



A Gap Analysis for the Accuracy and Reliability of Forensic Handwriting Comparisons towards Candidate Script Identification in Eswatini

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ABSTRACT

Judgement issues affect many aspects of our lives, including the future of our school-going children. The soundness of judgements made by examination administrators gets more serious in public high-stakes examinations where fairness on candidates is to be the most prized virtue. This paper seeks to ascertain the nature of the gap between current and desired practice of the Examinations Council of Eswatini (ECESWA) in resolving candidates' handwriting-based issues. The curiosity is on what law in Eswatini recommends as best evidence of genuineness of disputed writing; on how Eswatini schools resolve candidate handwriting issues; and on how public examination bodies in the SADC region ensure that questioned writings are resolved accurately and reliably. The theory of the individuality of handwriting and the human factor theory underpinned the study. Standard marking and Forensic Document Examination protocols served as a reference for gauging ECESWA's current practice. The inquiry involved a purposive sample of key informants, eight school management members and eight test development officials from SADC public examination bodies. The study revealed that ECESWA's processes of judging disputed handwriting are aligned to a larger extent with international practice. The absence, however, of the relevant forensic skill within the adjudicators, created a loophole that defined the gap. The study recommends the capacitation of the jury or outsourcing of the service. On a more preventative note, the candidate scripts could be rebranded by ECESWA with candidates' names prior to the examination day.

INTRODUCTION

Judgement issues affect many aspects of our lives, including the future of our school-going children. The soundness of judgement by examination administrators gets more serious in public high-stakes examinations where fairness on candidates is to be the most prized virtue. Ruling, by nature, requires the comparison of an item or method of unknown standard to one whose standard is known (Ofqual, 2014; Tate & Panteghini, 2007). Likewise, Forensic Document Examiners (FDEs) use standard criteria to qualify questioned documents (Moris, 2000; Hicklin, 2022). Standardisation then becomes the process of adopting the same procedures in order that comparable client results are achieved. It is the intention of this paper to examine the degree of closeness of methods of handling handwriting matters in Eswatini's public examinations' administration to standard practice.

The Examinations Council of Eswatini (ECESWA) is a corporate body established through the Examinations Regulation of 1984, a product of the Education Act of 1981. Its mandate is to administer examinations and issue certificates to Primary, Junior Secondary and Senior Secondary School graduates in Eswatini. ECESWA, like all public assessment bodies, pays particular attention to issues of fairness, validity, and reliability of their assessments. The fairness of an exam can make the difference between students getting the grade they deserve and a grade that does not reflect their knowledge and skills and that difference can be life - changing (Oxford University, 2022).

If fairness is that important to examination bodies, clear ways of ascertaining and mitigating its risk need to be put in place. One of such ways is managing the number of errors made during the examination administration and marking processes. Before candidate scripts are marked, the examination is written by candidates at the schools where the invigilator on the day of the examination is expected to conduct the examination in accordance with set ECESWA guidelines that are detailed in the ECESWA Handbook for Centres.

The Candidate register in the exam room has three columns drawn against each candidate's name. In the first column the candidate is confirmed present, through a tick, by the invigilator. The second column, still under the invigilator's jurisdiction, confirms that the candidate's script has been submitted in the examination room and the last column confirms that the script has been seen and marked by the Marker at the marking Centre.

Most of the time invigilators make mistakes in following the handbook instructions. The handbook states that the second column in the register should only be marked present if the invigilator has seen the name and examination number of the candidate script as opposed to merely seeing the face of the candidate. There are common cases where markers come across two or more scripts with no identity details. The Markers mark the scripts but fail to assign scores in the score card. The Principal Examiner then reports the

matter to the ECESWA office at the marking Centre. The challenge then gets resolved by generating a specimen writing where the Head of Centre, Invigilator and suspected candidate are called in to generate specimen writing. This writing is then compared with the disputed writing. Conclusions are then drawn and the issue "gets resolved". The challenge is the degree of accuracy and reliability of the steps leading to this conclusion. Specifically, this study attempted to respond to the following questions:

1. What does law in Eswatini recommend as best evidence of genuineness of disputed writing?
2. How do Eswatini schools arrive at handwriting – examination conclusions?
3. How do public examination bodies in the region ensure that questioned handwritings are resolved accurately and reliably?

