

## WhatsApp as Shadow Learning Management System: How University Teachers in Pakistan Build Parallel Pedagogical Infrastructure under Institutional Prohibition

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### ABSTRACT

*Learning management systems are usually discussed as institutional choices: platforms a university adopts, configures, and supports. This paper examines what happens when the formal LMS is absent, unreliable, or actively prohibited, and teachers build a functional substitute from the mobile messaging tools they already carry. Drawing on an explanatory sequential mixed-methods study in a Pakistani public university (N=127 survey respondents; N=32 interviews), the analysis focuses on how teachers with low and medium digital competence use WhatsApp to perform the core pedagogical work that their institutional systems cannot sustain. Findings reveal a three-layer shadow architecture. Teachers first use WhatsApp as infrastructural backup, sending materials in advance against the likelihood of classroom equipment failure. When direct contact with students is prohibited, teachers route communication through class representatives, preserving function while producing plausible deniability. Cross-institutional peer networks and Sci-Hub fill gaps left by inadequate database subscriptions. Reading these practices through Behrens' shadow systems, Alter's workaround theory, and de Certeau's tactical practice, the paper argues that WhatsApp operates in Pakistani higher education not as an informal supplement but as a functional LMS. The persistence of this shadow layer is diagnostic: it indexes the specific failures of formal provision rather than the deficiencies of individual teachers.*

**Keywords:** WhatsApp; shadow systems; learning management system; digital competence; higher education; Pakistan; Global South

### INTRODUCTION

The learning management system has become a standard institutional object in higher education. Most universities operate one, most accreditation bodies expect one, and most digital competence frameworks assume one. Yet the conditions that make a formal LMS work, stable electricity, reliable connectivity, adequate licensing, institutional maintenance, policy support, do not hold everywhere. Where they fail, the pedagogical work does not stop. It migrates.

This paper examines that migration in a specific setting. In a large Pakistani public university, teachers with low and medium digital competence described a coherent pattern of everyday practice. When formal institutional systems failed to deliver the services their professional work required, they substituted a mobile messaging platform they already owned. WhatsApp carried announcements, distributed content, mediated discussion, and, at the margins, supplemented an inadequate library. The platform did this work alongside a formal LMS in some cases, and in place of a formal LMS in others, and through a layer of student intermediaries when the university explicitly forbade it.

The framing of unofficial technology use in higher education has tended toward two positions. One treats informal tools as governance problems. Behrens (2009) named these shadow systems and traced their costs, their risks, and their ambiguous relationship to sanctioned provision. The other treats them as informal supplements, additions to a working formal system rather than substitutes for a missing one (Bouhnik & Deshen, 2014; Rosenberg & Asterhan, 2018). Neither position captures what the teachers in this study are doing. They are not working around a minor inconvenience, and they are not adding a layer on top of a functioning platform. They are sustaining the core pedagogical relation that their institution's formal provision cannot.

We argue that in this context WhatsApp functions as a shadow learning management system. The argument rests on three moves. First, the platform performs the canonical LMS functions, content distribution, announcement, discussion, resource sharing, well enough that teachers and students treat it as the main channel. Second, when institutional policy prohibits the platform, teachers preserve its function through an intermediary layer, routing communication via elected class representatives. Third, the platform connects outward into informal peer networks and alternative access services, extending the shadow architecture beyond the single institution. Together these layers form a functional substitute, built without institutional authorisation, maintained through everyday practice.

This analysis matters for three reasons. It sharpens the conceptual vocabulary used to describe unofficial technology use in teaching, moving beyond the vague category of WhatsApp as a communication tool to a more specific account of WhatsApp as infrastructure. It contributes to the comparative literature on educational technology in the Global South by showing how teachers in infrastructure-constrained settings produce functional continuity that formal systems cannot. And it raises a policy question that the paper takes up in the discussion: whether institutional responses should aim at eliminating shadow systems, or at reading them diagnostically for the service failures they expose.

The paper proceeds as follows. Section 2 situates the analysis in the literatures on shadow systems, WhatsApp in higher education, and digital infrastructure in the Global South, and sets out the theoretical framing that draws on Alter (2014), de Certeau (1984), and Scott (1990). Section 3 describes the study design and the thematic analysis. Section 4 presents the three-layer shadow architecture through participants' own words. Section 5 develops the conceptual argument, and Section 6 considers implications and limits.

