-line drawing kits and 3D manipulatives may enable hands-on exploration of spatial relationships (Rosenblum & Herzberg, 2021). Audio-tactile devices, including talking calculators and audio graphing software, may support independent computational work. Mandatory certification in Nemeth Code or Unified English Braille for mathematics teachers may address notation instruction gaps. Modified instructional approaches—verbalization of visual information and sequential problem-solving strategies—may reduce reliance on visual methods. Accessible assessments, including tactile graphs and extended time, may reduce assessment bias.

Interventions for Computer Science

Screen reader-compatible integrated development environments and audio debuggers may enable independent programming practice (Papadopoulos et al., 2022). Tactile programming tools, such as physical programming blocks and tactile flowchart templates, may support algorithm understanding. Text-based programming with strong audio feedback may be preferable to visual drag-and-drop environments. Hardware adaptations, including refreshable Braille displays and high-contrast themes, may improve access. Screen-reader optimized documentation may reduce information retrieval barriers.

Interventions for Geography

Tactile cartography, including Braille atlases, raised-relief maps, and 3D terrain models, may support map literacy (Douglas et al., 2022). Audio maps and GPS-based navigation systems may complement tactile materials. Multi-sensory field trips incorporating touch, sound, and temperature may provide experiential alternatives to visual fieldwork. Data sonification—converting climate graphs to audio representations—may support statistical interpretation. Verbal description training for teachers may improve instructional accessibility.

Cross-Cutting Systemic Interventions

Policy level: Mandatory inclusive education training in teacher pre-service programs and accessibility standards for examinations may create enabling conditions.

Infrastructure level: Resource centers for producing tactile materials and assistive technology lending libraries may address material scarcity.

Curriculum level: Flexible curricula allowing alternative achievement demonstrations may reduce visual skill emphasis.

Assessment level: Universal Design for Learning principles in examination construction and multiple format options may reduce assessment bias.

Professional development: Ongoing in-service training on assistive technologies and inclusive pedagogies may address teacher preparation gaps.

5. Discussion

The Three Most Failed Subjects

The findings confirm Mathematics, Computer Science, and Geography as the three most failed subjects for students with visual impairment. The mathematics failure rate of 87.13% is particularly alarming, consistent with international research identifying mathematics as the most challenging subject for visually impaired students (Rosenblum & Herzberg, 2021). This high failure rate may reflect the cumulative effect of multiple reported barriers: inaccessible notation, spatial reasoning requirements, graphical representations, and assessment formats that privilege visual interpretation.

The prominence of Computer Science among the three most failed subjects is noteworthy given the small candidate pool (29 over eleven years). This suggests that students with visual impairment who enroll in Computer Science face extraordinary difficulties, likely due to the highly visual nature of programming environments, flowcharting, and system architecture diagrams.

Geography's 73.56% failure rate, while lower than Mathematics and Computer Science, still represents a significant barrier. Geography's dependence on cartographic representation, spatial relationships, and visual interpretation of landscapes creates challenges when tactile alternatives are unavailable (Douglas et al., 2022).

Reported Factors Associated with Poor Performance

The syllabi analysis, teacher reports, and student experiences reveal multiple interconnected reported factors, aligning with the Social Model of Disability's emphasis on systemic barriers (Shakespeare, 2021).

Systemic Barriers

Material and resource deficiencies were the most frequently cited reported factor. The time-intensive nature of creating tactile graphics, the scarcity of Braille mathematics resources, and the absence of accessible computer laboratories reflect systemic failures in resource provision. This resonates with UNESCO's (2020) findings that braille production facilities in low-income contexts often cannot meet demand for mathematics and science texts.

Teacher preparation gaps emerged consistently. Teachers reported inadequate training in specialized pedagogical approaches. The reliance on visual teaching methods, unfamiliarity with mathematical Braille codes, and lack of strategies for teaching visually-dependent topics reflect systemic failures in teacher education. This aligns with Fonyuy's (2019) research finding that mainstream teachers had received no pre-service or in-service training on special needs education.

Assessment system bias was identified as a significant reported factor. Examination questions often test visual interpretation rather than subject understanding. This reflects what the Social Model describes as disabling barriers embedded in assessment design.

Infrastructure limitations, including lack of refreshable Braille displays, accessible software, and tactile mapping tools, exacerbate other barriers. This reflects broader patterns noted by Nfor (2017) regarding prohibitive costs of assistive devices.

