"I believe I did not preach into the desert": Opportunities & Challenges in Scaling Teacher Mentorship through Mobile Technology in Rural Côte d'Ivoire

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ABSTRACT

Mentoring is crucial for teachers' professional development but challenges of access, resources and capacity make it difficult for regular in-person mentorship in low-infrastructure contexts. Mobile technologies such as social media have the potential to scale teacher professional development and communities. This paper explores the culture of teacher mentorship in rural Côte d'Ivoire and the motivations and challenges mentors face in using mobile technology in their work through semi-structured interviews with 33 teacher mentors. We found that mentors valued social connections and knowledge sharing in using mobile technology. However, power dynamics between teachers and mentors affected how they could collaborate. Mentors also expressed frustrations with the lack of moderation within social media groups. Lack of infrastructure and connectivity also raise potential issues of inclusion and access to rural areas and schools. We conclude with design recommendations for technologies that scale culturally-relevant teaching mentorship in low-infrastructure contexts.

CCS CONCEPTS

• **Human-centered computing → Social networking sites**.

KEYWORDS

teachers, mentors, mobile technology, HCI4D, teacher professional development

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1 INTRODUCTION

Mentoring teachers plays a crucial role the success of teacher professional development programs, as shown in different cultural contexts [1]. Mentors who are administrative staff or senior teachers can help teachers develop professional competence, instill confidence and a sense of belonging, and reduce teacher attrition in their profession [1, 21, 61]. Mentors can include those trained and designated as mentors within an organization or informal mentors who take on mentoring roles outside of an official capacity [1]. Particularly in low-infrastructure contexts, mentors are instrumental in helping teachers establish pedagogical practices [7]. Low-infrastructure or low-income contexts mean that access to proper transportation infrastructure, electricity, internet, and other utilities is scarce[1]. In these contexts, mentors visit schools to provide feedback to teachers in their classrooms, which can provide pedagogical and motivational support to teachers [36, 50, 52]. Mentoring programs in low-infrastructure contexts can help develop teachers' capacities in pedagogical training and knowledge. For example, a mentorship program with pre-service teachers in South Africa helped teachers develop pedagogical knowledge through classroom observations [44].

Technology-mediated mentoring provides opportunities for scaling mentoring among teachers through social media platforms such as Facebook and WhatsApp [28, 38, 39, 45, 54, 55]. In a study of a global mobile mentoring program in a refugee camp in Kenya [38], WhatsApp facilitated communication between teachers and mentors to build camaraderie and share new ideas. Technology can also allow teachers and mentors to ask questions and receive more immediate responses than waiting for in-person support [38]

[1] from World Bank data

Technology can also create "third spaces" for communities of practice to emerge between teachers and mentors in discussing topics beyond pedagogy [22]. However, technology alone does not scale quality mentorship. Nelimarkka et al [45] found that consistent, active participation in online mentorship communities is difficult to maintain without proper moderation and structure. Moderation in these platforms also poses an issue as teachers may spread irrelevant information in these groups [55]. As social media platforms are primarily social connection spaces, professional development (PD) is not always supported beyond question and answers [38, 39].

While technology can foster communities of practice among teachers, it is important to consider mentor-mentee dynamics within the cultural context, which can impact the efficacy and sustainability of mentorship. For instance, matching mentees to mentors who are culturally-appropriate and relatable can shape mentoring interactions [15, 25]. In addition, the role of mentors and mentees need to be clearly defined in order for effective mentorship to take place [26]. Maphosa et al [37] found that many mentors were not aware of their role as mentors and did not receive professional development support for mentorship. Understanding the roles of mentors and mentees brings up questions of authority and hierarchy. Sawatsky et al [50] found that the culture of politeness in Malawi may have affected how mentors brought up difficult topics with their mentees. In this paper, we examine how the cultural context of rural Côte d'Ivoire impacts mentor motivations and usage of technology and the relationships between mentors and their mentees.

We conducted a longitudinal qualitative study with 33 teacher mentors in Côte d'Ivoire about their mentor-mentee relationships and the ways they use mobile technology for mentorship. We define teacher mentors as formal and informal advisors for teachers implementing a pedagogical program. Mentors typically share their knowledge, expertise, and experiences with teachers, offering encouragement, constructive feedback, and practical advice to help them navigate challenges and make informed decisions. In this paper, we ask the following research questions:

- **RQ1:** What is the culture of teacher mentorship in Côte d'Ivoire?
- **RQ2:** How do teacher mentors use mobile technology in their mentoring, and what are the challenges in scaling mentoring?

Our findings uncover that mentors are motivated in their career aspirations and desire for recognition. They used social media platforms like WhatsApp and Facebook to connect with mentees and peers and to share resources. However, there were potential power dynamics resulting from the the hierarchy between mentors and teachers that may hinder effective mentorship. In addition, mentors desired greater moderation and training in technology. While the cultural nuances of rural Côte d'Ivoire are not necessarily unique, they point to how technology as a one-size-fits-all approach to scaling virtual communities of practice may not be sufficient and instead require context-specific designs and structures. We contribute to the HCI4D and Learning at Scale communities by providing insight into how mentors use mobile technology to support teachers in Côte d'Ivoire, an under-examined context [34]. We discuss how these findings present both similar and unique challenges to scaling community and teacher professional development across global contexts. Our contributions expand opportunities to design online communities for teacher mentoring for diverse geographies in low-infrastructure contexts.