## **Background and Theoretical Framing**

### **Shadow Systems in Organisations**

Behrens (2009) introduced shadow systems to describe the unauthorised information systems that organisational members build and maintain alongside sanctioned provision. Her ethnographic study at an Australian university showed shadow systems as neither wholly good nor wholly bad. They enabled work that formal systems could not, and they introduced risks the institution could not govern. The literature that

followed has largely retained this ambivalence. Shadow IT is a problem to be managed, a deviation to be brought into compliance, or at best a signal of unmet user need.

Alter's (2014) theory of workarounds refines this picture. A workaround is a deliberate adjustment to a prescribed work practice that users adopt when the prescribed practice fails to meet their needs. Alter shows that workarounds are neither defects of users nor defects of systems but predictable outputs of the interaction between them. Users confronted with misaligned tools exercise practical judgement, combine resources, and produce a functional outcome. The workaround framework moves the analysis away from compliance, which treats deviation as failure, toward practice, which treats deviation as adaptive competence.

Our analysis builds on Alter but extends Behrens in one important direction. Where shadow systems have typically been studied in settings where a formal system exists and functions, the teachers here operate in settings where the formal system is often absent, unreliable, or actively hostile. The shadow system is not an alternative to a working system. It is, frequently, the only working system.

### **WhatsApp in Higher eEducation**

The literature on WhatsApp in teaching and learning has grown quickly. Bouhnik and Deshen (2014) opened the conversation with a study of secondary teachers in Israel, finding that WhatsApp eased communication, supported learning beyond the classroom, and altered the pedagogical relationship in ways teachers welcomed and worried about in equal measure. Subsequent studies have echoed the mixed findings. Cetinkaya (2017) reported significant gains in student performance when WhatsApp supplemented a traditional higher education course in Turkey. So (2016) examined mobile instant messaging in a Hong Kong university, showing that WhatsApp supported timely communication, collaborative work, and informal learning. Rosenberg and Asterhan (2018) looked at the same platform from the student side and found that students valued the access while experiencing the communication as work that intruded on personal time.

These studies share an important framing assumption. They treat WhatsApp as a supplement to, rather than a substitute for, a functioning institutional LMS. The research question is usually whether the addition of WhatsApp improves learning, communication, or engagement, holding the rest of the pedagogical infrastructure constant. Pimmer and colleagues' work on mobile instant messaging in low-income countries points in a different direction. Pimmer et al. (2017), studying rural community health workers in Malawi, showed that WhatsApp carried professional communication and learning that formal systems did not exist to carry. The platform was not a supplement but a ground-up infrastructure.

Our study occupies the space between these two literatures. The setting is a formal higher education institution with a nominal LMS, but the LMS is neither universally accessible nor consistently usable, and the everyday teaching of low and medium competence teachers happens on WhatsApp. The paper thus contributes to a growing body of work, including Afzal and Abdullah's (2022) study of WhatsApp in Pakistani schools, that examines what WhatsApp becomes when it is asked to do institutional, rather than merely supplementary, work.

### **Digital Infrastructure in the Global South**

The conditions that support a formal LMS, stable electricity, reliable bandwidth, licensed databases, institutional maintenance, are not evenly distributed. Czerniewicz et al. (2020) documented, during the pandemic, how digital inequality in South African higher education surfaced as a first-order pedagogical problem rather than a background condition. Selwyn (2014, 2017) has argued more broadly that educational

technology research has tended to assume the material conditions of its use, treating infrastructure as a given. The result is a literature that travels poorly into settings where those conditions are contested.

Star and Ruhleder (1996) proposed that infrastructure becomes visible precisely when it breaks down. In the setting we study, infrastructure is perpetually visible because breakdown is the expected state rather than the exceptional one. Teachers prepare for equipment failure as a matter of course. They plan around policy prohibitions that formal systems cannot accommodate. They distribute materials in advance because the possibility that the classroom technology will work is not one they can rely on. In this environment, the shadow system is not a workaround to an occasional failure but a parallel infrastructure that carries most of the pedagogical weight.

