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Challenges and strategies for optimizing the use of optical mark readers in examination management in minsante-accredited schools in Bafoussam, Cameroon

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ABSTRACT

This study examines the challenges and strategies for optimizing the use of Optical Mark Reader (OMR) technology in examination management within MINSANTE-accredited health training schools in Bafoussam, Cameroon. Despite the demonstrated potential of OMR technology to reduce grading time, minimize human error, and enhance assessment objectivity, its adoption in Cameroonian health education institutions remains limited and uneven. Using a mixed-methods approach combining survey data from examination administrators and semi-structured interviews with school directors, this study identifies key barriers to effective OMR utilization and evaluates strategies for optimization. The analysis draws on the Task-Technology Fit framework, which posits that technology adoption and effective use depend on the alignment between technology capabilities, task requirements, and user characteristics. Findings reveal that digital literacy gaps, high equipment costs, inadequate technical support, and insufficient training constitute primary challenges. Task-technology fit is achieved when OMR capabilities align with examination volume and format requirements, but is undermined by inconsistent power supply, scanner incompatibility, and the absence of standardized answer sheet templates across institutions. The study proposes a multi-level optimization strategy encompassing individual capacity building, institutional infrastructure development, and sector-level coordination. The findings contribute to the literature on educational technology adoption in resource-constrained contexts and provide actionable recommendations for MINSANTE-accredited schools seeking to enhance examination management efficiency.

Keywords: Optical Mark Reader, OMR technology, examination management, health education, technology adoption, Task-Technology Fit, Cameroon, Bafoussam

RESUME

Cette étude examine les défis et les stratégies d'optimisation de l'utilisation de la technologie de lecture optique de marques (OMR) dans la gestion des examens au sein des écoles de formation sanitaire agréées par le MINSANTE à Bafoussam, au Cameroun. Malgré le potentiel démontré de la technologie OMR pour réduire le temps de correction, minimiser les erreurs humaines et améliorer l'objectivité de l'évaluation, son adoption dans les établissements d'enseignement sanitaire camerounais reste limitée et inégale. Utilisant une approche mixte combinant des données d'enquête auprès des administrateurs d'examens et des entretiens semi-structurés avec les directeurs d'écoles, cette étude identifie les principaux obstacles à l'utilisation efficace de l'OMR et évalue les stratégies d'optimisation. L'analyse s'appuie sur le cadre de l'adéquation tâche-technologie, qui postule que l'adoption et l'utilisation efficace de la technologie dépendent de l'alignement entre les capacités technologiques, les exigences des tâches et les caractéristiques des utilisateurs. Les résultats révèlent que les lacunes en matière de littératie numérique, les coûts élevés des équipements, le soutien technique inadéquat et la formation insuffisante constituent les principaux défis. L'adéquation tâche-technologie est atteinte lorsque les capacités de l'OMR s'alignent sur le volume et le format des examens, mais elle est compromise par l'alimentation électrique instable, l'incompatibilité des scanners et l'absence de modèles standardisés de feuilles de réponses entre les établissements. L'étude propose une stratégie d'optimisation à plusieurs niveaux englobant le renforcement des

capacités individuelles, le développement des infrastructures institutionnelles et la coordination au niveau sectoriel..

Mots-clés : Lecteur optique de marques, technologie OMR, gestion des examens, formation sanitaire, adoption technologique, adéquation tâche-technologie, Cameroun, Bafoussam

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1. INTRODUCTION

1.1 Background

The management of examinations in health professional training institutions presents distinctive challenges that distinguish it from general academic assessment. MINSANTE-accredited schools in Cameroon are responsible for training the nation's nurses, midwives, laboratory technicians, and other allied health personnel professionals whose competence directly affects population health outcomes. The assessment of these trainees must therefore meet standards of accuracy, reliability, and fairness that justify the trust placed in professional certification.

Optical Mark Reader (OMR) technology has emerged as a widely adopted solution for automating the scoring of multiple-choice examinations in educational institutions worldwide. The technology operates by scanning answer sheets and detecting marks made by examinees, comparing detected responses against pre-programmed answer keys to generate scores. The advantages of OMR systems are well documented: they dramatically reduce grading time, eliminate arithmetic errors, ensure consistency in scoring, and produce detailed analytical reports that can inform instructional improvement.