2 RELATED WORK

2.1 Teacher Mentoring in African Contexts

Mentorship for teaching has been shown to improve teachers' pedagogical knowledge, confidence in teaching, and motivation in their profession [1, 26, 30, 42]. Mentorship can build communities of practice (CoP), groups of people who continuously share and deepen their knowledge and expertise [56, 57]. Hudson et al [29] lay out a model of mentoring that includes five factors to effective mentoring in teaching. First, personal attributes of the mentor integrate the mentor and mentee within a social ecosystem of teaching mentorship. Second, mentorship should be built into the educational system within which the mentor-mentee relationship functions. Third, mentors need significant pedagogical knowledge to guide their mentees. Fourth, mentors should model practice in their own teaching practices. Fifth, mentors should provide constructive and regular feedback to mentees. Several pieces of prior work examine mentorship within African educational contexts. In these contexts, mentorship mainly consists of mentors visiting schools to observe teachers and provide constructive feedback [52]. Administrators can also sometimes be considered mentors in their role to monitor teacher attendance in efforts to reduce teacher absenteeism [36]. In an examination of 26 pre-service teachers in South Africa, Ndebele and Legg-Jack [42] report that these teachers were positively impacted by mentorship in gaining significant pedagogical knowledge. Similarly, Nel and Luneta [44] and Sibanda and Jawahar [52] also report pedagogical as well as motivational gains in South African teachers who receive mentorship as part of their PD. Sawatsky et al [50] found that mentors provided emotional and social support for mentees in addition to pedagogical support in Malawi. Mentorship is important both to the development of teachers' teaching abilities as well as their motivational development in teaching.

Though mentorship brings significant benefits to teachers, ineffective implementation of mentorship programs is a prominent issue in the mentoring programs [19]. A major challenge in the implementation and maintenance of mentorship programs in low-infrastructure contexts is the lack of human resources. Rural schools in particular receive infrequent mentor visits due to both the shortage of available mentors and transportation costs and logistics [5, 36]. In Nel and Luneta's [44] work, only two mentors were available and could not provide all the help that teacher mentees desired for lesson and homework preparation. In a study of teachers in Zimbabwe, mentors lacked the necessary training to guide student teachers in pedagogical skills [37]. As mentors are still developing their own skills, mentorship programs do not always provide adequate PD and training for mentors [26, 36, 37, 40]. Challenges to implementing in-person mentoring can hinder the development of both mentors and their teacher mentees.

2.2 Technology to Scale Teacher Mentoring in Africa

To overcome the challenges of in-person mentoring, recent work has explored the use of technology to scale mentorship, specifically

in the use of social media platforms such as Facebook and Whatsapp. Social media platforms can serve as virtual communities of practice, a virtual collaborative space with unique characteristics from traditional communities practice that include larger numbers of enrollment and potential global participation [6, 18]. Through sharing new knowledge and forming social connections, social media can give teachers and mentors a "third place" to form a virtual community of practice outside of their home and professional setting [22]. Mentoring via social media has been explored in low-infrastructure contexts globally. For example, Nedungadi, Mulki, and Raman [43] found that WhatsApp mentoring to reduce teacher absenteeism increased teacher attendance and motivation while decreasing costs of field visits in India. Also in India, Varanasi et al [55] found that WhatsApp groups gave teachers in India ways to create both tightly- and loosely-coupled knowledge communities. Teacher-led teacher communities within social media can give teachers opportunities to share issues and solutions related to their teaching in both Jordan [39] and China [49]. Specifically in African contexts, mobile mentoring facilitated immediate communication and camaraderie-building in the Kakuma refugee camp in Kenya [38]. WhatsApp groups can also allow peer mentors to provide more individualized feedback outside of classroom training for health workers [28]. Informal or peer mentoring through WhatsApp groups also showed promise in providing guidance and training to mentees [2, 28].

Despite the benefits of technology for scaling mentorship, access to social media may not be enough. Waning participation from both mentors and mentees can be de-motivating, especially for mentors trying to engage with their teacher mentees [38, 45].PD is often not structured in social media groups and do not provide pedagogical resources for teachers and mentors to grow in their profession [37, 45]. Though teachers viewed technology-mediated mentoring positively, these programs were found to lack consideration of external factors such as school climate and socio-economic factors and the relationships between mentor and mentee matches [24]. There are also issues of moderation and the prevalence of irrelevant or even malicious posts [55]. Especially in low-infrastructure contexts, these challenges of participation are exasperated by lack of consistent electricity and internet [23, 38, 59]. Mendenhall et al [38] found that the lack of responses was partly due to slow or unreliable internet and the inability to send multimedia such as photos and videos. As teachers and mentors in these contexts are emergent users [17], technology knowledge and readiness also impact the way that teachers and mentors use mobile mentoring if they use it at all [33, 46]. This prior work has mainly explored these technology challenges among teacher mentees. The present paper contributes to this area of work through examining these challenges and opportunities in technology-mediated mentoring from the mentors' perspectives.

