

Using mobile instant messaging to leverage learner participation and transform pedagogy at a South African University of Technology

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Abstract

One of the most complicated academic endeavours in transmission pedagogies is to generate democratic participation of all students and public expression of silenced voices. While the potential of mobile phones, particularly mobile instant messaging (MIM), to trigger broadened academic participation is increasingly acknowledged in literature, integrating MIM into classrooms and out-of-the-classroom tasks has often been confronted with academic resistance. Academic uncertainty about MIM is often predicated on its perceived distractive nature and potential to trigger off-task social behaviours. This paper argues that MIM has potential to create alternative dialogic spaces for student collaborative engagements in informal contexts, which can gainfully transform teaching and learning. An instance of a MIM, WhatsApp, was adopted for an information technology course at a South African university with a view to heighten lecturer–student and peer-based participation, and enhance pedagogical delivery and inclusive learning in formal (lectures) and informal spaces. The findings suggest heightened student participation, the fostering of learning communities for knowledge creation and progressive shifts in the lecturer’s mode of pedagogical delivery. However, the concomitant challenge of using MIM included mature adults’ resentment of the merging of academic and family life occasioned by WhatsApp consultations after hours. Students also expressed ambivalence about MIM’s wide-scale roll-out in different academic programmes.

Introduction

The surging popularity of mobile devices as technologies that support collaborative learning has been widely debated in recent years (Echeverría *et al*, 2011; Hwang, Huang & Wu, 2011; Koole, 2009). Echeverría *et al* (2011) articulate the multiple academic purposes of mobile devices as follows: access to content, supplementation of institutionally provided content and acquisition of specific information, fostering interaction and information sharing among students. Despite this tremendous potential of mobile phones to activate deep student engagement with content, mobile instant messaging (MIM) remains one of the least exploited functionalities of mobile devices in higher educational institutions (HIEs). The academic uncertainty about MIM at African HIEs is

Practitioner Notes

What is already known about this topic

- Mobile devices are productive technologies with potential to foster informal collaborative learning.
- Mobile phones are useful tools for the transmission of basic content and the supplementation of institutionally generated content.
- Academic potential of mobile instant messaging (MIM) has been suboptimally exploited in higher education in general and South African higher education in particular.

What this paper adds

- Underutilisation of MIM can be attributed to lecturers' limited conceptualisation of how to integrate textual resources into mainstream instructional practices and their uncertainties about the academic rigour of discussions generated via text messages.
- Lecturer's use of an instance of MIM, WhatsApp, for peer-based engagement in an information technology course contributed to peer-based coaching and informal work teams, which transformed his hierarchical models of teaching.
- WhatsApp impacted student participation by promoting social constructivist learning through spontaneous discussions, boosting student self-confidence to engage anonymously and enhancing the sharing of collectively generated resources across multiple spaces.
- WhatsApp's supplementation of student academic material after hours bridged the information divide for geographically remote students who had limited access to academic resources after work hours.
- Mature, married students conceived the provision of academic materials after hours via WhatsApp as disruptive of their family life as quality family time became seamlessly integrated into academic pursuits.

Implications for practice and/or policy

- Academic use of WhatsApp should consider the additional responsibilities that it requires—need to contribute to an online learning community, expectations to interact at odd hours, and the pressure to read and reflect on peer-generated postings.
- Interaction after hours should be well timed and streamlined to account for mature students' competing family commitments, and additional software that signals and triggers to their learning clusters their availability for interaction should be installed on WhatsApp.
- Lecturers should harvest (mine) collectively generated resources on WhatsApp to support the institutional memory and sustained student meaningful interaction.

possibly explained by (1) the distractive nature of text messages, (2) limited academic conceptualisation of how textual resources can be optimally integrated into mainstream instructional practices and (3) uncertainties about the academic rigour of discussions generated via text messages. Notwithstanding these academic concerns about MIM, this social practice promotes subscriptions to information, builds social networks, supports brainstorming and fosters mutual understanding through sharing of assets like opinions (Hwang *et al.*, 2011). Therefore, MIM enhances productive communication among learning clusters through the sharing of mutual intentions, social objects, learning resources and needs.