This research is centred on forensic handwriting analysis. To understand the complexities that come along with handwriting comparison and isolation of gaps in current practices, the Forensic Document Examination Theory was considered, right from its principles, methodologies, factors of handwriting variability, and techniques used in comparing disputed writing with standards. Before delving into the FDE theory, we found it necessary to argue for our operational understanding of the construct: gap analysis.

Witkins (1984) defined "gap analysis" as the discrepancy between current and desired performance which can be prioritized based on the cost of meeting the need and that of ignoring it. Gap analysis, in Kim and Ji (2018)'s view is either a tool or a process to identify where gaps are and what differences exist between an organization's current situation and "what ought to be" in place. English and Kaufman (1975) in their focus on curriculum development described gap analysis as an empirical exercise which is not the innovation but an practice-based method for determining if the innovation is necessary and/or desirable. From what these authors perceive of gap analysis, our study postulates that gap analysis is an empirical method for establishing if innovation is needed based on comparing the current state of performance with the desired one.

The Forensic Document Examination Theory reveals that the work of an FDE is different from that of a Graphologist whose focus is on reading the personality traits that manifest through handwriting (Konnikova, 2014). There is need, nowadays, for expert testimony to be supplemented with scientific methodology when it comes to handwriting court cases (Srihari, Cha, Arora, & Lee, 2002). The scope of forensics besides focusing on DNA tests and fingerprints as unique tracers of human marks, further embraces handwriting (Doug, 2019). Several authors have confirmed the handwriting individuality principle and have agreed that its statement carries the gist that no two writers share the same combination of handwriting features given sufficient quantity and quality of writing to compare (Harrison, Burkes, &

Seiger, 2009; Srihari, Cha, Arora, & Lee, 2002; Srihari, Juang, & Srinivasan, 2008; Osborn, 1929)

Since judgement errors are human by nature, the human factors theory was also considered where it was found that the accuracy and reliability of human judgment could be improved through optimising human competence, cognitive biases, and perceptual abilities. Literature also reveals that rushed decisions and ability/demand mismatch are the major sources of decision-making errors (Kirwan, 1998).

Standardisation and Quality Assurance Frameworks serve as the basis for making sure that processes leading to forensic conclusions are consistent, reliable, and transparent. The American Society of Questioned Document Examiners (ASQDE) and the International Graphonomics Society (IGS) were considered towards establishing the degree to which current ECESWA practices are aligned to standard handwriting analysis practice. For standard handwriting analysis practice Harrison, Burkes & Seiger (2009); Riley (2023)'s model revealed that FDE's work was comparable to the Public Examination Markers' work. Zhu & Han (2011)'s Finland model for marking candidates' scripts was found to embrace most of the steps taken by Eswatini public examination markers.

Forensic handwriting examination studies dominated the twentieth century's sixth to last decade, with a particular reference and appreciation of conforming to the copybook, the use of handwriting to interpret personalities and to the individuality of handwriting (Black, 1970; Franks, 1985; Shannon, 1979; Gomez - Jimenez, 2015). While appreciating the individuality of handwriting, it might help to realise that handwriting variations are possible within the same individual.