2.3 Cultural Aspects of Mentoring

A consideration for using mobile technology in mentorship is understanding the role that culture plays. Sawatsky et al [50] found three cultural domains that impacted mentoring in Malawi: intrapersonal, interpersonal, and institutional. The intrapersonal domain included the culture of politeness and friendliness among mentors and mentees that could make sensitive topics difficult to broach. The interpersonal domain included aspects such as respecting elders and boundaries between personal and professional life. The institutional domain involved potential confusions in whether mentors are also considered supervisors and inadequate staffing of mentors compared to mentees. The authors report that the culture in Malawi can make asking for mentoring or bringing up difficult topics challenging. Mentors that are not clear in their roles as mentors can also cause tensions between mentors and mentees in their interactions due to ill-defined levels of authority [26]. For example, Maphosa et al [37] found confusion around the role of mentors, with mentors viewing mentees as helpers for their own teaching rather than a distinct mentor-mentee relationship. Mentoring can also fail within if mentors and mentees have tenuous relationships that hinder progress [1, 37, 44].

Due to these considerations, matching mentors appropriately and considering how cultural nuances impact mentor-mentee interactions in crucial for the success of integrating technology into mentorship programs [15]. A mentorship program for young people from the Horn of Africa in Australia implemented cultural competency training for mentors and established partnerships with local organizations to improve the culture of mentorship [25]. How technology integrates within a specific cultural context is also important to consider. Mendenhall et al [38] found that though technology can enable sharing media such as pictures and videos that help to bridge physical and cultural gaps between global mentors and teacher mentees, whether the media shared was productive or relevant impacted the sustained use of technology in mentorship. In a South African context, Nel and Luneta [44] found that building trust and rapport between teachers and their mentors was highly important for creating a environment conducive to mentorship. In Malawi, maintaining friendly yet professional relationships are impacted by the cultural nuances of respecting elders and politeness [50]. Though technology can scale mentorship by allowing mentors to reach multiple mentees, how social media platforms and other technology can aid in building trusting, professional, and sometimes authoritative relationships is an open question, particularly in African contexts. In this paper, we consider the cultural contexts of Côte d'Ivoire and how teacher mentors use technology within this culture.

3 METHOD

3.1 Research Context

3.1.1 The NewMethod Pedagogical Training Program. This study is a part of an ongoing research program on supporting literacy and mathematics in rural Côte d'Ivoire. The research program involves the implementation of technology to support a new teacher training program (*NewMethod*[2]) in collaboration with the Ivorian Ministry of Education. As part of this program, teachers receive training in both pedagogy and in using technology to support their work. The technology training taught teachers and mentors about the available social media groups and guidelines of communicating in these groups (Figure 1). The groups available for teachers and mentors included WhatsApp groups and a Facebook page to connect to others through messaging, posting multimedia content,

[2]we don't disclose the program to preserve the privacy of the communities

Figure 1: Mentors attending a training session.

Figure 2: Mentors engaging in a group meeting with teachers.

liking, and commenting on media. There were WhatsApp groups within regions and schools and a Facebook page available for all members of the administration, mentors, and teachers.

3.1.2 Mentoring within NewMethod. The program consisted of mentorship for teachers through a hierarchy of mentors. The different types and roles of mentors are as follows:

- **Teachers:** 3rd, 4th, and 5th grade teachers implement *NewMethod* as facilitators, engaging students in various activities in French and Math. More experienced teachers serve as informal mentors for other teachers without any official mentorship training.
- **Directors:** Similar to informal teacher mentors, Directors are senior teachers that receive official mentorship training to support the teachers within their school.
- **Pedagogical Advisor:** Pedagogical Advisors visit schools to observe teachers and provide feedback on implementing activities within *NewMethod*. They are appointed by administration and do not teach classes. They are former experienced teachers who progressed to become advisors.
- **Inspector:** Inspectors are appointed by administration to supervise the holistic school administration by region. They are trained on *NewMethod* and periodically visit schools to observe schools. They are encouraged but not required to provide motivational support to teachers on *NewMethod*.
- **Master Trainer:** Master Trainers are officials within the Ministry of Education in Côte d'Ivoire. They are the lead trainers of *NewMethod* for the country. They train pedagogical advisors and inspectors in *NewMethod* and also occasionally observe teachers in their classes.

Mentors primarily support teachers through in-person interactions in teacher observations and weekly meetings to provide guidance on planning lessons (Figure 2). They also engage with teachers remotely through the program's social media platforms. As WhatsApp groups are region and school-wide, Pedagogical Advisors and Directors interact with their teacher mentees in these groups while all mentors, teachers, administration members, and research team members can access and use the Facebook page.

3.2 Participants

We conducted two stages of semi-structured interviews with a total of 33 mentors in the Daloa (n=18) and Bouaflé (n=15) regions of Côte d'Ivoire. 9 teachers, 5 Directors, 4 Pedagogical Advisors, 2 Inspectors, and 1 Master Trainer participated in the first stage of interviews. All mentors and 5 teachers identified as male, and 4 teachers identified as female. The second stage of interviews focused on Directors and Pedagogical Advisors with 5 Directors and 7 Pedagogical Advisors participating in interviews. Because our interviews were about the culture of mentorship and the motivations of using mobile technology, the most active Pedagogical Advisors and Directors in the Facebook and WhatsApp groups were recruited. We chose these two groups of mentors because they have access to both the Facebook page and WhatsApp groups as overseers of a region (Pedagogical Advisors) or specific schools (Directors).