### **Tactics and Hidden Transcripts**

Two further theoretical resources help us describe what teachers are doing when they maintain a shadow LMS under institutional prohibition. de Certeau (1984) distinguished between strategies, which are the planned arrangements of those who hold institutional power, and tactics, which are the improvised movements of those who do not. Tactics are not oppositional in the direct sense. They operate within the space that strategy defines, using its constraints to find openings that strategy does not notice or cannot close. Routing a prohibited WhatsApp message through a class representative is a tactic. The strategy, the formal ban, remains in place. The function it was designed to eliminate survives.

Scott's (1985, 1990) work on hidden transcripts and everyday resistance adds a further layer. Where visible practice conforms, informal practice often preserves the meanings and relationships that visible practice denies. Teachers in this study do not defy the Vice Chancellor. They do not use WhatsApp directly with students. The function of direct contact, however, is preserved through a structure that the institution can see without quite seeing. The distinction is legalistic, as one participant's account effectively acknowledges. It is also navigationally sophisticated, and it is this sophistication that the paper wants to name as a form of competence rather than a failure of it.

## **METHODS**

### **Design and Setting**

The paper draws on data from a larger doctoral study, conducted by the first author, examining pedagogical digital competence in Pakistani higher education. The study used an explanatory sequential mixed-methods design (Creswell & Plano Clark, 2018). A quantitative phase mapped competence levels across the faculty using the CheckIn Higher Education instrument (Redecker, 2017). A qualitative phase then explored, through semi-structured interviews, how teachers at different competence levels navigate the conditions of their practice.

The study site was a large public university in Punjab, Pakistan, offering undergraduate and postgraduate programmes across humanities, sciences, and professional fields. The institution holds a formal learning management system and a subscription portfolio through the Higher Education Commission's digital library. At the time of fieldwork, access to both was uneven, and classroom technology provision varied across departments and buildings.

### **Participants and Sampling**

The quantitative phase surveyed 127 teachers using a stratified approach across faculty and career stage. Competence levels were distributed across the DigCompEdu proficiency band, with the largest group

falling in the B1 (medium) range and substantial minorities at A2 (low) and B2 (high). The qualitative phase then purposively sampled 32 interviewees to represent the full competence distribution, with deliberate over-representation of low and medium competence to address the study's focus on teachers who have been under-represented in existing accounts.

This paper reports primarily on interviews with low (n=12) and medium (n=13) competence teachers. Interviews with high competence teachers (n=7) appear in the analysis where they provide contrast. Participants were anonymised using letter codes (L, M, H) and sequential numbers.

### **Data Collection**

Interviews were conducted in Urdu or English, according to participant preference, by the first author. Each interview lasted between 19 and 85 minutes and covered six broad topics: current digital practice in teaching; experiences of institutional infrastructure; relationships with colleagues and students around technology; responses to specific breakdowns or constraints; histories of technology learning; and views on institutional provision. The interview guide was not followed rigidly. Participants led the conversation into the areas they considered most salient.

All interviews were audio-recorded and transcribed verbatim. Urdu portions were translated by the first author and cross-checked by a bilingual research assistant. Transcripts were returned to participants for member checking. Three participants added clarifications, which are incorporated into the quotations reported below.

### **Analysis**

We analysed the interview data using reflexive thematic analysis (Braun & Clarke, 2006). The first author generated initial codes inductively across the full transcript corpus. Codes relating to informal communication, prohibited platforms, and alternative access were grouped in an early theme that the analysis later refined as shadow systems. The second author reviewed the coding and guided to the final theme structure. Analysis was supported by NVivo 15.

Three decisions about analytic scope shaped this paper. First, we focused on practices that substituted for, rather than supplemented, institutional provision. A teacher using WhatsApp alongside a functional Moodle course was not coded to the shadow system theme unless the use stood in for a missing function. Second, we retained the teachers' own framings where these added conceptual clarity. The phrase plausible deniability appears in the analysis because it is the logic participants themselves described, not because we imposed it. Third, we treated the absence of findings as informative. Where high competence teachers did not describe shadow systems, we read this not as confirmation that such practices are unusual but as a signal that, where institutional provision works, the shadow layer recedes.

### **Ethics and Reflexivity**

Participation was voluntary, informed, and reversible. The practices reported in this paper are, in some cases, sensitive. Teachers described workarounds to explicit institutional prohibitions and use of Sci-Hub to access paywalled material. We have taken care that the quotations published here do not identify individuals or departments. Participants reviewed all direct quotations attributed to them.