Despite the aforementioned academic incentives, what is least understood in literature is MIM's influence on pedagogy (student academic participation, lecturers' ways of instructional delivery) and digital inclusion of learners from diverse academic backgrounds. The rationale of this paper, therefore, is twofold: (1) to explore the pedagogical value of a MIM service, WhatsApp, particularly its potential to enhance academic participation of all learners and transform lecturers' teaching practices and (2) examine its capacity to breach the digital divide among learners in geographically dispersed informal contexts. An informing framework comprising WhatsApp-enabled lecturer–student and student–peer consultations was drawn upon to explore the potential of MIM to promote equitable participation in diverse informal spaces.

The rest of the paper is structured as follows: a literature review and theoretical framework are articulated, research questions and methodology are presented, findings are discussed and a conclusion is given.

Literature review

M-Learning

For Kukulska-Hulme and Traxler (2005), mobile learning (m-learning) is generally about enabling flexible learning through mobile devices. However, new constructions of m-learning embrace the mobility of the context of interaction that is mediated by technologies. The Centre for Digital Education (2011) suggests that a new direction in m-learning enables lecturer mobility including mobile device-mediated creation of learning materials on the spot and in the field. This new approach foregrounds a transitory context in which all learning resources (interacting peers, lecturers, pedagogical content, the enabling technology) are all “on-the-move.” Consequently, m-learning potentially breaches the spatial, temporal and time zones by bringing educational resources at the disposal of the roaming learner in real time.

MIM

MIM is an asynchronous communication tool that works on wireless connections, handhelds and desktop devices via the Internet and allows students and peers to chat in real time (Dourando, Parker & de la Harpe, 2007). It fosters unique social presence that is qualitatively and visually distinct from email systems. As Quan-Haase, Cothrel and Wellman (2005) suggest, IM applications differ from emails primarily in their focus on the immediate delivery of messages through (1) a “pop-up” mechanism to display messages the moment they are received, (2) a user-generated visible list of other users (“buddy list”) and (3) a mechanism for indicating when “buddies” are online and available to receive messages. By providing a detailed account of the online presence of users (online, offline, in a meeting, away), MIM provides a rich context for open and transparent interaction that alerts communicants to the temporal and time-span constraints of the interaction. However, what remains unknown are the influences of MIM social presence on lecturers' instructional practices and the digital inclusion of students with varied exposure and experience in MIM academic usage.

Cameron and Webster's (2005) study on IM usage by 19 employees from four organisations suggests that critical mass is among the core explanations for the widespread adoption of IM. IM was considered appropriate when senders wanted to emphasise the intentionality of messages, elicit quick responses and enhance efficient communication (*ibid.*). What has not been explored, nevertheless, is the influence of pedagogical intentionality on the meaningful academic participation of underprepared learners. Sotillo's (2006) study explored English as Second Language (ESL) learners' negotiation of interaction and collaborative problem solving using IM. IM environment rendered interactions that facilitated student awareness of grammatical structures of second language communication. Although the study examined technology-mediated interactions of students with varied linguistic competences, it did not interrogate the relationship between MIM and digital inclusion of students.

The educational benefits of MIM are as follows: encouraging contact between students and lecturers, developing student-based reciprocal interactions and academic cooperation, promoting active learning, providing instant feedback, emphasising time spent on tasks, communicating high expectations, incorporating diversity of talents and affording authorised access to academic resources (Desai & Graves, 2006; Dourando, Parker & de la Harpe, 2007; Farmer, 2003). While these academic incentives constitute useful motivators for adopting MIM for learning, they render little insights into MIM's capacity to transform pedagogical delivery.