3.3 Procedure

We conducted two stages of semi-structured interviews with 33 mentors at different levels who were actively involved in supporting teachers with implementing the *NewMethod*. The first stage interviews addressed questions about mentors' roles and duties, their career aspirations, and their relationships with mentees. The second stage of interviews consisted of Pedagogical Advisors and Directors with questions about mentors' use of mobile technology and social media in support of *NewMethod* and their general views towards technology in their career aspirations. Interviewers from a third-party research firm in Côte d'Ivoire conducted these interviews either in-person in the first stage and over the phone in the second stage with considerations of COVID-19 safety guidelines. All interviews took place in French, the primary language of the teachers and mentors in Côte d'Ivoire. The interviews were then transcribed and translated to English for data analysis. This study was approved by the university IRB and the ministry of education in Côte d'Ivoire.

3.4 Data Analysis

Our research team consisted of faculty, a postdoctoral researcher, a Ph.D student, and two undergraduate and master's research assistants associated with a mid-size research university in the United States. The two lead authors and research assistants in inductive thematic analysis in which themes emerge from the data [14, 41, 53]. We started by reading over transcripts and taking notes. We then

re-read transcripts to form preliminary codes. These codes were discussed and iterated upon between the four members of the research team. After this coding process, we grouped quotes into high-level themes with affinity diagramming. Affinity diagramming is a common method for developing themes in qualitative research [8]. These themes were discussed until a consensus and saturation was reached.

4 FINDINGS

4.1 What is the culture of teacher mentorship in Côte d'Ivoire?

Our first research question addressed the cultural aspects of teacher mentorship in Côte d'Ivoire. Here we discuss this culture among mentors as well as differences between the different mentoring roles.

4.1.1 A Hierarchy of Mentorship Roles. Mentors have various roles that range from teaching to administrative oversight and guidance in helping teachers in implementing the pedagogical program. At the highest level are Master Trainers, who are high-ranking members of the Ministry of Education. They mainly interact with Pedagogical Advisors and Inspectors and see their role with teachers as motivators or support, "*Discussing the mentoring activities to encourage [teachers] because teachers always need support and encouragement. Because when you encourage [teachers] they feel supported so they take an interest in what they are doing*" (P3, Master Trainer). Master Trainers do occasionally observe teachers and communicate with teacher trainers if teachers do not have enough training in *NewMethod*, "*When you [leave the classroom observation] and you are not happy, the first challenge is to do a retraining quickly. You can ask the [teacher trainer] right away to organize a retraining so that the teachers are up to speed*" (P3, Master Trainer). At the next level, Inspectors are supervisors for both teachers and mentors in a region, "*The role of the pedagogical inspector is to help and supervise the facilitator and even the school director to monitor teachers and facilitators very closely and give them daily pedagogical practice*" (P14, Inspector). At the next level are Pedagogical Advisors, who frequently visit schools to observe classes. They have multiple responsibilities as mentors, "*[a Pedagogical Advisor] is first of all a supervisor, and administrator, and an evaluator*" (P2, Pedagogical Advisor). As part of administration, Pedagogical Advisors serve as liaisons for teachers, "*[Pedagogical Advisors] must supervise the teachers, whether they are old or new...They must also see to the organization of pedagogical and school examinations,...[and] facilitate relations between the administration and the teaching staff*" (P11, Pedagogical Advisor).

Directors are in an interesting role as they are both part of administration and also serve as teachers, "*The director has several responsibilities, but the most important is administration because he is between that and the school. He is at the same time a coordinator and a supervisor*" (P12, Director). As Directors oversee a school, they saw their role as management, "*[My role] is to ensure the proper management of school affairs...to guide and give advice to [teachers]...for the welfare of the children*" (P19, Director). Though teachers are not given official mentoring capacities, they are driven by improving children's education and in sharing their passion for education, "*Teaching itself is not easy. You have to take the job in hand, you have to love it and if you love it you will climb the ladder*" (P1, Teacher). Within this culture of mentorship, there are clear distinctions in the educational hierarchy from informal teacher mentors to Master Trainers in the Ministry.

4.1.2 Mentors See Teacher Mentees as Friends and Family. Even with the distinction of mentor roles within the hierarchy of *NewMethod*, mentors saw their relationship with teachers as highly collaborative and almost family-like. One mentor said, "*I told [the teachers] that I am there for us to work and that I will consider them as brothers and friends in the work because the work is stressful, and we have to do it rigorously*" (P15, Pedagogical Advisor). Another Director also mentioned brotherhood in his relationship with teachers, "*I wanted them to have brotherly relationships...and that if ever a conflict arises that we seek to resolve this so that peace reigns and therefore when a teacher has difficulties, he has no problem asking his colleague*" (P2, Director). Seven mentors brought up the importance of collaboration enabling them to accomplish more in their work, "*It is the union that makes the strength! Alone, we can't do anything, but if we are numerous, we can do a lot*" (P1, Pedagogical Advisor). Another reiterated, "*You can't achieve certain goals alone...as it is a team the objective will be achieved*" (P8, Teacher). They saw this collaboration as critical for the successful implementation of pedagogy, specifically in having human connections, "*In any human work there are necessarily aspects that will make setting up the program a little tricky, but we hope that with the advice of each other...this implementation will be done in a way we can say successfully*" (P5, Teacher). Human collaboration and the feeling of being together as a team was important for mentors to feel that they could do rigorous work in implementing *NewMethod*. At different levels of the hierarchy, mentors carry varying degrees of authority. This authority might impact how teachers themselves view mentors and the familial relationship between the two parties.