With a team of 11 co-authors, Hicklin (2022) conducted a five-year study that involved 86 Forensic Document Examiners (FDE) who looked at 100 pairs of scripts. About 7000 conclusions from this study were drawn through a five-Likert conclusion scale. The study involved the Analysis, Comparison, Evaluation and Verification (ACEV) method of data handling. According to this study both the questioned and the known writing needs to: (a) be original; be freely and naturally prepared; and contain a sufficient quantity and quality of writing. In addition, the composition of the FDEs needs to reflect a rich mix of relevant skill. In the Eswatini context upskilling the workforce and teaching towards competencies has been strongly recommended at educational policy level (Marope, 2010)

Forensic Document Examination has also been researched extensively over the 20th and 21st century. In 2013 for instance, the ability of Arabic writers to simulate elements in signatures was investigated where it emerged that adults were significantly less accurate in simulating line form and proportion while they were more accurate in simulating line quality than young people (Alkahtani, 2013). In the same year an attempt to embrace the emerging digital age was then focused on the analysis of digital signatures and how it posed challenges to the practice

of FDEs (Harralson, 2013). Forensic Handwriting Examiners are different from lay people who only can differentiate gross features of handwriting such as letter formation, size, and slope of the handwriting. The experts go further to looking into size and slope of writing, pen pressure, pen lifts, the spacing between words and letters, the position of the writing on the baseline, height relationships, beginning and ending strokes, and line quality (Harrison, Burkes, & Seiger, 2009).

The characteristics FDEs focus on, when comparing handwritings, are the subtle, subconscious habits of the writer such as writing in relation to baseline; the overall formation of the letters; the heights of letters in relation to one another; the manner of connecting letters; the size and spacing of letters; the beginning and ending of strokes; and pen pressure (Hicklin, 2022; Nye & Sood, 2018).

Forensic Document Examination despite lacking in objectivity in the past has now been made more quantitative, objective and data driven through quantitative models that permit automation (Riley & Eisenhart, 2023). Such initiatives bring huge relief to the teacher or educational assessor since it brings their attention back to their core mandate of teaching and evaluating candidates' performances. The context in Eswatini as highlighted in several media reports, indicates that there is no public forensic science laboratory in the country except one at the police college which is not yet fully equipped (Mhlongo, 2020). These media reports together with the data from tertiary institutions indicates a gap in the popularity of the idea of forensic science in the country, let alone an understanding of the roles of FDEs and the value they add to public examination contexts.

MATERIALS AND METHODS

A descriptive research paradigm viewed from the purpose of research perspective was adopted leading to a qualitative survey design. All ECESWA stakeholders were considered as the population for this study. The researcher then sampled purposively with focus on stakeholder relevance to handwriting issue resolution. Data were then collected from a key informant that was nominated by the Law Society. A face-to-face interview was conducted with this participant. The data they gave was then triangulated with a desk review of the legal documents that were linked to forensic handwriting examination. Heads of Examinations in both primary and secondary schools were also purposively sampled and telephonically interviewed. The criteria were to have two per region, one from rural and the other from urban settings as summarised in table 1. The names of the participants and their schools were kept anonymous for ethical reasons.

There was also the condition of ensuring that members in the total sample were representative of both secondary and primary schools. Open ended questionnaires with telephonic follow ups were also run with participants representing each of the SADC public examinations. In collecting data from the Eswatini

case, the researcher assumed a participant observer role throughout the data collection process where the process of concluding handwriting issues was observed and probed. Data were analysed thematically as they got collected.

The interview schedules were validated by two randomly selected ECESWA test design staff members. The questionnaire that was sent to the SADC examination boards was first piloted with ten purposely selected ECESWA staff members.

Table 1: School Participants

School code (Pseudonym)	Region, School Level and Location	Respondent's Designation	Current School Leaving Class Enrolment
A	Manzini (North), Primary, Urban	Headteacher	56
B	Manzini, Primary, Rural	Deputy Headteacher	35
C	Manzini (South), Primary, Urban	Senior Teacher and Head of Discipline	189
D	Manzini, Primary, Peri-Urban	Deputy Headteacher	108
E	Hhohho, High School, Peri-urban	Head of Department	125
F	Hhohho, High School, Rural	Head of Department	67
G	Lubombo, High School, Peri-urban	Head of Department	110
H	Shiselweni, High School, Rural	Headteacher	10

RESULTS AND DISCUSSION

This section focuses of three parts: the recommendations of the Eswatini law on the best evidence of genuineness of disputed writing, schools' viewpoints on how handwriting cases could be resolved and the practice landscape of dealing with handwriting cases in the SADC region.