The first author is a Pakistani educator affiliated with a European research institution. This position shaped the study in ways we have tried to hold open rather than resolve. Proximity to the setting enabled candid

discussion of practices that participants might not have described to an outsider. The theoretical framing, drawn from European and Anglophone literatures, is not neutral, and we return to its limits in the discussion.

## **FINDINGS**

The analysis identified three layers of a shadow architecture that together perform the functions of a learning management system. The first layer is the teacher's use of WhatsApp as a direct channel to students and as a pre-emptive distribution mechanism against infrastructural failure. The second layer is the intermediary structure that teachers adopt when direct contact is institutionally prohibited. The third layer is the external network of peers, colleagues, and alternative services that extends the shadow system beyond the institution. Each layer is illustrated below, drawing on participant accounts.

### **Layer 1: WhatsApp as Infrastructural Backup and Primary Channel**

The most common account we heard concerned pre-class distribution of teaching materials. Teachers could not rely on classroom equipment functioning when a lesson began. Projectors failed, tablets did not connect, Wi-Fi dropped, and electricity cut without warning. Against this background, WhatsApp became the place where materials lived in advance.

"I usually send the videos to students on WhatsApp beforehand. If the LED or tablet won't connect, at least they have the video on their phones." (Participant L5, Interview15)

The logic of this practice is worth unpacking. The teacher does not treat classroom technology as the primary delivery channel with WhatsApp as backup. She treats WhatsApp as the reliable channel. The classroom screen is a bonus, used when it works. The phrase "at least they have the video" names the point precisely. The backup is not equivalent to the intended delivery. It represents the minimum that will keep the lesson functional if everything else fails.

For many low competence teachers, WhatsApp also carried the announcement function that an institutional LMS would ordinarily hold. Changes of room, shifted deadlines, and reading assignments moved through group chats rather than through official channels, partly because the official channels were slower, partly because they were not read, and partly because no official channel reliably existed. The platform was doing, quietly, the distribution work that a functioning LMS would do.

### **Layer 2: Intermediated Communication under Prohibition**

For some teachers, the situation was complicated by institutional prohibition. The institution had, at a senior level, forbidden WhatsApp communication between teachers and students.

"Our former Vice Chancellor stopped us from interacting with students via WhatsApp. We were told not to use WhatsApp." (Participant L4, Interview 12)

The reasons behind the prohibition, which participants described variably as safeguarding, political caution, or the preferences of an individual administrator, are not our concern here. What matters for the analysis is the gap the prohibition produced. Teachers lost the channel they relied on for distribution, announcement, and low-stakes discussion, and they did not receive a working institutional replacement. They responded by reconfiguring the channel rather than abandoning it.

"I'll send any link or critical information to the CR, who then shares it in their informal class group." (Participant L4, Interview 12)

The class representative is an elected student who, among other roles, liaises between the class and its teachers. In the reconfigured system, the representative becomes an intermediary between the teacher and the class WhatsApp group. The teacher sends material to the representative. The representative shares it with the group. The teacher, technically, does not use WhatsApp to communicate with students. The function, just as technically, is preserved.

Participants spoke about this arrangement as a routine navigational matter rather than as an act of defiance. The phrase several teachers used was "plausible deniability." The institution could not accuse the teacher of using WhatsApp with students, because the interaction involved only the representative. The students received what they needed because the representative did the sharing. The ban remained visibly in force. The function it was designed to eliminate remained quietly functional.

The intermediary layer is the most distinctive feature of the architecture we describe. A supplementary WhatsApp group is commonly reported in the literature. A workaround that preserves function through an inserted human layer is less commonly reported and is analytically specific. It shows, among other things, that the teachers are thinking about the shadow system structurally. They are not simply using an unofficial tool. They are designing a routing arrangement that the institution can tolerate.

### **Layer 3: Cross-Institutional Peer Networks**

Beyond the classroom, teachers described a parallel infrastructure for accessing research materials. Institutional databases were often inadequate. Licensed journals were frequently paywalled. Open-access alternatives did not cover the range of material that teaching and research required.

