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Digital limits and teaching potentials

A case study from Madagascar

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Abstract: This chapter examines pedagogical practices in teacher education in Madagascar under conditions characterised by unstable electricity, costly internet access, and limited availability of digital devices. Drawing on theories of Bildung (education and formation), literacy studies, and sociomaterial approaches, it analyses how teacher educators navigate conditions of digital scarcity through flexible, low-tech teaching strategies. The study is based on semi-structured interviews with teacher educators at SFM in Fandriana, Madagascar, and focuses particularly on how teaching, assessment, and inclusion are organised in environments where digital infrastructure is unstable or absent. The findings show that teacher educators employ a range of pragmatic solutions, such as blackboard-based instruction, group sharing of mobile phones, and parallel teaching plans, to ensure continuity and participation. At the same time, the study highlights how limited digital access affects assessment practices, learning outcomes, and students' opportunities to develop digital competence. The chapter argues that pedagogical quality in resource-constrained contexts depends largely on professional judgement, relational work, and didactic adaptation rather than on technology alone.

Keywords: Teacher education in Madagascar, digital scarcity, parallel teaching plans, professional judgement, digital competence, and didactic adaptation

Introduction

Digital technologies are promoted globally as the key to modern education. However, in teacher education in Madagascar, digitalisation takes on a very different meaning from that found in contexts where digital technologies are more widely established. Here, power fluctuations, costly internet access, and limited availability of digital devices shape everyday life. The question is then not how technology can optimise teaching, but rather how teaching can be sustained when technology repeatedly fails, infrastructure is limited, or opportunities are scarce. In this respect, Madagascar and teacher education provide a good example of what educational responsibility entails both within and beyond the digital age.

Drawing on perspectives from Bildung theory (Biesta, 2010, 2015; Klafki, 2014), this chapter is based on the premise that good teaching cannot be reduced to a matter of technological capacity or digital pedagogical competence. Fundamentally, it is about the kind of people education seeks to form and the values that guide teachers' pedagogical choices. In a low-resource context, these fundamental questions become visible in ways that often remain hidden in digitally resource-rich environments. The practical judgement exercised by teachers when digital tools fail demonstrates how teaching is realised in concrete and vulnerable situations through improvisation, adaptation of content, and the use of both analogue and digital resources.

This study therefore examines digital scarcity not as a problem of limitation, but as an entry point for understanding how professional practice is shaped by socio-material conditions. When electricity, internet connectivity, and digital devices cannot be taken for granted, teachers' professional judgement, relational work, and ability to ensure participation become crucial elements of educational quality. This opens a broader discussion of the normative horizons, values, purposes, and Bildung ideals that should guide pedagogical decision-making in digital times, including in more resource-rich educational systems.

> *Against this background, the chapter addresses the following key research question: How is teaching realised and challenged within a teacher education programme where digital infrastructure is unstable or absent?*

Based on this central question, two research questions were formulated:

- RQ1: How do Malagasy teacher educators manage teaching under conditions of unstable or minimal digital infrastructure?
- RQ2: How do these conditions influence professional responsibility, pedagogical decision-making, and conceptions of digital competence in teacher education?

Through interviews, the chapter demonstrates how practice in a low-resource context both constrains and enables learning, and how Bildung-oriented perspectives can provide a framework for evaluating pedagogical choices when access to technology is inconsistent or limited. The Malagasy teacher education programme examined here therefore emerges not merely as a case of scarcity, but also as a context that highlights the fundamental value-based and relational dimensions of educational practice, dimensions that are relevant far beyond the geographical setting of this study.

Background

Madagascar combines ambitious educational aspirations with vulnerable infrastructure. At the primary school level, completion rates have improved, although from a relatively low starting point. In 2023, it was estimated that 60.4 per cent of pupils completed primary education. Statistics from the UNESCO Institute for Statistics (UIS, 2022, 2024) and the World Bank (2024) indicate completion rates of 62 per cent for girls and 57 per cent for boys. Educational challenges are further intensified by persistent learning poverty and considerable regional disparities in both access and quality (UIS, 2024).