Other literature emphasise MIM's potential to bridge formal and informal learning (Cook, Pachler & Bradley, 2008), support the participation of muted voices (Ng'ambi, 2011) and support flexible personalised learning (Rambe & Bere, 2012), and heighten direct and indirect student scaffolding in perceivably complex subjects (Botha & Butgereit, 2012). However, since MIM often complements traditional learning environments like learning management systems (LMSs), it is critical to compare these learning contexts.

Comparing LMS and MIM

Beatty and Ulasewicz (2006) highlight that LMS functions as (1) providing *instructional* materials, (2) *assessment* through evaluation of learner capabilities using online quizzes or exams and (3) *communication* via synchronous and asynchronous interactions (ibid.). While MIM supports academic instruction through mobile web interfaces (Ng'ambi, 2011; Rambe & Bere, 2012), it is mobile phones' personalisation, perceived non-intrusive nature, mobile access to learning resources and instruction that make MIM more preferable to LMS. Users' generation of texts in various formats (text messages, videos, graphics, pictures) deepens student learning experience more than LMS' pre-packed content. LMSs are often employed as static repositories that suppress robust social experience and fail to support personalisation (Lee & McLoughlin, 2010; Veletsianos & Navarrete, 2012).

While LMS' discussion forums possess some interactive capabilities, they fail to sufficiently support asynchronous interaction as messages posted when users are offline are not necessarily retrievable upon their logging on, as is the case with MIM platforms. Moreover, in South Africa, using mobile Internet data to access LMSs is more expensive than MIM. Kreutzer (2009) affirms South African students from disadvantaged communities' higher usage of mobile phones compared with desktop computers, due to cheaper mobile Internet data. Wang, Woo, Quek, Yang, and Liu (2012) document the limitations of LMS: their acquisition costs, trainee educators' (eg, tutors) lack of access to some features (eg, course creation, student enrolment and student groups), which may be reserved for educators and administrators, and inaccessibility of LMS resources by students upon their graduation.

The following section discusses concepts used in this work namely *distraction technologies*, *formal and informal learning* and *digital inclusion*. These are elaborated in the sections that follow.

Distraction technologies

These are Web-based technologies that shift users attention from relevant educational tasks and activities towards other social concerns (eg, chatting, lurking and social networking). Wisconsin Centre for Educational Research (2011) highlights that these Web services simultaneously seize and fragment our attention, subvert higher-order reasoning processes, academic concentration and persistence necessary for critical thinking and intellectual development. A typical example of distraction is "tethering" (Turkle, 2008), technology users' over dependence and intense preoccupation with technology, leading to fragmentation of attention and disengagement from authentic activities.

Formal and informal learning

Conventionally, formal learning is conceivably marked by intentionality (goal setting), curricula focus, teacher-directed instruction and unfolds in formal contexts. On the contrary, informal

learning is natural (/subconscious), tacit, self-directed (individually or collectively), without lecturer direction or curricula focus (Cook *et al.*, 2008; Livingston, 2006; Vavoula, Scanlon, Lonsdale, Sharples & Jones, 2005). The complexity is that even informal learning defies consensus on whether it is intentional or serendipitous and natural (Rogers, 2006; Vavoula, 2004).

Given that MIM supports access to learning resources across different contexts (formal and informal), m-learning integrates informal and formal learning through its multidimensional clustering of informal and formal learning activities (Cook *et al.*, 2008).

Digital inclusion

Digital inclusion, involves all interventions aimed at eliminating disparities between those with access to and use of, including capability to effectively use information and communication technologies (ICTs) and those without. It encapsulates all efforts aimed at closing the vast differences among individuals' ability to learn using or effectively use ICTs (Avgerou & Madon, 2005). It emphasises that designing and using ICT applications should empower marginalised groups through ICT skills development, information access and strengthening the poor's capacity to access, process, and apply information and ICTs.