"If I can't access something, I'll ask a friend at another university to download it for me." (Participant L4, Interview 12)

"At our current university, access is limited. Many papers aren't open, so we approach colleagues or other resources." (Participant M01, Interview 01)

The logic here mirrors the prohibition workaround. An individual institutional constraint, limited subscriptions, is resolved by extending the social graph outward. A friend at another university downloads a paper. A colleague in a different country forwards a PDF. The aggregate effect is a distributed access system that sits across institutional boundaries and relies on personal relationships rather than licensing arrangements.

Medium competence teachers extended this logic further, naming Sci-Hub directly.

"If an article isn't open access, I generally use Sci-Hub or other methods." (Participant M03, Interview 04)

The comment is unusually direct. Sci-Hub sits in a legally contested space, and its use is rarely stated plainly in official educational discourse. The teacher's matter-of-fact naming of the service reflects what we think is worth taking seriously as an analytic observation. From the inside of the practice, the service is part of the ordinary toolkit. The institutional library is one source, open repositories another, Sci-Hub another. The practical question is access, and the practical answer uses whichever channel delivers the material.

A subset of medium competence teachers described a third, semi-formal access route through library staff.

"If I can't find something, I send it to the library staff. Usually, 95% of our needs are met this way." (Participant M02, Interview 02)

Library staff in this account do not provide official access. They provide a personal service that works around the institution's licensing limits, using their own contacts and channels. The shadow system here has been partially absorbed into a formal institutional role without being acknowledged as such.

### **The Contrast Case: High Competence Teachers and the Formal LMS**

We did not code high competence interviews to the shadow system theme in most cases. Where we did, the shadow element was smaller in scope and different in function. High competence teachers who reported direct WhatsApp use described it as a supplement to, rather than a substitute for, a functioning Moodle course.

"We have the Moodle-based LMS framework, so we leverage features like course automation, new assessment methods, and so on." (Participant H01, Interview 05)

This matters for the analysis. The shadow LMS is not a feature of Pakistani higher education in general. It is a feature of a specific stratum of that education, teachers whose material conditions prevent them from relying on institutional systems that nominally exist. Where those systems work, the shadow layer recedes. The absence is analytically informative. It tells us that the shadow system is not a cultural preference or a generational habit. It is a response to institutional failure.

## **DISCUSSION**

The findings have pushed us toward a reframing of shadow systems that we want to state plainly, then qualify, then locate in the literature.

### **WhatsApp as Shadow LMS**

A learning management system, in its operational rather than product sense, is the arrangement that delivers four functions: announcement, content, discussion, and access to resources. A formal LMS packages these functions into a single platform that the institution licenses, configures, and maintains. In the setting we studied, the formal LMS performs these functions inconsistently, intermittently, or not at all for most low and medium competence teachers. The functions nevertheless have to be performed. Teaching is not optional.

The shadow architecture we described performs the four functions through a distributed set of components. Announcement runs through WhatsApp groups, directly where permitted and through intermediaries where prohibited. Content runs through pre-class file distribution, where WhatsApp is used pre-emptively against the likelihood of classroom technology failure. Discussion runs through group chats that the teacher is often formally absent from but that the institution knows exist. Access to resources runs through cross-institutional peer networks, Sci-Hub, and library staff acting outside their formal briefs. The whole is less unified than a formal LMS, but it is more reliable, and it is the actual infrastructure on which teaching depends.

The shadow LMS is not, strictly, a system. It has no administrator, no vendor, no configuration panel. What it has is a design, produced distributively by teachers making compatible decisions under pressure. That design is the object we want to name. Calling it WhatsApp, or informal communication, understates what it does. Calling it a shadow LMS locates it in a tradition of analysis that can hold its institutional and pedagogical significance.

### **Competence, not Compliance**

Behrens (2009) left open the question of how to evaluate shadow systems. The literature that followed has largely read them through a compliance lens. Shadow IT is a governance problem. Shadow systems are deviations from institutional provision. Workarounds are symptoms that institutions should address by improving the official system.

The finding we want to press against this framing is that the teachers in our study are doing institutional work, not deviating from it. The teacher who routes material through a class representative is maintaining the communication function that the institution also needs maintained. The teacher who uses Sci-Hub is performing the research function that the institution expects its faculty to perform. The teacher who sends videos to students' phones in advance is ensuring the teaching function that the institution is paying them to deliver. These are not lapses in compliance. They are delivery under constraint.