The country's digital infrastructure remains weak and unevenly distributed. National access to electricity stood at approximately 39 per cent in 2023, with substantial differences between urban and rural areas (Tracking SDG7, 2024; World Bank, 2024). Low levels of electrification lead to frequent disruptions in teaching and make it difficult to charge digital devices. At the same time, access to the internet is increasing. At the beginning of 2024, there

were an estimated 6.31 million internet users in Madagascar (approximately 20.6 per cent of the population), while active social media users accounted for around 12–13 per cent (DataReportal, 2024). In practice, this has resulted in a "mobile-first" pattern in which low-bandwidth, offline-compatible teaching arrangements and accessible communication channels such as Facebook and WhatsApp often fulfil functions that would otherwise be provided by learning management systems in settings where mobile data are expensive and network coverage remains uneven (DataReportal, 2024; Zafitsara & Velo, 2022).

Teacher education in Madagascar is a two-year programme and is dominated by public institutions located in the country's major cities, including Antananarivo, Toamasina, Mahajanga, Fianarantsoa, Toliara, and Antsiranana. The École Normale Supérieure (ENS) in Antananarivo is responsible for teacher education, continuing professional development, and educational research (Université d'Antananarivo, n.d.). In addition, there are three private teacher education institutions operated by different Christian denominations, one of which is SFM (Sekoly Fanomanana Mpampianatra) in Fandriana.

There is a national curriculum for teacher education in Madagascar, but there are no specific national targets concerning digitalisation. Consequently, each institution is responsible for developing its own curricula and educational objectives. In higher education, institutions frequently combine digital and analogue solutions to ensure continuity during power outages and internet disruptions. Printed materials, local storage systems, and social media often function as bridging solutions in the absence of formal digital platforms (Ratompomalala & Razafimbelo, 2020; Zafitsara & Velo, 2022).

Experiences from the COVID-19 pandemic describe compressed academic semesters and improvised channels for maintaining teaching activities, findings that correspond with international research on lower- and middle-income countries (LMICs). Initiatives focusing solely on hardware have been shown to have limited impact without accompanying pedagogical support (Hennessy et al., 2022), and the pandemic functioned as "a wake-up call" that exposed existing digital inequalities (Czerniewicz et al., 2020, p. 946). Although technology promises greater access to education, the reality is that digital divides persist in ways that may ultimately exacerbate educational inequalities (UNESCO, 2023, p. 6).

In Madagascar, these issues become particularly evident when teacher educators adopt offline-first strategies, analogue assessment practices, and

transparent systems for allocating scarce resources. Such approaches may be understood as expressions of practical wisdom (*phronesis*) rather than temporary solutions; they constitute attempts to uphold the educational integrity of teaching amid structural scarcity.

For teacher education, this implies that operational reliability, including access to electricity, basic maintenance, and printing facilities, often has greater significance for quality and inclusion than marginal increases in the number of digital devices. Mobile phones constitute the primary student platform. It is therefore beneficial to design learning activities that can easily be adapted to paper-based formats, and to include analogue redundancies such as tactile materials, clear printing and distribution procedures, and alternative support mechanisms for students with disabilities when digital tools fail or are unavailable (Hennessy et al., 2022; Zafitsara & Velo, 2022).

Overall, the evidence points towards an offline-first, low-/no-tech-sensitive pedagogy within teacher education, grounded in local realities and realistic operational conditions (Økland, 2024). It is against this backdrop that the study's research questions concerning teaching, inclusion, and professional responsibility must be understood.