Law in Eswatini that Recommends the Best Evidence of Genuineness of Disputed Writing.

The lawyer's response was gathered and probed leading to the data below: The excerpts are the participant's own words. "You need to use experts, avoid doing the comparisons yourselves, the irrelevance of your credentials weakens the evidence in the end. (After probing) Judging handwriting yields stronger evidence in a court if done by an expert. The expert in our understanding is somebody who is suitably qualified and will involve different handwriting samples before drawing a conclusion. The experience, qualifications, of the expert and objectivity of the

approach to judging earns this expert's report the desired credibility in a court of law."

The theme that emerged from this data set was that a suitably qualified person should judge or lead the judging team. A further observation was made from scrutinising the set of relevant documents recommended by the law society. The Eswatini Criminal Law and Procedure Act 67 of 1938 subsection 230 was found to be the most relevant where stated: "Comparison of a disputed writing with any writing proved to the satisfaction of the court, or of a magistrate holding a preparatory examination, to be genuine may be made by the court or magistrate, as evidence of the genuineness or otherwise of the writing dispute." The content theme with the Eswatini Criminal Law and Procedure Act 67 of 1938 subsection 230 was found to be conveying a recommendation in favour of the comparison of handwritings.

The main finding for this section is that approaching the resolution of a disputed handwriting requires comparing the disputed writing with the writing whose source is known. This is backed by Act 67 of

1938 subsection 230 of the Criminal law of Eswatini. The person doing the comparison needs to be experienced and suitably qualified. The implication is that a qualification that will enable the officers to notice and manage the subconscious handwriting habits of the writer such as writing in relation to baseline; the overall formation of the letters; the heights of letters in relation to one another; the manner of connecting letters; the size and spacing of letters; the beginning and ending of strokes; and pen pressure (Hicklin, 2022; Nye & Sood, 2018). In addition, they should go further to looking into size and slope of writing, pen pressure, pen lifts, the spacing between words and letters, the position of the writing on the baseline, height relationships, beginning and ending strokes, and line quality (Harrison, Burkes, & Seiger, 2009). From this it can be inferred that the ECESWA officer must at least have a tertiary qualification in the area.

Such competence, among the current staff compliment needs to be supplemented through the competency-based approach that Marope (2010) alluded to in the world bank report assessing the efficiency of Eswatini Educational System. Beside adopting this approach, the fact that the 4IR is already in session and its dictates are already putting pressure on current workforces to upskill, multitask and reskill. We therefore assert that this is where the teacher and the examiner within the education system of Eswatini belong: in the era where the best move is to upgrade the skills we had when first got employed so that we keep our existence in the 4IR job market.

HOW SCHOOLS ARRIVE AT HANDWRITING – EXAMINATION CONCLUSIONS

When asked about how they handled handwriting dilemmas, the Eswatini school leaders, remarked verbatim that: “The number of reported handwriting dilemmas at the primary school level is less than at the secondary school. The primary schools regret the dwindling handwriting standards attributing that change to reduced teacher motivation towards handwriting, particularly at the lower grades. Sometimes pupils vary their handwriting size and style to accommodate either the pressure of not having enough content or that of having too much content.

One deputy headteacher from the Manzini sub-urban area indicated that: *“We do encounter handwriting challenges especially where it varies within the same script. We do not rush to call it malpractice but note that sometimes: When hesitant about answer the student writes faint and with a wobbly handwriting. Now within the same script when they see a familiar question they begin to write with normal and more legible handwriting. So somehow it is linked to how they feel about the question. On essays if they are given a fixed page to write on and they know very little, they amplify their handwriting so that they fill the requested page. It might happen that as they near ¾ of the page new ideas come up, they will then change the handwriting and write small where the letters become sharp and compact to match their tension and desire to fill the page”*.