This reframing matters because it relocates the problem. If shadow systems express competence rather than non-compliance, then institutional responses should not seek to eliminate them. They should read them diagnostically. The persistence of a WhatsApp-based shadow LMS indicates a specific set of formal system failures: an unreliable or absent LMS, inadequate database subscriptions, classroom equipment that cannot be trusted, and, in some cases, prohibitions that were issued without functional replacement. The shadow system is the signal. The failures are the thing that needs addressing.

Alter's (2014) workaround framework already supports this move at a conceptual level. Our contribution is to extend it from the individual workaround to the distributed architecture, and to show what happens when the workaround is not a local patch on a functioning system but the functioning system itself.

### **Tactics, Plausible Deniability, and Distributed Competence**

The intermediary layer, which we take to be the most distinctive feature of the architecture, is illuminated by de Certeau's (1984) distinction between strategy and tactic. The VC's prohibition is a strategy. It is a planned institutional arrangement that draws a line between permitted and forbidden. The class representative workaround is a tactic. It does not contest the line, it uses the space the line created. A direct teacher-student WhatsApp exchange would cross the line. A teacher-representative-group exchange does not, because the line was drawn around a relational structure that did not anticipate the intermediary.

The tactic works because it respects the formal surface. This is what participants captured in the phrase plausible deniability. The institution's visible policy remains intact. The institution's view of who is communicating with whom remains, at the level it cares about, accurate. The function the policy was meant to prevent continues, but through a structure that the policy does not quite cover.

The practice is also distributed in a way that conventional accounts of digital competence cannot see. The DigCompEdu framework measures what an individual teacher can do with a digital tool. It does not measure what a teacher and a class representative, together, can arrange, or what a teacher and a friend at another university can access. The relational competence at work here, knowing who to ask, how to frame the request, and how to structure the channel, is invisible to instruments that measure teachers in isolation. This has implications for how competence frameworks are developed and applied in settings where much of what teachers know is held collectively.

### **Risks and limits of the Shadow Architecture**

We do not want to romanticise the practice we have described. A shadow LMS distributes costs and risks asymmetrically. Teachers pay for their own data. Class representatives absorb communication work that a proper system would handle. Students who are not in the informal group do not receive the announcement. The institution benefits from continuity it is not providing and is not accountable for. Teacher resilience, as our wider thesis argues, enables institutional neglect.

The shadow system also carries specific risks. Sci-Hub use exposes teachers to legal ambiguity that the institution does not shoulder. WhatsApp group chats are not searchable, archived, or protected in the ways an institutional system would be. Class representatives who leave or fail to forward a message create gaps that the teacher may not detect. These risks are real, and the paper's argument is not that the shadow system is desirable. The argument is that the shadow system is competent, and that treating it as non-compliance misreads both the practice and the failure that produced it.

### **Contribution and Location in the Literature**

The paper contributes to three conversations. Within the shadow systems literature, it extends Behrens (2009) and Alter (2014) into a setting where the shadow system carries primary rather than auxiliary load, and where the analysis must therefore reckon with the shadow as infrastructure rather than as deviation. Within the WhatsApp-in-education literature, it moves beyond the supplementary framing that has dominated since Bouhnik and Deshen (2014), toward an account of WhatsApp as a substitutive infrastructure in institutions where formal provision is inconsistent. And within the critical educational technology literature, following Selwyn (2014) and Czerniewicz et al. (2020), it adds a specific case from the Pakistani context to the growing body of work that refuses to treat infrastructure as a background condition.

The paper also responds, we hope, to a broader call for educational technology research that attends to the material conditions of its use. Star and Ruhleder (1996) argued that infrastructure becomes visible when it breaks. In the conditions we have described, infrastructure is perpetually visible. The shadow LMS is what teachers build to keep teaching going while they wait for the formal one to be there.

### **CONCLUSION**

Three observations will close the paper. First, WhatsApp is not, in the setting we studied, an informal add-on to institutional teaching. It is, for many teachers, the functional core of institutional teaching. Naming it as a shadow LMS clarifies what the platform is doing and helps the analysis take seriously a practice that might otherwise be dismissed as ad hoc.