Theory

This study examines how learning is realised under conditions of limited digital access, using an offline-first, low-/no-tech-sensitive pedagogy in teacher education in Madagascar, and how professional responsibility and professional judgement are exercised under such circumstances. To understand the situation from both pedagogical and socio-material perspectives, the analysis is grounded in an interdisciplinary framework drawing on Bildung and learning theory, literacy studies, and assessment for learning. Taken together, these perspectives provide an epistemological scaffold that makes it possible to conceptualise everyday teaching practices – such as the use of space, time, paper, lesson planning, and related activities – as expressions of normative, material, and organisational conditions (Biesta, 2010, 2015; Buckingham,

2003; Erstad, 2005; Fenwick & Edwards, 2010; Gamlem & Smith, 2013; Haug, 2017; Klafki, 2014; Krumsvik, 2007; Lipsky, 2010; Livingstone, 2009).

In Haug's (2017) understanding, inclusion is not an intervention directed at individual students, but rather a systemic quality of the educational situation as a whole. This perspective offers methodological value in the Malagasy context, where the material conditions of teaching – characterised by unstable electricity supplies, limited access to digital devices, and a lack of universal assistive technologies – must be understood as collective conditions for participation. When teachers in our data establish predictable routines and varied forms of expression, these practices may therefore be interpreted as attempts to institutionalise inclusion within a low-resource context. Haugestad and Keeling (2020, 2024, 2025) demonstrate, in a Nordic context, how digital course design influences students' learning experiences. Applied to Madagascar, this suggests that the absence of technology does not neutralise the pedagogical demands of inclusion; rather, it reconfigures them.

Klafki's didactical perspective offers a framework in which teaching content and methods are selected according to their educational and formative value rather than their technological availability (Klafki, 2014). This perspective rejects both technological optimism and deficit narratives, framing teachers' decisions as fundamentally categorical choices. The focus is on which experiences open the world to the student and, conversely, enable the student to engage with the world. Biesta develops this argument further by insisting that education must always be evaluated in relation to three purposes: qualification, socialisation, and subjectification. These purposes cannot be reduced to instrumental goals centred on learning outcomes or digital skills (Biesta, 2010, 2015).

In low-resource settings, such as parts of Malagasy teacher education, Klafki's (2014) Bildung perspective, Biesta's framework of educational purposes (2010, 2015), and Haug's conception of inclusion (2017) become particularly powerful analytical lenses. Together, they highlight how the quality of teaching depends on professional judgement, local adaptation, and robust analogue alternatives rather than on technology itself.

The literacy framework further deepens our understanding of knowledge work under conditions of limited digital access. Livingstone (2009) demonstrates how ideals of online participation continually collide with material and socio-economic constraints. Buckingham (2003) conceptualises media

literacy as a situated competence characterised by source evaluation and translation between digital and analogue media, such as the use of blackboards and printed handouts.

Norwegian research has contributed to a more nuanced understanding of digital competence in education by drawing attention to the interplay between technology, pedagogy, and didactics. Krumsvik (2011) highlights teachers' professional digital judgement, while Erstad (2013) analyses digital practices as situated forms of learning and literacy. Both perspectives underline that digital competence should be understood as more than technical proficiency and as an integral component of professional practice.

In the Malagasy context, educational quality and inclusion cannot be meaningfully understood apart from the material infrastructure available at any given time. Standardised analogue backup systems and routines for setting up and dismantling learning activities therefore appear not as improvised solutions, but as elements of a socio-material pedagogy.

The assessment-for-learning perspective (Gamlem & Smith, 2013) contributes to understanding how assessment practices develop under conditions of limited digital resources. This perspective demonstrates the importance of transparent criteria, dialogue, and actionable feedback irrespective of technological support. The principle of varied forms of expression becomes particularly relevant. In educational environments characterised by frequent power outages and limited access to digital devices, oral, practical, and paper-based forms of assessment constitute the dominant, and often the only available, assessment modalities.

Lipsky's (2010) theory of street-level bureaucracy frames the teacher educator as a frontline actor who must continually translate political ambitions into concrete solutions under conditions of limited resources. In Madagascar, this means that teachers must negotiate structural constraints such as limited access to devices, unstable electricity supplies, and the absence of systematic support. This gives rise to a range of local practices, including parallel teaching plans (both digital and analogue), shared equipment, manual assessment systems, and routines designed to ensure continuity of instruction. These practices are not random; rather, they represent expressions of professional judgement.