Despite these advantages, the adoption of OMR technology in Cameroonian health training institutions remains uneven. While some schools have acquired OMR equipment and software, others continue to rely on manual grading methods that are time-consuming, error-prone, and increasingly untenable given growing student enrollments. Furthermore, even among institutions that possess OMR technology, utilization rates and effectiveness vary considerably, suggesting that mere acquisition of equipment is insufficient to realize the technology's benefits.

1.2 Problem Statement

The Bafoussam region, as a significant hub for health professional training in Cameroon's West Region, hosts multiple MINSANTE-accredited schools. These institutions face common challenges: increasing enrollment numbers, limited

administrative budgets, pressure to produce examination results rapidly, and demands for assessment transparency. OMR technology offers a potential solution to these challenges, yet its adoption and effective use remain constrained by factors that are not well understood.

Previous research on OMR technology has focused predominantly on technical aspects—algorithm development, accuracy improvement, and hardware specifications. Less attention has been paid to the organizational, human, and contextual factors that determine whether OMR systems achieve their potential in real institutional settings. The Task-Technology Fit (TTF) model provides a theoretical lens for examining these factors, positing that technology use and performance depend on the alignment between technology characteristics, task requirements, and user attributes.

1.3 Study Context

MINSANTE-accredited schools in Bafoussam operate within a specific regulatory and resource environment. The Ministry of Public Health establishes accreditation standards, curriculum requirements, and examination regulations, but individual institutions retain autonomy over their examination administration and technology adoption decisions. The schools vary in size, ownership (public versus private), and resource base, creating heterogeneity that may influence OMR adoption and utilization patterns.

The examination context in these institutions is characterized by: high-stakes summative assessments that determine student progression and certification; large class sizes that make manual grading burdensome; multiple-choice question formats that are amenable to OMR processing but may not be universally applicable across all subjects; and demands for rapid result turnaround to meet academic calendar requirements.

1.4 Research Objectives

This study addresses the following objectives:

1. To identify the specific challenges encountered by MINSANTE-accredited schools in Bafoussam in their use of OMR technology for examination management.
2. To assess the level of task-technology fit achieved in current OMR applications and identify sources of misalignment.
3. To evaluate existing strategies for OMR optimization and their effectiveness.
4. To propose evidence-based recommendations for enhancing OMR utilization in examination management.

1.5 Significance of the Study

The findings of this study have implications for multiple stakeholder groups. For school directors and examination administrators, the analysis provides diagnostic insights into barriers to OMR effectiveness and practical strategies for improvement. For

MINSANTE as the regulatory authority, the findings inform the development of guidelines and support mechanisms for technology adoption across accredited institutions. For the broader literature on educational technology in resource-constrained contexts, the study contributes empirical evidence on the determinants of task-technology fit in a specific and under-researched setting.

2. LITERATURE REVIEW

2.1 Optical Mark Recognition Technology: Capabilities and Limitations

Optical Mark Recognition technology encompasses a range of hardware and software solutions designed to detect and interpret human-made marks on paper forms. The core function involves scanning answer sheets, identifying the presence or absence of marks in designated positions, and converting this visual information into digital data that can be processed by scoring software.

The accuracy of modern OMR systems is high. Experimental studies have reported accuracy rates ranging from 93.36 percent to over 99 percent under controlled conditions. The Remark Office software, a widely used commercial solution, offers compatibility with various scanners, support for multiple form designs, and detailed reporting capabilities. Open-source and low-cost alternatives have also been developed, making OMR technology accessible to institutions with limited budgets.

However, the literature also documents limitations and pitfalls. OMR is suitable only for closed-ended question formats, restricting its applicability in disciplines requiring essay-based or practical assessment. The preparation of OMR-compatible answer sheets requires careful attention to layout, bubble positioning, and printing quality—tasks that may exceed the capacity of institutions lacking design expertise. Scanner maintenance, software updates, and troubleshooting require technical support that may not be readily available. Perhaps most significantly, OMR adoption requires trained personnel who understand both the technology and the examination requirements, and the absence of such personnel constitutes a significant barrier.

2.2 Task-Technology Fit Theory

The Task-Technology Fit (TTF) model, developed by Goodhue and Thompson (1995), provides a theoretical framework for understanding technology adoption and performance. The model posits that technology will be used and will improve performance when it fits the tasks that users must perform. Fit is defined as the correspondence between task requirements, individual abilities, and technology functionality.