4.1.3 Mentors Had Long-Term Career Aspirations in Education, but Did Not Always Feel Appreciated. All mentors had career aspirations of climbing the hierarchy in the educational system. In Côte d'Ivoire, educators can advance in the educational system by taking competitive exams that show their proficiency in their work. For teachers, their goals were to advance to either school Director or teacher trainer (moving to the organization responsible for training teachers). Some teachers had specific goals to take exams and advance to a specific level, "*I would like to pass the professional competition and become [teacher trainer/Pedagogical Advisor]*" (P10, Teacher). A Director expressed wanting to become an Inspector through the competitive exams, "*I want to access a higher cycle to become [Inspector] by competition of course. I am even studying for it because I still want to move forward*" (P15, Pedagogical Advisor). While others mentioned loftier goals (i.e. to progress through many stages over the course of the next few years), "*I will be in the B3 civil servant category within three years, why not even next year move to the A3 category and so on, arrived in A4. Either counselor or educator or [teacher trainer]*" (P4, Teacher). For those already serving in administration (such as Pedagogical Advisors and Inspectors), they had aspirations for promotion, "*I will be at the rank of principal inspector*" (P14, Inspector). Each of these advancement

exams are rigorous, and both teachers and mentors use these exams as motivation for improvement in their careers.

Although mentors had long-term career aspirations to advance in the educational hierarchy, mentors also had short term goals to be recognized for their efforts. Mentors mentioned that seeing a direct impact on teachers' practice based on their guidance was especially important in feeling rewarded for their work, "*When a teacher has to go and pass on to the children what we have taught him, he reassures us...We must ensure that the teachers who must provide knowledge to the children live up to our expectations, this is our daily challenge*" (P14, Inspector). This visible impact helped mentors feel as though their work was meaningful, "*In my experience what I appreciate the most is when in a classroom the teacher implements what we have shared with him. It is my great joy because I believe that I did not preach in the desert*" (P3, Master Trainer). However, not all mentors felt that they were sufficiently recognized for their work. Some of these feelings came from higher-ups in the hierarchy as one Pedagogical Advisor recalls in a specific scenario, "*The Inspector did not seem to appreciate [my] approach, and this was noticeable in his behavior towards me*" (P11, Pedagogical Advisor). Another mentor stated that they did not hear appreciation from colleagues, "*I don't think I've had a big impact on a school yet. If that were the case, the colleagues would attest to it*" (P7, Teacher). While prior work has shown how teachers use WhatsApp to celebrate their peers [55], mentors do not seem to have the same level of recognition in their groups.

4.1.4 Some Teachers May Resent Mentors for Advancing in Their Careers. Aside from feelings of appreciation, two mentors mentioned negativity from teachers because of their role in administration, "*Some people have contempt for us because of our evolution [to administration], they hate us, they are bitter. So we tell them that life is like that, there are some who are made to succeed and others who have no chance*" (P1, Pedagogical Advisor). This comment suggests a sense of fatalism in whether teachers can advance in their careers or stay stagnant. With these attitudes, both teachers and mentors may build a sense of competition between each other. A Director mentioned possible jealousy of mentors' authority, "*There are teachers who may not consider you a role model because some are very competitive. When a teacher is obsessed with this idea, I step back and just carry out my administrative tasks*" (P12, Director). Directors, who oversee teachers within a school, may feel that if teachers are bare jealousy or resentment, they will instead do administrative duties such as paper work instead of teacher observations and feedback. Interestingly, these sentiments came from Directors and Pedagogical Advisors who, unlike Master Trainers and Inspectors, interact directly with teachers more regularly as supervisors of schools and regions. Feelings of resentment or jealousy may represent a potential consequence of power dynamics coupled with close collaboration.

4.2 Why and how do teachers mentors use mobile technology in their mentoring?

In both interviews, we explored the various motivations and purposes for which mentors used technology to support their mentees. Here we describe how mentors used mobile technology to maintain collaboration within their mentoring culture as well as the challenges of using technology for scaling mentorship.

4.2.1 Infrastructure Challenges in Human Connection for Mentoring. The main challenge mentors mentioned in visiting schools or having in-person meetings was infrastructural. A Pedagogical Advisor mentioned that traveling between schools can be a large burden, "*you have to travel a long distance to reach schools, work and come back late*" (P11, Pedagogical Advisor). A potential issue of inclusion is that rural schools were especially difficult to access due to lack of transportation infrastructure, "*There are certain villages which are easy to access but others, on the other hand, are very difficult to access because of unpaved roads*" (P20, Inspector). Basic utilities such as electricity, water, and internet were often inconsistent, "*Sometimes there are problems with water, electricity, often the internet does not work*" (P6, Teacher). Mentors also said their many responsibilities can be overwhelming, "*We as teachers cannot do everything, whether it is in the morning, in the evening or even at night*" (P5, Teacher). Another mentor noted, "*We are obliged to schedule in such a way that we cannot go [to the schools] regularly*" (P2, Pedagogical Advisor). They also reported frustration at the lack of financial incentive, particularly for traveling between schools, "*At the level of the Advisors...[we] no longer receive allowances or bonuses for visits...There is a fuel bonus...but since 2012 it no longer reaches us, and we talk about it within ourselves, but no one hears us*" (P11, Pedagogical Advisor). These challenges led to inconsistent and infrequent visits to schools and fewer observations and feedback for teachers, especially at rural schools where infrastructure is especially lacking.