The results led to the finding that as candidates stress over running out of content to write up to expected page margins, their handwriting changes and grows sharper and more compact. The finding confirms the graphology theory highlighted by Gomez-Jimenez (2015) that handwriting vary with human emotional states. This finding has the implication on the criteria that markers use to identify a suspected handwriting-based malpractice. This matter does not only require objective criteria to be availed, but it also requires that such criteria be documented on ECESWA policies and consistently applied.

This point links well with the fact that currently, ECESWA relies on the marker's professional judgment of what ends up being tagged as suspected malpractice. The strength, however, on this current practice is that the marker then escalates the matter to an authorised ECESWA officer for further evaluation. There is, however, still a gap in that though there are hierarchies of viewing and hypothesising on the suspected malpractice, in the absence of a clearly articulated model of evaluating the suspected script judgment error is likely to occur. The relevance of the skill the evaluators of the script have, might also increase the chance of error, especially after Kirwan (1998) noted that rushed decisions and ability/demand mismatch were the major sources of decision-making errors.

Teachers also proposed that they check the handwriting with other subjects to identify the name of the author of the questioned script. This is corroborated by the evidence from how they deal with similar situations in Namibia as confirmed by the data collected through the third research question. This is a scenario where the schools are recommending something that other examination boards in the region are already practising, yet the local examination board has not yet visibly began practising it. According to how Kim and Ji (2018) defined gap analysis, there is a gap in that current ECESWA practice is to involve the school in resolving the handwriting case, yet there is a recommendation from the schools that we first check across other marking committees besides the one where the query originated (subjects). This implies ECESWA needs to pilot the approach for effectiveness and value for money both to the organisation and its major stakeholder – the head teacher.

HOW PUBLIC EXAMINATION BODIES IN THE REGION ENSURE THAT THEIR FORENSIC HANDWRITING – BASED DECISIONS ARE ACCURATE AND RELIABLE.

The collected data is summarised in table 2. Seven of these countries' participants were interviewed and most of them (six of seven) experienced the handwriting dilemmas during their marking. Malawi even indicated that these concerns were frequently within and across script disciplines. These were generally resolved through side-by-side comparison between the known and the questioned handwriting. The DNEA from Namibia reported that they considered

the side-by-side comparison as a last resort; they first identified the script from other syllabus components where they still followed the sided-by-side comparison of known to unknown handwriting. In their own words, the Namibian participant even highlighted more aspects of the challenge they face:

"We also come across such challenges. We check with the other subjects that the candidate sat for, compare

handwriting from the other subjects' papers after proper investigation has been done and candidates narrowed down".

This approach to tracing the authorship of the script has also been recommended by one of the schools earlier in this report.

Table 2: SADC Members Responses

	Existence of handwriting dilemmas from Scripts?	Categories of how the dilemmas are managed
Botswana	Yes	The discretion of the Subject Officer on the matter is prioritised.
Eswatini	Yes	Side by side comparison by subject officer. If unresolved, involved the headteacher and invigilator in a face-to-face interview.
Lesotho	Yes	The discretion of the Subject Officer on the matter is prioritised.
Malawi	Yes	Side by side comparison by subject officer. If unresolved then check with other marking committees
Namibia	Yes	Side by side comparison by subject officer. If unresolved then check with other marking committees
Zambia	Yes	Side by side comparison by subject officer.
Zimbabwe	Yes	Side by side comparison by subject officer.
Tanzania	Very rare	They rarely occur as the cause of omitted names is eliminated from when the candidate submit their script. The process is coded and given high vigilance by the school and invigilators.

THE QUALITY OF THE GAP

The dimensions of the quality of the steps leading to quality conclusions on handwriting issues emerged from data as the standard, the evaluator – evaluation panel - performance evidence, Comparison, Conclusion, Frequency, and type summary as well as Extent of Deviation from Standard and Levels of Evidence.

The Standard

The comparison of ECESWA's model of concluding handwriting cases against Zhu & Han (2011) and Harison et al (2023) shows that a standard sample to gauge the disputed writing against is necessary. In the Finland marking context, this specimen is the marking scheme, while in forensics it is the specimen. This standard is a result of standardisation, where all members of the jury or marking committee in the case of marking discuss the standard until all those who will be implementing it have common understanding. The current practice at the ECESWA marking Centres shows that the standard is the text that is produced by the validated suspect. So in terms of practice there appears to be no gap in practice.