Previous research

Research on digital scarcity in teacher education demonstrates that the absence of stable technological resources not only creates practical challenges but also reshapes the pedagogical possibilities within which teaching can be realised. In Norwegian higher education, Korseberg and Svartefoss (2024, pp. 155–166) document how weak support and maintenance structures hinder the pedagogical use of technology and create a discrepancy between ambitions for digitalisation and actual practice. Similar patterns are identified by Hjukse et al. (2020), who show that differences in professional digital competence lead to unequal access to both learning resources and learning design. Aagaard et al. (2022) further argue that teacher educators may nonetheless develop a form of "transformative agency" when required to adapt, underscoring the situated and relational nature of technology.

When technological resources are unstable, decisions concerning content and teaching methods must increasingly be guided by their educational value rather than by the availability of digital support (Klafki, 2014). Biesta's framework of qualification, socialisation, and subjectification further demonstrates that pedagogical decisions made under conditions of digital scarcity require professional judgement that cannot be delegated to technology (Biesta, 2010; 2015). In practice, digital scarcity is therefore not merely a condition of deficiency but a context that makes teacher educators' evaluations of purposes and possibilities more visible. Recent research on AI-based writing tools in Norwegian higher education further suggests that digital divides increasingly concern unequal abilities to use such tools, a shift described by Hodøl et al. (2025) as moving "from access to ability", rather than merely issues of technical access. Warschauer (2004) similarly argues that digital inequality must be understood in broader terms.

This insight leads directly to the study's first research question, which examines the opportunities and challenges that arise when teacher educators work in contexts characterised by unstable electricity supplies, unreliable internet connections, and limited access to digital devices (RQ1). International studies demonstrate that this is far from a marginal phenomenon. During the COVID-19 pandemic, university staff across the world reported both flexibility and inventiveness, but also the emergence of profound digital inequalities when infrastructure failed (Czerniewicz et al., 2020; Sum & Oancea, 2022). In

low- and middle-income countries, systematic reviews identify "constraints related to infrastructure and cost" as persistent factors shaping the fundamental conditions for learning (Ndibalema & Mucho, 2022, pp. 600–602). This is particularly relevant in Madagascar, where Ratompomalala and Razafimbelo (2020), as well as Zafitsara and Velo (2022), document how teachers and students navigate poverty, unstable electricity supplies, and underdeveloped broadband infrastructure through hybrid, low-threshold, and improvised teaching practices. Self-regulation and autonomy consequently become essential coping resources for student teachers in such environments (Hattie & Timperley, 2007).

At the same time, research clearly demonstrates that digital scarcity affects individuals differently (Czerniewicz et al., 2020; Ratompomalala & Razafimbelo, 2020; Warschauer, 2004). This observation informs the study's second research question, which examines how technical constraints shape teaching and educational quality (RQ2). Haug (2017) defines inclusion as a quality of the educational situation as a whole, and this understanding makes it necessary to investigate how scarce technological resources shape opportunities for participation, variation in forms of expression, and accommodation of students with diverse needs. Research indicates that differences in digital competence and resource use have tangible consequences for access to academic communities (Czerniewicz et al., 2020; Ndibalema & Mucho, 2022; Zafitsara & Velo, 2022), while insufficient technical support can undermine learning environments even in countries with relatively strong digital infrastructure (Korseberg & Svartefoss, 2024). In LMIC contexts, this becomes a matter of structural accessibility. Hennessy et al. (2022) conclude that "hardware alone is insufficient", while other studies demonstrate how learning often has to be organised through everyday and analogue practices when digital systems fail.

In Madagascar, these dynamics are particularly evident. Ratompomalala and Razafimbelo (2020) describe how socio-economic conditions constrain universal design, while Zafitsara and Velo (2022) show that, although social media platforms may help sustain teaching activities, they frequently lack accessibility features necessary for students with disabilities. Viewed through Biesta's tripartite framework, the consequences of digital scarcity are therefore not merely pedagogical but normative. The absence of technology restricts not only teaching methods but also the forms of qualification, socialisation, and subjectification to which students gain access (Biesta, 2010, 2013).