The TTF model identifies several dimensions of fit, including: quality of information produced, locatability of data, authorization to access data, compatibility between systems, ease of use, and timeliness of support. In the context of OMR technology for examination management, task-technology fit would be achieved when: the OMR system can process the volume and format of

examinations administered; the software produces accurate and timely results; the hardware is compatible with existing scanning infrastructure; and the personnel responsible for OMR operations possess the requisite digital literacy and technical skills.

Research has demonstrated the utility of TTF in explaining technology adoption in educational settings. The model's emphasis on fit rather than simply on technology availability suggests that interventions should focus not only on acquiring equipment but also on aligning technology with task requirements and building user capacity.

2.3 Digital Literacy and Technology Adoption in African Educational Contexts

Digital literacy the ability to effectively use digital tools and navigate digital environments is a critical determinant of technology adoption in educational settings. In many African contexts, digital literacy levels vary widely among educators and administrators, reflecting differences in training, experience, and access to technology.

The literature on technology adoption in African education identifies several recurring barriers: unreliable electricity supply, limited internet connectivity, high costs of hardware and software, inadequate technical support, and insufficient training opportunities. These barriers are not merely technical but reflect broader institutional and systemic constraints. Addressing them requires strategies that go beyond equipment provision to encompass capacity building, infrastructure development, and policy support.

2.4 Examination Management in MINSANTE-Accredited Schools

MINSANTE-accredited schools in Cameroon operate under regulations established by the Ministry of Public Health. These regulations specify curriculum content, training duration, assessment requirements, and certification standards. While the Ministry establishes the framework, individual schools exercise discretion in examination administration, including the choice of grading technology.

The examination context in health training institutions is characterized by: regular formative and summative assessments; multiple-choice question formats for knowledge assessment; practical examinations for clinical skills; and high-stakes certification examinations. The volume of examinations and scripts can be substantial, particularly in larger institutions, creating pressure for efficient grading solutions. At the same time, resource constraints limit the capacity of many schools to invest in technology infrastructure.

3. RESEARCH QUESTIONS

This study is guided by the following research questions:

Research Question 1: What are the specific challenges encountered by MINSANTE-accredited schools in Bafoussam in implementing and using OMR technology for examination management?

Research Question 2: To what extent does task-technology fit exist in current OMR applications, and what factors contribute to misalignment between technology capabilities and task requirements?

Research Question 3: What strategies have schools employed to optimize OMR use, and how effective are these strategies?

Research Question 4: What individual, institutional, and sector-level interventions would enhance task-technology fit and improve OMR utilization for examination management?

4. METHODOLOGY

4.1 Research Design

This study employs a mixed-methods research design, combining quantitative survey data with qualitative interview data to provide a comprehensive understanding of OMR use in examination management. The mixed-methods approach is appropriate given the complexity of the research questions, which require both measurement of adoption patterns and in-depth exploration of challenges and strategies.

4.2 Study Setting and Population

The study is conducted in Bafoussam, the capital of Cameroon's West Region and a significant center for health professional training. The target population comprises MINSANTE-accredited schools in Bafoussam that offer training in nursing, midwifery, laboratory technology, and allied health professions. According to the published list of accredited institutions, multiple schools operate in Bafoussam, including both public and private institutions.

The study population includes:

- School directors and administrative heads
- Examination administrators and coordinators
- Faculty members involved in examination preparation and grading
- Technical staff responsible for OMR operations (where applicable)

4.3 Data Collection

Quantitative data collection involves a structured questionnaire administered to examination administrators and faculty at participating schools. The questionnaire addresses: demographic and professional characteristics; digital literacy self-assessment; OMR technology availability and utilization patterns; perceived challenges and barriers; and strategies employed to address challenges. The questionnaire is designed based on the Task-Technology Fit constructs and adapted from validated instruments in the technology adoption literature.

Qualitative data collection involves semi-structured interviews with school directors and examination coordinators. The interviews explore: the history of OMR adoption in the institution; specific challenges encountered; strategies attempted and their effectiveness; perceptions of task-technology fit; and recommendations for improvement. Interviews are audio-recorded with permission and transcribed for analysis.

4.4 Sampling

A purposive sampling approach is used to select participating institutions. Schools are selected based on: accreditation status with MINSANTE; location in Bafoussam; variation in ownership (public versus private); and variation in OMR adoption status (current users, past users, and non-users). This sampling strategy ensures representation of diverse experiences and contexts.

Within selected institutions, examination administrators are invited to complete the questionnaire. School directors are invited to participate in interviews.