Theoretical model

The FRAME model

Koole (2009) proposes a Framework for the Rational Analysis of Mobile Education (FRAME) to grasp learning that emerges from the convergence of mobile technologies, learning capacities and social interaction. The FRAME model conceives collaborative construction of knowledge in mobile contexts as dependent on the intersection of interactions (between individuals, dyads, groups), and mediation of conversational technology (see Figure 1).

As shown in Figure 1, the **device aspect** (D) refers to the physical, technical and functional characteristics of mobile devices, which invariably affect the interface between the mobile *learner* and the *learning task(s)* (Koole, 2009). The **learner aspect** (L) underscores the cognitive abilities,

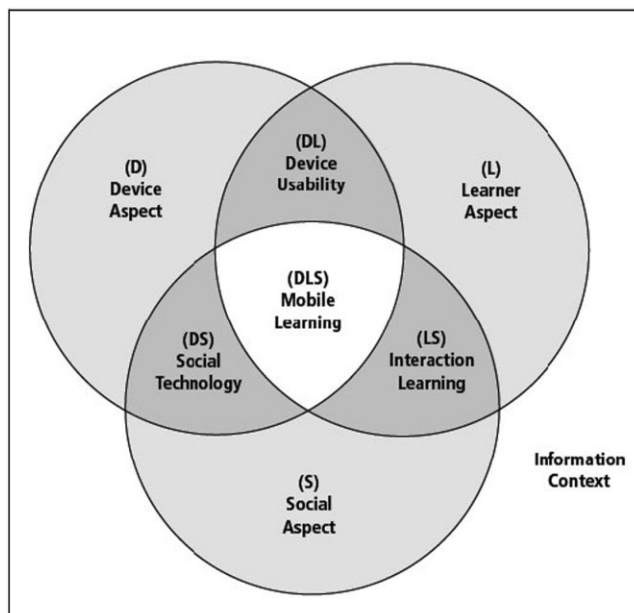


Figure 1: *The FRAME model* (Koole, 2009, p. 27)

memory, prior knowledge, emotions and possible motivations of the individual learner. It emphasises understanding how learners use prior knowledge to encode, store and transfer information. Mobile learners in a MIM context bring tacit, peer-based and pedagogical content knowledge and perspectives to their dialogic conversations via networked devices. The **social aspect** (S) constitutes the seedbed of interaction and cooperation. Lecturers and learners must adhere to the rules of engagement and cooperation, which enable information exchange, knowledge construction and sustenance of cultural practices.

Koole (2009) suggests that **device usability intersection** (DL) draws on considerations from both device aspect functionalities and individual/collective individuals' attributes. It foregrounds technology's technical aspects, which impact on users' cognitive demands and psychological satisfaction, thus influencing their cognitive load, access to information and ability to traverse different physical and virtual locations (ibid.).

Social technology intersection (DS) emphasises devices' capacity to trigger and sustain communication and collaboration among multiple individuals and systems. Device technical capabilities such as short messaging service, telephony and Internet access directly influence information exchange and collaboration between people with diverse needs, intentions and priorities (Koole, 2009). The **interaction learning intersection** (LS) synthesises learning and instructional theories and rides on social constructivism philosophy (ibid.).

Research questions

1. What is the influence of WhatsApp's affordances (physical, functional and technological) on the academic participation of third-year information systems students at the Central University of Technology (CUT)?
2. Can the use of WhatsApp gainfully shift pedagogical delivery in informal learning contexts?
3. How can WhatsApp be harnessed to effectively bridge digital exclusion among students in resource-constrained learning environments?