4.2.2 Mentors Used Technology to Maintain Social Connection Even Without Frequent In-Person Visits. Mentors in our study did not use only mobile technology to conduct their work. Mobile technology was a supplement for guiding and helping teachers even when they could not conduct in-person visits. Mentors cited actively using social media platforms highly regularly, often everyday, "*I use WhatsApp to communicate with people I know, every day I go to WhatsApp*" (P28, Pedagogical Advisor). For higher-level mentors like Master Trainers, mobile technology also helped in monitoring teachers' progress, "*It is a channel for exchanges and capacity building, also for monitoring activities...we also have to ask [teachers] to tell us where they are with the activities... we can follow them remotely using the means of communication*" (P3, Master Trainer). Social media helped mentors build rapport with their mentees, "*I manage to exchange with my correspondents easily and very often I see their photos and...then we exchange information...so that's what motivates me to go on Messenger*" (P31, Pedagogical Advisor). For mentors, the value of social media was built upon the human connections created in-person.

Social media also allowed mentors to maintain social connections. A Director mentioned the close connections social media allowed, "*The human relationship with others by WhatsApp, when I need didactic courses..., there is a person who sends me the information. It creates links, closeness*" (P24, Director). Mentors also liked to share social content with teachers, connecting with their mentees beyond professional purposes, "*They also give other information of a playful and also humorous nature... we try to balance the educational*

documents" (P23, Pedagogical Advisor). Given some of the personal nature of the messages on these platforms, mentors appreciated that the WhatsApp groups were private and not moderated by administration, "*The information is not too exposed, the information you send is between you and then your group does not come out*" (P24, Director). Another mentor also liked the privacy of WhatsApp, "*as long as I haven't given the opportunity to a third person, nobody can write on my page...So [on WhatsApp] my data is confidential because it is between us corresponding only and it is not known to everyone*" (P31, Pedagogical Advisor). This suggests a distinction between how mentors lower in the hierarchy might view the authority of higher mentors within the administration and Ministry.

4.2.3 Mentors as Learners: Sharing and Seeking Knowledge. As found in prior work [2, 28, 49, 55], mentors used mobile technology as a way to support teachers in the implementation of *NewMethod*. Mentors could quickly answer questions from teachers, "*When one has difficulties [with the program], they ask questions to everyone on the platform and then we give answers which they use*" (P28, Pedagogical Advisor). Mentors also posted videos and documents related to pedagogical practices to social media groups, "*I put these trainings on these platforms, so that the teachers can immerse themselves*" (P27, Director). This knowledge sharing helped mentors reach teachers to help with *NewMethod*, "*It allows us to share knowledge. When a person conducts an activity, he names the activity and the [grade he teaches]. This is very important, since it is a sharing of knowledge. We exchange experiences on this platform*" (P25, Director). Here, the Director is explaining that the help they provide is specific to the context of the teacher and the grade they teach as they are in charge of overseeing all teachers within a school.

As mentors still seek to advance in their careers, they are still learners themselves and use mobile technology to seek out information as well. They use a variety of platforms, "*I go a lot on Facebook, on Google, to take certain information...When there is something I want to look up, I type in Google and take the information I want...If there is an activity that I did not understand, I posted [to WhatsApp] and then those who understood these activities better explained to us...I call my colleagues who have gone through this stage, and they give me the information. Often there are courses that people publish on WhatsApp, the materials to pass the competitions*" (P24, Director). Directors, who often aspire to become Pedagogical Advisors and beyond wanted access to resources to help them pass their advancement exams. However, they wanted more pedagogical training and resources that they could access through technology. One mentor specifically said, "*I wish that we could still make video captures on the practice of certain activities*" (P22, Pedagogical Advisor). As mentors help teachers plan their class sessions, mentors also wanted more support for teachers through technology, "*In establishing their session plan, there is no support as such*" (P24, Director). Some felt that the training period for the technology available was also too short and wanted more time for themselves and teachers to become familiar with the technology, "*[Teachers] did not have the time they needed to be well-equipped. They only have one week...so it's the training time that wasn't really enough*" (P32, Director). Structured PD within social media groups could help to scale effective mentorship.

4.2.4 A Lack of Moderation Leading to Irrelevant Posts. Interestingly, though mentors liked the privacy and unmoderated nature of the WhatsApp groups for social purposes, this sometimes led to irrelevant posts, "*some who put images and even information that does not fit into the framework of the [teacher] training so some have complained to them*" (P31, Pedagogical Advisor). Some mentors felt that these types of posts did not benefit the group, "*There are messages that come that don't benefit the group, we can be wrong to send these kind of messages*" (P29, Director). They also felt that spaces like Facebook were too moderated by organizational leadership, which shows the distinction between some mentors and those higher in administration, "*There is information that we do not publish there, since there are leaders in this group...So there are things that we cannot have fun doing there*" (P24, Director). One mentor mentioned that they would inform their peers to delete irrelevant messages due to the supervision of leadership, "*In this group, it is the leaders who are there, so as soon as someone throws out a message that does not fall within the framework of [NewMethod], we automatically call him out to delete his message*" (P30, Pedagogical Advisor). Mentors also worried about privacy, particularly in using Facebook, "*I don't like to publish my private life...I prefer to go on it to see what others are doing...But [to] go strut around there [myself], no, I don't like it*" (P24, Director). They felt too exposed on social media platforms, "*What I don't like about Facebook is that everyone goes there and often there are certain things and images that people put that I don't like too much*" (P30, Pedagogical Advisor). These concerns denote a potential power dynamic between teachers, mentors, and administration that impacts how mentors use social media technology.