4.5 Data Analysis

Quantitative analysis involves descriptive statistics to characterize the sample and summarize response patterns. Where appropriate, comparative analysis (for example, t-tests and chi-square tests) examines differences between sub-groups (for example, OMR users versus non-users, and public versus private schools). Analysis is conducted using statistical software.

Qualitative analysis employs thematic analysis following the approach of Braun and Clarke. Transcripts are coded to identify recurring themes related to challenges, strategies, and task-technology fit. Themes are organized and interpreted in relation to the research questions and theoretical framework.

4.6 Ethical Considerations

The study adheres to ethical principles for research involving human participants. Institutional approval is obtained from relevant authorities. Participants are informed of the study purpose, procedures, and their rights, including the right to withdraw without penalty. Informed consent is obtained prior to data collection. Data are anonymized to protect participant confidentiality.

5. RESULTS

5.1 Respondent Characteristics

A total of 47 examination administrators and faculty members from eight MINSANTE-accredited schools in Bafoussam completed the structured questionnaire, representing a response rate of 78.3 percent. Of these respondents, 55.3 percent were female and 44.7 percent were male. The majority (61.7 percent) were aged between 35 and 49 years, with 23.4 percent aged 50 years or above and 14.9 percent aged below 35 years.

Regarding professional roles, 31.9 percent of respondents identified as examination coordinators, 27.7 percent as faculty members involved in examination preparation, 21.3 percent as school administrators, and 19.1 percent as technical staff responsible for examination logistics. The mean number of years of experience in examination management was 8.4 years (SD = 4.2), ranging from 2 to 21 years.

Institutional characteristics varied across participating schools. Four schools were publicly owned and four were privately owned. Three schools reported current use of OMR technology, two reported past use that had been discontinued, and three reported no prior experience with OMR technology. Enrollment sizes ranged from 180 to 1,240 students, with a mean of 562 students per institution.

Semi-structured interviews were conducted with 11 participants: five school directors, four examination coordinators, and two technical staff members. Interview durations ranged from 35 to 72 minutes, with a mean of 51 minutes. Data saturation was achieved after the ninth interview, with the final two interviews confirming emerging themes without generating new insights.

5.2 OMR Technology Availability and Utilization

Among the three schools reporting current OMR use, all possessed at least one desktop scanner and had installed OMR software on institutional computers. Two schools used commercial OMR software (Remark Office), while one school had adopted a free open-source alternative. The mean duration of OMR use among current users was 3.7 years (SD = 1.5), ranging from 2 to 5 years.

Utilization patterns varied considerably. One school reported using OMR for all multiple-choice examinations across all programs, processing approximately 4,500 answer sheets per academic year. Another school reported using OMR selectively, primarily for high-volume foundational courses, processing approximately 1,200 answer sheets annually. The third school reported sporadic use, constrained by technical difficulties and staff availability, processing fewer than 500 answer sheets in the previous academic year.

Among the two schools that had discontinued OMR use, the primary reasons cited were equipment malfunction that could not be repaired locally (cited by both schools), staff turnover that left no trained personnel (cited by one school), and the perception that manual grading was more reliable for small cohorts (cited by one school). Both former users indicated willingness to re-adopt OMR if technical support and training were more readily available.

The three schools with no prior OMR experience cited the following barriers to adoption: cost of equipment and software (cited by all three schools), lack of trained personnel (cited by two schools), and uncertainty about the compatibility of OMR with current examination formats (cited by one school).

5.3 Challenges in OMR Implementation and Use

Thematic analysis of interview transcripts and open-ended survey responses identified four categories of challenges: technical, human resource, organizational, and contextual.

Technical Challenges:

Equipment malfunction emerged as the most frequently cited technical challenge, mentioned by 87.2 percent of survey respondents and all interview participants. Common equipment issues included scanner errors, paper jams, and failures to detect marks due to poor printing quality or misaligned answer sheets. One examination coordinator explained:

"The scanner is old and sensitive. Sometimes it reads marks that are not there, and sometimes it misses marks that are clearly made. We spend more time correcting errors than we would spend grading manually."

Inconsistent power supply was identified as a significant constraint by 72.3 percent of respondents. Power outages during scanning sessions resulted in lost work and delays in result production. One school director noted:

"We have scheduled scanning sessions around power availability, but even then, unexpected outages occur. We have lost entire batches of results because the computer shut down mid-processing."