At the same time, several studies indicate that specific strategies emerge under such conditions that can promote participation. Chen (2025) demonstrates that low-technology serious games can generate significant learning gains, while Niens et al. (2021) show that locally grounded educational approaches can be particularly effective in low-resource Malagasy contexts. These findings support the assumption that education is not necessarily dependent on advanced digital technologies, but rather on teachers' professional judgement, as emphasised by Haug (2017), Klafki (2014), and Biesta (2010, 2013) in different ways.

Taken together, the research literature demonstrates that digital scarcity is not merely a technical issue but a socio-material and normative framework that shapes pedagogical practice.

Methodology

Data collection relied exclusively on two rounds of semi-structured interviews, conducted to elicit rich, experience-based accounts of how teacher educators in Malagasy teacher education navigate limited digital infrastructure while continuing to deliver teaching. SFM was chosen because there was an established professional co-operation between SFM and one of the researchers' institutions. The interview guide was structured around two analytical themes: (1) how digital scarcity shapes pedagogical choices and learning opportunities (RQ1), and (2) how inclusive practices and professional responsibility are realised under these conditions (RQ2). The guide combined open-ended questions with follow-up probes that encouraged participants to elaborate on specific situations, decisions, and rationales (Kvale & Brinkmann, 2015). The interviews were conducted in two phases: three face-to-face interviews on campus and four digital interviews via videoconferencing or telephone. Digital interview formats provided flexibility in a context characterised by geographical distances and limited time resources, but also involved risks associated with reduced access to non-verbal information and technical interruptions. To ensure data quality, brief introductory conversations were conducted to establish rapport, technical testing procedures were undertaken

to secure stable audio and video connections, and contingency arrangements (SMS or telephone) were put in place in the event of connection failures (Deakin & Wakefield, 2014; Hanna, 2012). Where participants consented to recording, interviews were audio-recorded and transcribed verbatim. Any need for interpretation services was clarified and organised in advance.

The interview data were analysed thematically (Braun & Clarke, 2006), with an explicit focus on the research questions structuring the study. First, the analysis examined how learning is organised, challenged, and enabled in contexts characterised by unstable electricity supplies, low internet access, limited devices, and the absence of digital assistive technologies (RQ1). Particular attention was given to participants' descriptions of everyday challenges, including network failures, malfunctioning projectors, limited access to computers, improvisational practices, and judgements about what was pedagogically feasible and defensible. Second, the analysis examined how inclusive practices and professional judgement are enacted when digital tools are unavailable or unreliable, with particular attention to students with visual and hearing impairments (RQ2). The analysis examined how teacher educators adapted learning resources – such as paper-based materials, tactile resources, and oral routines – and how they allocated scarce resources while navigating ethical tensions between educational aspirations and structural constraints.

The coding process combined deductive codes derived from theory with inductive codes emerging from the empirical material, including examples such as *parallel planning*, *electricity-driven vulnerability*, and *collegial equipment sharing*. These codes were subsequently grouped into broader analytical themes capturing patterns across participants and teaching situations. To ensure transparency, a codebook and a series of analytical memos were developed to document interpretations, alternatives, and analytical decisions (Miles et al., 2014).

Trustworthiness was enhanced through the use of closely grounded quotations, detailed contextual descriptions, and reflexive awareness of one researcher's positionality within a partnership between Norwegian and Malagasy teacher education institutions. Transferability is supported by rich descriptions of material and organisational conditions, enabling readers to assess the relevance of the findings to other low-resource contexts (Lincoln & Guba, 1985). Dependability and confirmability were addressed through systematic documentation of procedures, decisions, and coding processes.