Second, the shadow architecture is competent, distributed, and, where institutional prohibition intervenes, tactically sophisticated. The class representative workaround is not a lapse. It is an engineered response to a policy that was issued without a functional replacement. The competence involved is not individual. It is relational, and it is invisible to frameworks that measure teachers in isolation.

Third, the policy implication of this analysis is not that institutions should sanction or formalise the shadow LMS. The implication is that institutions should read the shadow system as a diagnostic, and should address the specific failures, of provision, of maintenance, of policy design, that the shadow is compensating for. Eliminating the shadow without fixing the underlying conditions would leave teachers and students materially worse off, because the shadow is currently carrying work the formal system is not.

The paper has limits. It is based in a single institution in one region of Pakistan. The generalisability of the specific architecture, teacher, class representative, peer network, to other Global South contexts is an empirical question we have not answered. The analytic framing draws on European and Anglophone theoretical traditions, and we are aware that other framings, grounded in Pakistani educational scholarship or in comparative Global South research, would illuminate aspects we have not pursued. The teachers whose words we have reported are the ones best placed to tell us where the analysis has under-read what they do. We offer the paper in that spirit.

## REFERENCES

- Afzal, I., & Abdullah, N. A. (2022). Role of WhatsApp in teaching and learning process in schools in Pakistan. *Journal of Educators Online*, 19(3).
- Alter, S. (2014). Theory of workarounds. *Communications of the Association for Information Systems*, 34, 1041–1066. <https://doi.org/10.17705/1CAIS.03455>
- Behrens, S. (2009). Shadow systems: The good, the bad and the ugly. *Communications of the ACM*, 52(2), 124–129. <https://doi.org/10.1145/1461928.1461960>
- Bouhnik, D., & Deshen, M. (2014). WhatsApp goes to school: Mobile instant messaging between teachers and students. *Journal of Information Technology Education: Research*, 13, 217–231.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Cetinkaya, L. (2017). The impact of WhatsApp use on success in education process. *International Review of Research in Open and Distributed Learning*, 18(7), 59–74.
- Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE.
- Czerniewicz, L., Agherdien, N., Badenhorst, J., Belluigi, D., Chambers, T., Chili, M., de Villiers, M., Felix, A., Gachago, D., Gokhale, C., Ivala, E., Kramm, N., Madiba, M., Mistri, G., Mqgwashu, E., Pallitt, N., Prinsloo, P., Solomon, K., Strydom, S., ... Wissing, G. (2020). A wake-up call: Equity, inequality and Covid-19 emergency remote teaching and learning. *Postdigital Science and Education*, 2(3), 946–967. <https://doi.org/10.1007/s42438-020-00191-2>
- de Certeau, M. (1984). *The practice of everyday life* (S. Rendall, Trans.). University of California Press.
- Pimmer, C., Mhango, S., Mzumara, A., & Mbvundula, F. (2017). Mobile instant messaging for rural community health workers: A case from Malawi. *Global Health Action*, 10(1), 1368236. <https://doi.org/10.1080/16549716.2017.1368236>
- Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu* (Y. Punie, Ed.). Publications Office of the European Union. <https://doi.org/10.2760/178382>
- Rosenberg, H., & Asterhan, C. S. C. (2018). "WhatsApp, Teacher?" Student perspectives on teacher–student WhatsApp interactions in secondary schools. *Journal of Information Technology Education: Research*, 17, 205–226. <https://doi.org/10.28945/4081>

- Scott, J. C. (1985). *Weapons of the weak: Everyday forms of peasant resistance*. Yale University Press.
- Scott, J. C. (1990). *Domination and the arts of resistance: Hidden transcripts*. Yale University Press.
- Selwyn, N. (2014). *Distrusting educational technology: Critical questions for changing times*. Routledge.
- Selwyn, N. (2017). *Education and technology: Key issues and debates* (2nd ed.). Bloomsbury Academic.
- So, S. (2016). Mobile instant messaging support for teaching and learning in higher education. *The Internet and Higher Education*, 31, 32–42. <https://doi.org/10.1016/j.iheduc.2016.06.001>
- Star, S. L., & Ruhleder, K. (1996). Steps toward an ecology of infrastructure: Design and access for large information spaces. *Information Systems Research*, 7(1), 111–134. <https://doi.org/10.1287/isre.7.1.111>