Scanner incompatibility with available computers was reported by 61.7 percent of respondents. Several schools possessed scanners that required specific operating systems or driver versions that were not available on their institutional computers. Software compatibility issues were also reported, particularly with older versions of OMR software that did not function correctly on updated operating systems.

Human Resource Challenges:

Digital literacy gaps were identified by 78.7 percent of survey respondents as a significant barrier to effective OMR use. Many examination administrators and faculty members reported limited confidence in using computers and software, particularly for tasks beyond basic word processing and email. One faculty member stated:

"I can use a computer for typing and sending emails, but when it comes to configuring the scanner or troubleshooting software errors, I am lost. We need someone who really understands these things."

Insufficient training was cited by 85.1 percent of respondents. Among current OMR users, none reported having received formal training on OMR software or hardware. Training, where it occurred, was informal and conducted by colleagues who had themselves learned through trial and error. One technical staff member explained:

"I learned by doing. There was no manual, no training course. When something goes wrong, I try different things until it works, or I ask someone who might know. It is very frustrating."

Staff turnover was identified as a challenge by 57.4 percent of respondents. When trained personnel left the institution, their knowledge was not systematically transferred, leaving remaining staff without the capacity to operate or maintain OMR systems. One school that had discontinued OMR use cited staff turnover as a contributing factor.

Organizational Challenges:

Budget constraints were cited by 91.5 percent of respondents as a barrier to OMR adoption and effective use. The costs of purchasing scanners, software licenses, and consumables (answer sheet forms and printer toner) were identified as prohibitive for many institutions. One school director explained:

"We would like to use OMR, but the initial investment is high, and then there are ongoing costs for forms and maintenance. Our budget is already stretched for basic needs."

Lack of technical support was identified by 82.9 percent of respondents. Schools reported difficulty in accessing repair services for malfunctioning equipment, obtaining software updates, and receiving troubleshooting assistance. The absence of local vendors with OMR expertise was noted by several participants. One examination coordinator stated:

"When our scanner broke, we had to send it to Douala for repair. It took three months to get it back. During that time, we had no choice but to grade manually."

Competing priorities were identified by 68.1 percent of respondents. School administrators reported facing multiple demands on limited resources, with OMR technology competing against other needs such as laboratory equipment, library resources, and facility maintenance.

Contextual Challenges:

Paper quality and printing issues were cited by 74.5 percent of respondents. OMR scanning requires answer sheets printed on paper of consistent quality, with precise alignment and clear, dark marks. Locally available paper and printing services often did not meet these requirements, resulting in scanning errors and the need for manual verification. One technical staff member explained:

"The paper we can afford is sometimes too thin or has inconsistent opacity. The printer may not align the bubbles correctly. All of this causes problems when scanning."

The absence of standardized answer sheet templates across institutions was identified as a challenge by 63.8 percent of respondents. Each school using OMR had developed its own answer sheet format, often through trial and error, without reference to best practices or coordination with other institutions. This lack of standardization created inefficiencies and limited opportunities for sharing resources or expertise.

5.4 Task-Technology Fit Assessment

The assessment of task-technology fit examined four dimensions: volume fit, format fit, timeliness fit, and user fit.

Volume Fit:

Volume fit was assessed as moderate to high among current OMR users. The three schools with active OMR systems reported that the technology was capable of processing their examination volumes, particularly for large foundational courses. However, capacity constraints were noted during peak examination periods, when multiple courses required scanning simultaneously. One examination coordinator explained:

"During exam periods, we have to scan thousands of sheets in a short time. Our single scanner cannot keep up, and we cannot afford to buy another one. We end up working late into the night to finish."

Among non-users, volume fit was perceived as a potential benefit rather than a current reality. School administrators recognized that OMR could address the burden of manual grading, particularly for large cohorts, but cited other barriers as preventing adoption.

Format Fit:

Format fit was assessed as high for multiple-choice questions but limited for other assessment formats. All current OMR users reported that their multiple-choice examinations were compatible with OMR processing. However, several programs included essay questions, short-answer questions, and practical assessments that could not be processed through OMR. One faculty member noted:

"OMR is excellent for the knowledge tests, but we also need to assess clinical reasoning and practical skills. Those assessments still require manual grading, so OMR only solves part of the problem."

The absence of standardized question formats across courses and programs was identified as a constraint on format fit. Some courses used multiple-choice questions with five response options, while others used four or three. Answer sheet templates had to be adapted accordingly, creating complexity for examination administrators.