Evaluator, Evaluation Panel and Performance Evidence

The evaluator from the legal expert and the schools feedback needs to be suitably qualified. In Finland Zhu and Han (2011) noted that it was required that makers are suitably qualified. In addition, it emerged that the Jury composition also needs to have a diverse pull of experts. The performance evidence according to these authors is necessary. In the marking the candidate script serves as concrete evidence that the candidate attempted the examination, while in Forensic Document Examination, the evidence is the disputed writing. The current practice shows that the performance evidence exists as the questioned writing that the Principal Examiners will pick up and submit to the office at the marking centre. This then highlights that for this dimension, ECESWA's practice is airtight.

Comparison, Conclusion, Frequency, and type summary

Comparison involves imposing the marking scheme over the candidate's work, while with Forensic Document Examination, the specimen is superimposed over the disputed writing before degrees of deviation are noted. ECESWA's practice currently

involves juxtaposition of the specimen writing with the questioned writing, where the jury use common sense and professional judgment to identify deviations in forms and other glaring features of the handwriting. The gap between standard practice and that of ECESWA is identified in line with Harrison, Burkes and Sieger (2009)'s assertion that lay people only differentiate gross features of handwriting such as letter formation, size, and slope, whilst experts go further to looking at pen pressure and pen lifts and the spacing between words and letters.

Extent of Deviation from Standard and Levels of Evidence

The raw score is converted to percentage at both the marking and Forensic Document Examination stage. The current ECESWA practice, however, at this stage fails to happen since in the previous stage, the specimen is not superimposed but juxtaposed against the disputed writing. This is a gap in practice.

The levels of gathered evidence are categorised into strong, medium, and weak, where symbols A*, A and B belong to the strong evidence level, symbols C, D and E the medium level and lastly F, G and H fall under the weak level. The same levels of evidence exist with Forensic Document Examinations. ECESWA practice, however, reaches this stage but the levels are cast subjectively.

The study has revealed that ECESWA's processes of judging disputed handwriting are aligned to a larger extent with international practice. The approach adopted is on the right direction but the absence of relevant skill within the Jury, created a loophole that sums up the gap. This challenge can possibly be overcome by choosing to capacitate the jury or outsource the service. On a more preventative note, the candidates can be made to write on an answer script with a name and centre number that has been typed below.

CONCLUSIONS AND RECOMMENDATIONS

The study has revealed that ECESWA's processes of judging disputed handwriting are aligned to a larger extent with international practice. The absence, however, of relevant skill within the adjudicators, created a loophole that sums up the gap. This challenge can possibly be overcome by choosing to capacitate the jury or outsource the service. On a more preventative note, the candidate scripts could be rebranded by ECESWA with candidates' names. The process towards making the conclusion, often involved Heads of Centre travelling long distances from their Centres to the marking centres. Evidence from the schools and the SADC region highlights that the issue of bringing the stakeholders to vouch for the identity of the candidate could be mitigated by first searching with counterpart marking committees before calling the principal, invigilator and student.

AUTHOR'S BIOGRAPHY

Sibusiso Masuku holds an M.Ed. degree in Curriculum Studies and Teaching from the University of Eswatini and an M.Sc. degree in Mathematical Modelling from the University of Zimbabwe, a B.Sc. in Mathematics and Chemistry from the University of Eswatini, A Post Graduate Certificate in Education from the University of Eswatini and a Project Management Certificate from the University of Cape Town. He taught Senior Secondary Mathematics and Physical Science for 10 years at IGCSE and Matric (IEB) Level before joining the National Curriculum Centre, a role he served for 5 years before assuming his current job at the Examinations Council of Eswatini. His research niche is in scientific reasoning and quality assurance of public examinations processes such as marking. He currently serves the Examinations Council of Eswatini as a Research Manager within the Test Development Department.

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