4.2.5 Connectivity Issues within Schools Limit How Mentors Can Use Mobile Technology for Mentorship. Similar to issues of physical infrastructure, mentors also mentioned issues of connectivity. They themselves did not necessarily have connectivity issues, but the schools and teachers they served did not have adequate access, "*more often than not, network coverage is the problem. Not all of our schools have telephone network coverage*" (P23, Pedagogical Advisor). The lack of connectivity was especially noted in rural areas, "*We're in a rural area, there's no internet...the school where I teach, there is no network*" (P24, Director). Mentors also expressed a lack of financial support in providing sufficient data and internet for their work, "*We don't even have a powerful device...and often we don't have a connection because we don't have an internet pass*" (P2, Pedagogical Advisor). This might lead to more connected schools receiving greater communication with mentors than more rural, less connected schools.

5 DISCUSSION

Our findings show how mentors use mobile technology for their work within their cultural context. While mentors frequently relied on mobile technology for remote mentoring, cultural power dynamics impacted how mentors and teachers used and moderated social media platforms for mentoring. Our findings expand the Learning at Scale work to Côte d'Ivoire, an understudied context[34], providing novel opportunities to design systems to cater to cultural nuances. We discuss the challenges of scaling mentorship through mobile technology and future directions forward here.

5.1 Scaling Teacher Mentorship through Virtual Communities of Practice

Social connection and trust between mentors and mentees is important in establishing close professional relationships in mentorship [1, 42, 44]. Prior work has examined the use of social media platforms such as WhatsApp and Facebook in building social connections and community for teacher mentorship [22, 28, 39, 45, 49, 55]. Surprisingly, our findings show the dichotomy between wanting a collaborative environment with the power dynamics between teachers and mentors. Due to the hierarchical nature of the educational system in Côte d'Ivoire, feelings of jealousy and resentment arose from some teachers towards mentors. In our work, some mentors felt that they were capable of moving into mentorship roles while some teachers who failed to do so simply were not capable. How social media and mobile technology reconciles these power dynamics remains an open question. We provide two potential directions to answer this open question.

5.1.1 Integrating PD into Communities of Practice. Social media platforms can be useful in forming virtual communities of practice between teachers and mentors, but because they are not designed for professional development, they do not always serve the needs of teachers and mentorship [37, 39, 45]. Integrating professional development resources into social media groups can fill the gap of aligning pedagogical goals with the technology. This could include specific channels within messaging apps to focus on topics of PD like the MCL app, which consists of discussion forums, resources, activities calendar, and progress trackers for teacher professional development [16]. This could also include conversational agents, or chatbots, such as in Cannanure et al [11, 13] where a conversational agent built within Facebook Messenger could automatically provide expert knowledge and resources based on teacher questions. Structured spaces for teaching-related content could improve both the relevance of knowledge shared and improve how teachers and mentors communicate in these communities of practice.

5.1.2 Self-Moderated Communities. Moderation practices are a long-standing challenge within virtual teaching platforms [32, 60]. In our study, mentors enjoyed the social aspects of sharing resources and media through social media, but did not like that irrelevant posts were common. This finding is similar to prior research that also reports on the challenge of separating interpersonal and professional content in social media groups. For example, Varanasi et al [55] observed that while WhatsApp groups were useful for sharing pedagogical resources and encouragement, they also led to spam, misinformation, or malicious forwards.

One possible way forward is in creating self-monitored and moderated groups within virtual communities of practice. We found that mentors in our study did not want moderation from administration but also wanted messages within their teaching groups to remain relevant to pedagogy. Self-moderated groups can lead to informal networks not closely tied to a pedagogical organization, which can support the collaboration and close connections mentors desire with their peers and teacher mentees [55]. However, self-moderation brings about issues of power and social dynamics, which could be exacerbated by the existing power dynamics we observed between mentors and teachers. Some mentors mentioned teachers' feelings of resentment or bitterness because of their level of authority. Similarly, self-moderation among peer groups might de-incentivize full participation because group members may not feel safe to engage [4, 55]. This decrease in participation and lack of engagement may discourage further usage of a community [38], which for teachers in Côte d'Ivoire would mean even less support for their work.

There are also aspects of cultural considerations within self-moderated social media groups. In our study, all mentors and a majority of teachers were male. While we did not explicitly examine how gender may impact mentorship, prior work has found that negative stereotypes of women negatively impacted mentoring for women in African contexts [35, 47, 51]. Self-moderation can also add burden on teachers and mentors, many of whom already feel overwhelmed with their many responsibilities [54]. One potential area for future work is incentive structures for moderation that could support mentors' career aspirations and recognition. This could also apply to teachers who desire to become mentors, giving them informal mentorship experience through moderation tasks and potentially bridging the perceived hierarchical divide between mentors and teachers. Future work could examine how divisions of labor could be structured to ensure equitable workloads across educator roles.

5.2 Designing for Legitimate Peripheral Participation

An essential aspect of virtual communities of practice is the concept of legitimate peripheral participation (LPP) [56], when novice users passively participate in communities to transition to becoming active users. Through our work and prior literature [13, 20, 39], we see design opportunities for digital tools to support social connection and mentoring practices for rural teachers. For example, earlier work with teachers found that structuring co-planning during teacher mentorship can lead to better peripheral participation for novice teachers [20]. In the context of technology, rural teachers benefited from in-person workshops to assist digital interactions on WhatsApp groups [39] for a virtual community of practice. We see two design opportunities through offline workshops and structuring mentorship to facilitate legitimate peripheral participation in digital mentorship.