Digital interviews carried the risk of information loss due to network disruptions and limited non-verbal communication. These challenges were addressed through contingency communication channels, additional time devoted to relationship-building, and opportunities for asynchronous follow-up questions. Language and interpretation issues also had the potential to create shifts in meaning; therefore, key concepts were clarified and participants' understandings were verified through summarising and member-checking procedures (Kvale & Brinkmann, 2015). While the strategic sample does not permit statistical generalisation, it is well suited to uncovering depth, variation, and recurring patterns in professional experiences within this context (Patton, 2015).

Ethical approval was obtained from SIKT (the Norwegian Agency for Shared Services in Education and Research), and the study complies with guidelines for informed consent, confidentiality, and secure data management. Audio recordings were deleted following transcription, and all data were anonymised. Particular care was taken given the institution's inclusion mandate and the small size of the professional community, which increased the risk of indirect participant identification.

Analysis and discussion

This chapter presents and discusses findings from seven interviews with teacher educators at the teacher education institution Sekoly Fanomanana Mpampianatra (SFM) in Fandriana. Drawing on the theoretical framework, the discussion demonstrates how limited digital resources condition teaching, assessment, and students' learning processes within teacher education. The discussion explicitly addresses the research questions by examining how teacher educators manage digital scarcity (RQ1) and how such conditions shape professional responsibility, pedagogical decision-making, and understandings of digital competence (RQ2).

A recurring finding is that teachers operate within a context where digital technology plays only a marginal role in teaching. Informant 1 expressed this clearly: "*We teach in the classroom, everything in the classroom. Online only*

during COVID." Informant 2 described a similar situation, emphasising that *"digital resources are not available everywhere, so we have to teach without them."* These accounts indicate that the absence of digital teaching is not primarily the result of pedagogical preferences but rather of structural and material conditions. This finding corresponds with Selwyn's (2016) observation that digitalisation in education is inseparably linked to economic, political, and infrastructural factors. Where infrastructure is weak – as described by the participants through unstable electricity supplies, limited internet access, and scarce digital devices – digital technologies inevitably remain marginal. Warschauer (2004) argues that digital inequality must be understood broadly. It concerns not only access to hardware but also the quality of the surrounding conditions, including electricity, broadband connectivity, training, and technical support. The participants' accounts demonstrate that SFM faces challenges across many of these dimensions and provide a concrete illustration of the issues addressed in RQ1 regarding how teaching is organised when technology cannot be taken for granted.

When Informant 3 explained that "we often have to cancel digital plans because the electricity goes out without warning," this reinforced the picture of an institution lacking the fundamental prerequisites for basic digital teaching. Digitalisation therefore remains a possibility in principle, but one that is realised only sporadically and in limited situations. This points to a structural rather than a pedagogical digital deficit and supports the argument that professional responsibility should be understood as ensuring continuity rather than maximising technology use (Biesta, 2010, 2013).

Despite these limitations, teacher educators demonstrate considerable agency through practical and flexible adaptation strategies. When technology fails, they shift seamlessly to alternative teaching approaches. Informant 1 explained: "When the technology does not work, we have to adapt the teaching … we use the blackboard and chalk." Similarly, Informant 3 described a prepared dual-track strategy in which one lesson plan assumes access to a projector while another does not: "I cannot risk standing there with nothing. Therefore, I always have two plans." The ability to adapt teaching to local conditions appears to be at least as important as technological competence itself (Chen, 2017; Haug, 2017; Niens et al., 2021). In this context, low-technology approaches such as blackboard teaching, library-based learning, group work organised around students' own mobile phones, and the use of outdoor spaces

emerge not merely as emergency solutions but as sustainable and carefully considered pedagogical alternatives within the constraints of the local context.

Informant 4 reinforced this perspective by stating: *"Even without digital equipment, students can learn well as long as the teaching is clear."* Low technology therefore appears not as a barrier, but as a didactical strategy that provides teacher educators with professional room for manoeuvre within constrained circumstances. Viewed through the perspectives of Klafki (2014) and Biesta (2010, 2013), these choices can be interpreted as expressions of practically wise, Bildung-oriented professional judgement. Understanding, participation, and relationships are prioritised over technological perfection.