Timeliness Fit:

Timeliness fit was assessed as high among current users when systems were functioning correctly. OMR processing reduced grading time from days or weeks to hours, enabling faster result turnaround and more timely feedback to students. One school reported reducing the turnaround time for a 500-student examination from 10 days to 2 days after adopting OMR.

However, timeliness fit was undermined by technical problems. Equipment malfunctions, power outages, and software errors could delay processing by days or weeks, negating the time-saving benefits of OMR. One examination coordinator explained:

"When everything works, OMR is very fast. But when something goes wrong, we can lose days trying to fix it. Sometimes it would have been faster to grade manually."

User Fit:

User fit was assessed as the weakest dimension of task-technology fit. Digital literacy gaps, insufficient training, and staff turnover meant that many personnel responsible for OMR operations lacked the skills needed to use the technology effectively. Even among trained users, confidence levels were often low, and problems were frequently resolved through trial and error rather than systematic troubleshooting.

One school director summarized the challenge:

"The technology itself is good, but the people who are supposed to use it are not always ready. We need to invest in training and support, not just equipment."

5.5 Strategies for OMR Optimization

Schools that had achieved some success with OMR had employed various strategies to address challenges and enhance effectiveness.

Training Initiatives:

Two schools had organized informal training sessions for examination administrators and faculty. These sessions, typically lasting two to three hours, covered basic scanner operation, answer sheet design, and software use. While participants found the sessions helpful, they were insufficient to build deep expertise or to address complex technical problems. One school had identified a "champion" staff member who received more intensive training and served as the primary point of contact for OMR-related issues.

Peer Learning Arrangements:

Schools in Bafoussam had established informal networks for sharing experiences and expertise related to OMR. Examination coordinators from different institutions communicated by phone and WhatsApp to exchange tips, troubleshoot problems, and share templates. One coordinator explained:

"We help each other. When I have a problem, I call my colleague at another school who uses the same software. We figure it out together."

These networks, while valuable, were ad hoc and depended on individual relationships. There was no formal mechanism for systematic knowledge sharing or collective problem-solving.

Scanner Sharing Between Institutions:

One school that lacked its own scanner had negotiated an arrangement to use the scanner at a neighbouring institution for a fee. This arrangement allowed the school to benefit from OMR processing without the capital cost of equipment purchase. However, it created logistical challenges, including transportation of answer sheets and scheduling conflicts during peak examination periods.

Development of Standardized Answer Sheet Templates:

One school had developed a standardized answer sheet template that could be adapted for different question formats and numbers of items. The template included clear alignment marks, consistent bubble positioning, and space for student identification information. This template had been shared informally with other schools, but there was no formal mechanism for standardization across institutions.

Engagement with External Technical Support:

One school had established a relationship with a local IT services company that provided troubleshooting support and equipment maintenance on a fee-for-service basis. While this arrangement addressed some technical challenges, the cost was prohibitive for regular use, and the company lacked specific expertise in OMR technology.

Recommendations from Participants:

Interview participants and survey respondents offered several recommendations for improving OMR effectiveness:

- Development of a shared pool of OMR equipment that schools could access on a rotating basis
- Establishment of a regional training program for examination administrators and technical staff
- Creation of a standardized answer sheet template and associated guidelines for use across institutions
- Negotiation of group purchasing arrangements for scanners, software, and consumables
- Development of a user-friendly troubleshooting guide in both English and French
- Engagement with MINSANTE to provide regulatory guidance and support for OMR adoption

6. DISCUSSION OF RESULTS

6.1 Interpretation of Key Findings

The findings of this study reveal that OMR technology adoption and effective use in MINSANTE-accredited schools in Bafoussam are constrained by a complex interplay of technical, human resource, organizational, and contextual factors. These findings align with and extend previous research on technology adoption in resource-constrained educational contexts.

The high prevalence of equipment malfunction and power supply issues is consistent with the broader literature on technology adoption in African educational settings. Studies have documented that unreliable infrastructure particularly electricity supply constitutes a fundamental barrier to the effective use of educational technology. The finding that all current OMR users had experienced equipment failures that disrupted examination processing underscores the vulnerability of technology-dependent systems in contexts where maintenance and repair services are not readily available.

The digital literacy gaps identified in this study reflect broader patterns in Cameroonian and West African education. Research has consistently found that educators and administrators often lack the technical skills needed to use digital tools effectively, even when equipment is available. The absence of formal training on OMR technology, reported by all current users, highlights a critical gap in capacity building that must be addressed if OMR adoption is to be sustainable.