One direction for design is assisting novice teachers in easing into technology through in-person workshops to streamline cooperation into digital interactions. Similar to prior work in Côte d'Ivoire [12], where they found teachers had strong solidarity, we discovered the intrinsic collaborative nature of mentorship. Our work found that teachers and mentors leverage their sense of community to balance their many responsibilities. Therefore, the community culture can be woven into collaborative workshops that train teachers and mentors on technology. Teachers can observe and participate with their peers through activities integral to communities of practice (CoP), such as storytelling [27] and peer support [48]. These workshops allow teachers with higher technology expertise to utilize their desire for recognition to take leadership roles in technology contexts. These roles, as Wenger [58] calls them technology shepherds, are early adopters who train and encourage novice users and play a crucial role in online communities, leading to greater

technology adoption. Lastly, involving mentors in senior leadership roles, such as master trainers and inspectors, with the teachers in the technology workshop can provide peer validation and superior endorsement to encourage novice teachers to use technology.

Another opportunity for supporting participation is by structuring mentorship to support LPP. Therefore, introducing co-working sessions during teacher-mentor interaction [20] could allow novice teachers to learn from community members collectively. For example, teacher-mentorship interactions such as advisor visits could use technology to augment their existing interactions. The advisor visit program could then transfer some of the in-person interaction into digital tools, such as posting the summary of discussions on a WhatsApp group [39] or posting the question to a conversational agent [10, 11]. The co-working sessions could allow group members to observe and learn from each other through repeated periodic interactions with mentors. Although CoP literature prioritizes learning of novice teachers, prior work in Côte d'Ivoire found that mentors could also be novices in contexts of technology [13]. Thus, teachers proficient in technology could support mentors in learning technology during collaborative activities, exercising their agency through LPP. For example, Ismail et al. [31] found community health workers challenging their societal hierarchy using technology.

Our recommendations apply to large-scale, longitudinal deployment studies in developing countries. Cannanure et al. [10] deployed a chatbot to over 300 rural teachers in Côte d'Ivoire for a year to provide remote monitoring. Still, a limitation of this work was sustained adoption of the technology due to limited technology literacy among teachers [10] and reduced motivation to use the system over time [11]. Thus, mentors playing the role of technology stewards can allow them to re-train teachers on the deployed technology. Additionally, structured mentorship of technology can enable teachers to have agency while participating in a novel intervention. Thus, our recommendations provide appropriate recommendations for scaling mentorship through mobile technology.

5.3 Barriers of Connectivity

The use of social media for mentoring would not be possible without proper connectivity, which was a challenge mentioned consistently by our mentor participants along with transportation access. Poor transportation infrastructure often meant that mentors could not visit the required schools for observations and feedback for teachers. Poor connectivity meant that mentors could not communicate with teachers even if they were not able to visit for in-person mentoring. These challenges are common across low-infrastructure contexts and often limit the implementation of pedagogical or formal mentoring programs [38]. These issues also suggest a potential problem of inclusion. Lack of proper infrastructure was often associated with more rural schools. If the teachers at these schools do not have adequate connectivity or are too difficult to access, they may receive less mentoring overall, leading to potentially poorer academic performance for students and less teacher retention [3, 23, 40**?**].

To solve these inclusion issues, a larger structural change for mentorship programs is necessary. This could include scheduling mentoring calls and visits at times when teachers are in areas with more reception. This could also include ensuring that both teachers and mentors have access to offline resources. Delivering asynchronous, offline resources and PD courses can engage teachers in co-creating a community of knowledge sharing [9]. The Zambian Education School-Based Training (ZEST) program utilizes an offline networked learning approach in which teachers in close proximity to each other can share resources with their mobile devices without the need of internet connectivity [23, 59]. This approach allows teachers in areas with low internet connectivity to still participate in a virtual community of practice. This might be especially helpful for local mentors who oversee their an entire school, such as Directors in our study. Future work could examine additional ways to provide low-bandwidth technology for teacher mentoring.

5.4 Limitations

Our study has several limitations, primarily related to our sample. Because our research questions asked how mentors used mobile technology in their work, our sample of mentors was selectively chosen based on their active usage of social media groups. This biases our sample towards those who are more technology literate and active within the *NewMethod* community. Similarly, this also biases our sample to those with adequate connectivity to actively use mobile technology. Our sample was also primarily male, which though representative of the teacher population of Côte d'Ivoire [12], could lead to different insights and results than if the sample was more diverse in terms of gender. Additionally, we did not have access to teacher and mentor communications within WhatsApp groups, which could provide further insight into how mentors utilized mobile technology.

6 CONCLUSION

In this paper, we present a qualitative interview study with 33 teacher mentors about the culture of mentorship in Côte d'Ivoire and how mentors use mobile technology to support their teacher mentees. We found that though there is a strong collaborative culture between mentors and teachers, there are power dynamics that arise that may impact how mentors can collaborate with teachers. We also found that though mobile technology was important for mentors to be able to share knowledge and communicate with mentees, complex issues of moderation and a lack of pedagogical resources for mentors could limit the usefulness of mobile technology for scaling effective pedagogy and mentorship. Hierarchy and power dynamics could affect how effectively these technologies could be moderated and used. Our findings suggest that mobile technologies for mentorship, especially in low-infrastructure contexts, should contextualize the technology within the professional culture of where it is implemented.

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