An important feature of the pedagogical landscape at SFM is the uneven distribution of digital devices among students. Informant 1 describes this situation as follows: "Not all students have equipment… we use phones and work in groups." Informant 2 points out that only a small proportion of students have laptops, and that many students in practice rely on a single digital device per group: "We often have to gather several students around one screen." This situation gives rise to a form of collective digital practice, in which sharing and collaboration become necessary pedagogical strategies (Haug, 2017; Ndibalema & Mucho, 2022). As a result, technological participation becomes a collective project, requiring teachers to design teaching approaches that enable the sharing of devices, access, and knowledge.

At the same time, this collective practice also creates challenges. Informant 4 describes how "some groups become dependent on one student who has a phone with internet access, and this can make the distribution unfair." In this sense, digital devices may function as capital in a Bourdieusian sense: those who possess them gain greater opportunities for active participation, while those who do not risk becoming passive (Zafitsara & Velo, 2022). This underscores how digital access – or the lack thereof – acts as a socially differentiating factor in the classroom (Warschauer, 2004) and directly affects questions of inclusion as understood by Haug (2017): as a quality of the educational situation as a whole.

All informants report that their own digital competence is insufficient and that this limits their opportunities for continuous development. Informant 1 explains: "My digital competence… not very much." Informant 3 notes that students often surpass teachers in digital competence: "Students often know more than we do, but we cannot give them room to use it." Informant 4 calls

for more practical training: "We get theory, but no time to try things ourselves." Digital competence is therefore shaped both by individual limitations and by structural conditions that make practical skill development difficult (Ng'ambi, 2013; Selwyn, 2016; UNESCO, 2023).

Teachers' reliance on technological assistance–and on one another–can be understood through Lipsky's (2010) theory of street-level bureaucrats, where local solutions compensate for structural shortcomings. Informant 2 makes this explicit: "We ask each other first. The technician has too much to do."

All informants describe a political and institutional desire for increased digitalisation. Informant 1 states: "We try to introduce it little by little." At the same time, Informant 4 notes that current digitalisation initiatives remain largely theoretical: "We learn theory about digital teaching, but we cannot practise because we lack equipment." This reveals a clear gap between formal policy ambitions and actual practice–a pattern well documented in international research on education in low-income contexts (UNESCO, 2023). Digitalisation processes at SFM can therefore be understood as a mismatch between vision and reality. Without resources, time, and infrastructure, digital competence remains an abstract concept, detached from teachers' everyday professional practice.

On assessment, informants describe practices that are predominantly paper-based. Informant 1 explains: "Students only write… it limits assessment." Informant 2 notes that all submissions must be handed in physically because digital systems are unavailable: "We have no platform. We get everything in piles." This results in limited variation in assessment formats and constrains opportunities for more process-oriented or multimodal assessment. When such possibilities are unavailable, the breadth and depth of assessment are reduced, and principles of assessment for learning (Gamlem & Smith, 2013) become more difficult to realise in practice.

Informant 1 is the only participant to mention AI explicitly: "Students use artificial intelligence for writing, but not in tests… it is fine if they master it." This points to an interesting dynamic. While the institution itself is not driving digitalisation, a form of "unofficial digitalisation" is occurring from below. AI becomes a tool students use on their own initiative, without teachers having the means to regulate or support its pedagogical use. This aligns with Selwyn's (2019) notion of "everyday AI", whereby technologies – including advanced ones such as artificial intelligence – are taken up through mobile

devices and informal learning practices that are not necessarily visible or institutionally governed.

As shown by Hodøl et al. (2025) in a Norwegian context, such tools may simultaneously create new digital divides between students who possess the linguistic, analytical, and technical skills required to make productive use of AI tools, and those who do not. This finding highlights how the shift "from access to ability" is also a relevant perspective in Malagasy teacher education.

Paper-based submission practices also place a heavy workload on teachers. Informant 3 states: "It takes a long time to read and write comments." Informant 2 explains that feedback is often delayed due to workload pressures: "It can take weeks before they get a response." This complicates continuous formative assessment, which Hattie and Timperley (2007) identify as central to learning outcomes. When digital tools are unavailable, the provision of frequent and detailed feedback becomes more difficult, rendering assessment more static and limiting students' opportunities for ongoing improvement.