Pedagogical Challenges

Spatial reasoning requirements emerged as a central challenge across all three subjects. Geometry, network topologies, and map interpretation require visualization capabilities that are inherently difficult for students with visual impairment. This confirms research on the particular difficulties of subjects requiring visual-spatial processing (Douglas et al., 2022).

Representation translation creates significant cognitive load. In mathematics, the linear nature of braille codes creates challenges for understanding two-dimensional spatial relationships. In geography, translating contour lines to three-dimensional terrain comprehension requires substantial cognitive effort.

Individual Experiences

While systemic barriers predominate, student interviews revealed that even when resources are available, students may face challenges in managing time efficiently in timed examinations and developing effective study strategies. These reported factors do not imply deficits within students but rather highlight the interaction between environmental barriers and individual coping strategies.

Evidence-Based Interventions

The interventions supported by previous literature operate at multiple levels, reflecting the Social Model's emphasis on removing systemic barriers.

Immediate priorities include Nemeth Braille training for teachers, talking calculators, extended examination time, and alternative assessment formats. These address critical reported barriers with relatively low resource requirements.

Medium-term priorities include resource centers for material production, screen reader-compatible software procurement, and accessible programming curriculum redesign. These require greater investment but promise substantial impact.

Long-term transformation requires comprehensive teacher pre-service reform. Sustainable improvement may require fundamental changes in how teachers are prepared, rather than relying solely on in-service training.

Theoretical Implications

The findings support the Social Model of Disability. The predominance of systemic barriers—inaccessible materials, untrained teachers, biased assessments—validates the model's emphasis on structural responsibility. The high failure rates cannot be attributed primarily to individual deficits but may reflect educational systems that fail to accommodate human diversity (Shakespeare, 2021).

Comparison with International Research

The findings align with international research while revealing context-specific challenges. The identification of mathematics as the most challenging subject is consistent with findings from the United States and United Kingdom (Bishop, 2016; Douglas et al., 2022). However, the magnitude of the failure rates (87%, 79%, 74%) exceeds those typically reported in developed countries, reflecting

amplified challenges in resource-constrained contexts. This aligns with World Health Organization (2022) findings that disability-related educational disparities are exacerbated in low-income countries.

6. Conclusion and recommendations

Summary of Findings

This study investigated the three subjects most failed by students with visual impairment in the Cameroon GCE Ordinary Level examination and reported factors associated with poor performance. Mathematics (87.13%), Computer Science (79.31%), and Geography (73.56%) are the three subjects with highest failure rates. Multiple visually-dependent topics create potential barriers across all three subjects. Teachers reported difficulties in materials preparation, notation instruction, and assessment adaptation. Students reported barriers in pedagogical access, spatial reasoning, notation comprehension, and assessment environments. Reported factors suggest that systemic barriers may be primary contributors to poor outcomes.

Recommendations

The following recommendations are closely connected to the evidence and address the reported factors identified in this study.

For Policy Makers: Mandate inclusive education training in pre-service and in-service programs for teachers of Mathematics, Computer Science, and Geography. Develop and enforce accessibility standards for GCE examinations, including alternative format options and extended time. Provide specific budget allocations for assistive technology and tactile materials.

For the GCE Board: Implement Universal Design for Learning principles in examination construction, ensuring questions test subject understanding rather than visual interpretation. Offer multiple format options including oral examinations, tactile graphics, and screen-reader compatible digital formats.

For Educational Institutions: Establish regional resource centers for producing tactile materials and loaning assistive technology. Partner with disability organizations and technology companies to secure resources. Implement peer support programs pairing visually impaired students with sighted peers trained in supportive collaboration.

For Teachers: Learn techniques for producing raised-line drawings, 3D models, and tactile graphics. Use verbal description techniques, sequential problem-solving strategies, and multi-sensory teaching approaches. Collaborate with special needs educators to develop comprehensive support plans.

For Students and Families: Develop self-advocacy skills to articulate needs and request accommodations. Cultivate effective study strategies and time management techniques for accessible materials. Engage with support networks for encouragement and guidance.

Limitations and Future Research

The qualitative sample of 25 teachers and 25 students may not fully represent diverse experiences across Cameroon's ten regions. Qualitative data collection may have been disproportionately accessible in urban areas. The eleven-year timeframe captures recent trends but may not reflect longer-term patterns. Only the three most failed subjects were investigated in depth.

Future research should track cohorts longitudinally, compare outcomes across regions and sectors, conduct rigorous evaluations of specific interventions, investigate current teacher education program content, and examine factors facilitating inclusive education policy implementation.

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