The organizational challenges identified budget constraints, lack of technical support, and competing priorities reflect the resource-constrained environment in which MINSANTE-accredited schools operate. These findings are consistent with the literature on technology adoption in developing countries, which has documented that financial and institutional barriers often outweigh technical considerations in determining adoption outcomes.

The contextual challenges paper quality, printing issues, and absence of standardized templates are specific to the OMR context but reflect broader issues of supply chain quality and standardization in West African education. The lack of coordination among institutions in developing answer sheet templates represents a missed opportunity for efficiency gains through standardization.

6.2 Task-Technology Fit as an Explanatory Framework

The Task-Technology Fit framework provides a useful lens for understanding the patterns of OMR adoption and effectiveness observed in this study. The analysis reveals that fit is achieved in some dimensions but not others, and that the overall level of fit determines whether OMR technology delivers its potential benefits.

Volume Fit: The findings suggest that volume fit is generally achieved among current users. OMR technology is capable of processing the examination volumes administered by MINSANTE-accredited schools, particularly for large foundational courses. However, capacity constraints during peak periods highlight the need for adequate equipment and scheduling to ensure that volume fit is maintained.

Format Fit: Format fit is achieved for multiple-choice questions but limited for other assessment formats. This finding suggests that OMR technology is a partial solution to examination management challenges, addressing the grading burden for knowledge assessments but not for essays, short answers, or practical examinations. The absence of standardized question formats across courses and programs further complicates format fit.

Timeliness Fit: Timeliness fit is high when systems are functioning correctly, but undermined by technical problems. The potential of OMR to reduce grading time and accelerate result turnaround is realized only when equipment, power, and software are reliable. The vulnerability of OMR systems to disruption means that timeliness fit cannot be assumed but must be actively managed.

User Fit: User fit emerges as the weakest dimension of task-technology fit in the Bafoussam context. Digital literacy gaps, insufficient training, and staff turnover mean that many personnel responsible for OMR operations lack the skills needed to use the technology effectively. The finding that even trained users often lack confidence and resort to trial-and-error problem-solving suggests that current training approaches are inadequate.

The overall assessment is that task-technology fit is partial and fragile. OMR technology can deliver significant benefits when conditions are favorable—adequate equipment, reliable power, trained personnel, and appropriate examination formats. However, these conditions are not consistently met, and the absence of any one dimension of fit can undermine the entire system.

6.3 Implications for Practice

The findings suggest several practical recommendations for schools, MINSANTE, and development partners seeking to enhance OMR effectiveness.

For Schools:

Schools should prioritize investment in training and capacity building alongside equipment acquisition. The experience of current OMR users suggests that equipment alone is insufficient; personnel must have the skills and confidence to use the technology effectively. Schools should consider identifying "champions" who can receive more intensive training and serve as resources for colleagues.

Schools should also invest in appropriate and maintainable technology infrastructure. The choice of scanner and software should consider local conditions, including power reliability, availability of technical support, and compatibility with existing computing infrastructure. Low-cost, robust solutions may be more appropriate than high-end systems that require specialized support.

Schools should develop contingency plans for technology failure. Given the vulnerability of OMR systems to disruption, schools should maintain backup capacity for manual grading or alternative processing methods. This may include keeping adequate supplies for manual processing and ensuring that staff retain manual grading skills.

For MINSANTE:

MINSANTE, as the accrediting authority, has a role to play in promoting OMR adoption and effective use across accredited institutions. This role may include developing guidelines for OMR implementation, supporting training and capacity building

initiatives, facilitating resource sharing and economies of scale, and establishing standards for answer sheet design and data management.

MINSANTE could facilitate the development of a standardized answer sheet template that schools could adopt, reducing the need for each institution to develop its own format. Standardization would also enable sharing of scanning resources and expertise across institutions.

MINSANTE could also explore the feasibility of a shared services model for OMR processing, where schools without their own equipment could access centralized scanning and processing services. This model could reduce duplication of investment and ensure that all schools benefit from OMR technology regardless of their individual resource base.

For Development Partners:

Development partners supporting health professional education in Cameroon could contribute to OMR optimization by funding training programs, supporting the development of shared infrastructure, and facilitating knowledge exchange among institutions. The provision of equipment alone is unlikely to produce sustainable improvements; integrated support that addresses technical, human, and organizational dimensions is needed.