Informants further describe how limited digital access affects students' learning trajectories. Informant 1 notes: "All teachers and students are affected." Informant 4 expresses concern that students may complete their education without acquiring basic digital skills, despite curriculum requirements: "They may finish their studies without knowing how a computer works." This suggests that students receive an education that does not fully prepare them for the demands of the profession. Ng'ambi (2013) argues that such limitations may reinforce existing inequalities and make it more difficult for newly qualified teachers to meet societal expectations regarding digital competence in schools.

At the same time, the findings suggest that student motivation is not necessarily contingent on digital access. Informant 1 claims: "Students are motivated with digital tools… but also without." This indicates that the quality of teaching, relationships (Haugestad & Keeling, 2024), and support are central to students' learning experiences – factors that are not directly dependent on technology but closely aligned with the Bildung- and inclusion-oriented perspectives emphasised by Haug (2017), Klafki (2014), and Biesta (2010, 2013).

Across the interviews, a picture emerges of a teacher education programme caught between ideals of digitalisation and a reality in which infrastructure does not support such practices. Teachers compensate in impressive ways through flexibility, creativity, and low-technology solutions. Nevertheless, limited equipment, training, and institutional support constrain teaching,

assessment practices, and student learning outcomes. Theoretically, the findings indicate that digitalisation in education is primarily a structural issue. Without material infrastructure, pedagogical digitalisation remains fragmented and dependent on individual initiative.

Teachers' practices can be understood through Lipsky's (2010) theory of street-level bureaucrats, where frontline professionals address systemic shortcomings through improvised and pragmatic solutions. Unequal digital access further underscores the relevance of Warschauer's (2004) analyses of the digital divide, where access concerns not only technology itself, but the broader system surrounding it. The emergence of AI use nevertheless shows that technological change does occur, albeit in informal and weakly regulated ways.

Overall, the findings show that teachers demonstrate considerable professionalism, but that contextual constraints nonetheless impose clear limits on digitalisation at SFM. This forms the core response to both research questions: teaching, inclusion, and professional responsibility are enacted and challenged within a constant tension between normative ambitions and fragile infrastructure.

Conclusion

In light of Haug (2017), Klafki (2014), and Biesta (2010, 2013), the study shows that inclusive teaching in low-technology contexts is not primarily a matter of technological capacity, but of didactical and normative priorities that enable participation within existing constraints. The findings demonstrate that teacher educators exercise professional judgement that compensates for structural limitations through stable routines, analogue support systems, and relational work. This aligns with socio-material perspectives (Fenwick & Edwards, 2010), which emphasise how learning is shaped through the interplay between people, practices, and infrastructure.

These insights carry clear implications for teacher education at SFM. If the goal is inclusive teacher education in contexts of limited digital access, priority should be given to reliability, maintenance, basic infrastructure, and

competence support rather than technological scaling alone. International research shows that "hardware alone is insufficient" (Hennessy et al., 2022), and this study supports that claim: sustainable teaching practices emerge where technological ambitions are combined with professional agency and pedagogical judgement.

The study also points to directions for future research. First, future research should examine the development of professional judgement over time in low-resource contexts, as well as the role of collegial support in strengthening this capacity. Second, comparative studies across institutions in different LMIC contexts are needed to identify recurring patterns in how low-technology practices support inclusive learning environments. Third, student perspectives should be explored more systematically, particularly regarding how Bildung, participation, and academic development are experienced when teaching is shaped by analogue, hybrid, or improvised infrastructures.

Overall, the study demonstrates that inclusive teacher education under conditions of scarcity requires a strategic alignment between realistic policy design and teacher educators' professional judgement. This constitutes a field in which educational policy, didactics, and global justice intersect – and where further research can generate insights of relevance far beyond the Malagasy context.

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Ansvar og roller i journalistikken