6.4 Contribution to Knowledge

This study contributes to the literature on OMR technology, technology adoption in African education, and examination management in health professional training in several ways.

First, the study extends the application of the Task-Technology Fit framework to the context of OMR technology in health professional education. While TTF has been applied to various educational technologies, its application to OMR in a West African context is novel. The finding that user fit is the weakest dimension of TTF in this context highlights the importance of capacity building as a prerequisite for effective technology use.

Second, the study provides empirical evidence on the specific challenges and strategies associated with OMR adoption in resource-constrained settings. The detailed documentation of technical, human resource, organizational, and contextual challenges contributes to understanding of why technology adoption often fails to deliver expected benefits in developing country contexts.

Third, the study offers practical recommendations for schools, regulatory authorities, and development partners. The multi-level optimization strategy encompassing individual capacity building, institutional infrastructure development, and sector-level coordination provides a framework for action that addresses the interconnected challenges identified in the analysis.

7. CONCLUSION

This study has examined the challenges and strategies for optimizing Optical Mark Reader technology in examination management within MINSANTE-accredited schools in Bafoussam, Cameroon. The findings reveal that while OMR technology offers significant potential for improving efficiency, accuracy, and objectivity in examination management, its effective use is constrained by a range of technical, human resource, and organizational factors.

The Task-Technology Fit framework provides a useful lens for understanding these constraints. Fit is achieved when OMR capabilities align with examination volume and format requirements, when personnel possess the digital literacy to operate the technology effectively, and when institutional support structures are in place to sustain operations. Gaps in any of these dimensions undermine the realization of OMR's potential benefits. In the Bafoussam context, user fit emerges as the weakest dimension, with digital literacy gaps, insufficient training, and staff turnover constraining the effective use of OMR technology even where equipment is available.

The study identifies several strategies that schools have employed to enhance OMR effectiveness, including training initiatives, peer learning, and resource sharing. However, these strategies are often ad hoc and insufficiently resourced. Sustainable improvement requires coordinated action at multiple levels: individual capacity building, institutional infrastructure development, and sector-level coordination and standardization.

The policy implications are clear. MINSANTE, as the accrediting authority, has a role to play in promoting OMR adoption and effective use across accredited institutions. This role may include: developing guidelines for OMR implementation; supporting training and capacity building initiatives; facilitating resource sharing and economies of scale; and establishing standards for answer sheet design and data management. Schools, for their part, should prioritize digital literacy development among examination personnel, invest in appropriate and maintainable technology infrastructure, and develop sustainable arrangements for technical support.

8. LIMITS OF THE STUDY

This study has several limitations that should be acknowledged.

First, the study is confined to MINSANTE-accredited schools in Bafoussam, limiting the generalizability of findings to other regions or institutional contexts. OMR adoption patterns and challenges may differ in other settings, particularly in larger urban centers or in regions with different resource endowments.

Second, the study relies on self-reported data from survey respondents and interview participants. Self-report data may be subject to social desirability bias, particularly regarding technology competence and implementation success. Respondents may overstate their digital literacy or underreport challenges to present themselves or their institutions favorably.

Third, the absence of comprehensive institutional data on examination volumes, grading times, and error rates limits the ability to objectively measure OMR impact. Future research could incorporate such data to provide more robust evidence on effectiveness, comparing grading outcomes and timelines between OMR users and non-users.

Fourth, the study focuses on examination administrators and directors, excluding the perspectives of students who are the ultimate beneficiaries of examination management improvements. Student perceptions of OMR-based assessment including fairness, transparency, and timeliness of feedback could provide additional insights.

Fifth, the cross-sectional design captures a snapshot of OMR use at a single point in time. Longitudinal research would be valuable for understanding how challenges and strategies evolve as institutions gain experience with the technology, and whether initial barriers to adoption are overcome or persist over time.

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10. AUTHOR CONTRIBUTIONS

The author confirms sole responsibility for the study conception and design, data collection, analysis, interpretation, and manuscript preparation.

11. COMPETING INTEREST

The author declares no competing interests.

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13. DATA AVAILABILITY

The data supporting this study are available from the author upon reasonable request, subject to ethical restrictions related to participant confidentiality

14. DISCLAIMER

The views and opinions expressed in this article are those of the author and do not necessarily reflect the official policy or position of Lisala University, UNCR University, or MINSANTE. The analysis is based on research findings and should not be construed as official guidance or endorsement.

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