Methodology

The case study

The case study involved third-year information technology (IT) students undertaking an IT module at the CUT in South Africa. Given the study's focus on exploring MIM's potential to foster digital inclusion, a technology-based module provided an ideal context for such an investigation. The IT lecturer observed that question-based lecturer–student and peer-based engagements in class were very limited due to limited contact time, perceived transactional distance between the lecturer and students, and low self-esteem students' lack of confidence in addressing the lecturer's questions publicly due to potential ridicule by peers. The lecturer introduced WhatsApp, MIM application to boost participation, and interaction lasted for a semester. WhatsApp did not replace didactic teaching but served to extend academic consultation during and after hours. For the lecturer, this project constituted community engagement, and hence he was not paid for his interaction with students. About 163 IT students enrolled for the IT module, although 95 participated in this study.

To supplement lectures and the institutional LMS (locally branded "E-Thutho") academic resources, WhatsApp was adopted to allow for synchronous and asynchronous interaction. The lecturer required students with Web-enabled devices (smart phones, PDAs, iPhones) to download WhatsApp and form consultative clusters (interaction groups) comprising 7–10 students per cluster in addition to the lecturer. There were 12 clusters that comprised a total of 95 students who discussed questions they generated in their respective clusters including one the lecturer posted to all clusters. The study population comprised 59 female and 36 males. Of these participants, 76 were black, 11 coloured, 6 white and 2 Asian. Of these, only 16 were married and 5 engaged.

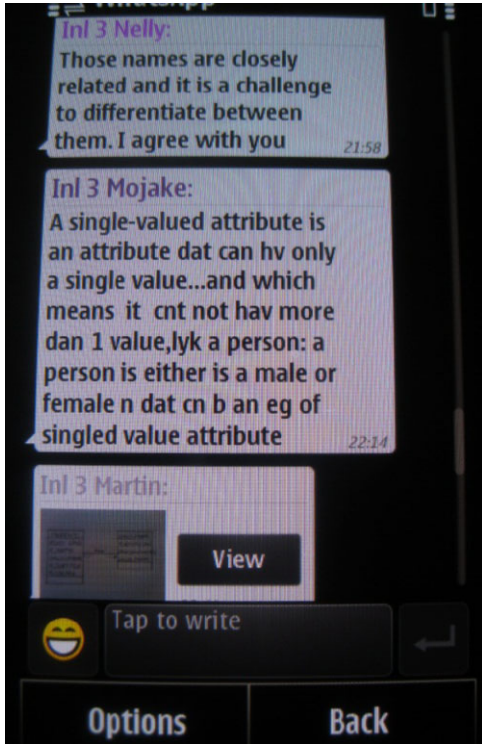


Figure 2

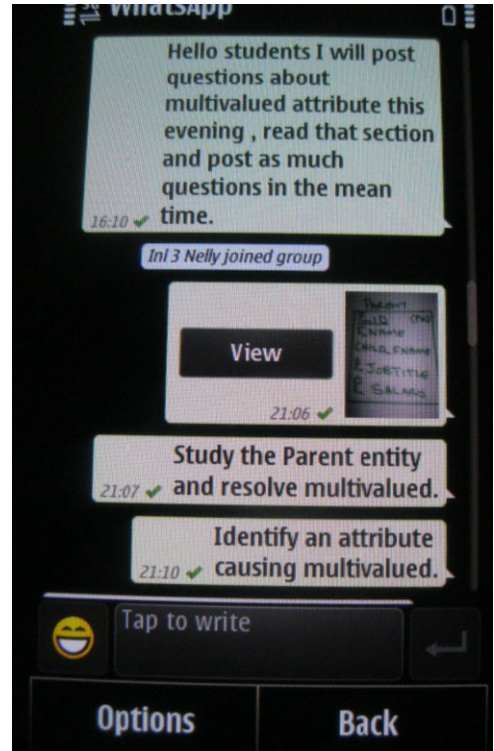


Figure 3

Figure 2: Shows student-peer discussion of single-valued attributes (snapshot on the left) as they appeared on the lecturer's WhatsApp-enabled phone. The lecturer had saved the authentic names of the students so that he could trace and monitor their participation informally

Figure 3: Illustrates the lecturer's provision of IT tasks in the form of questions (snapshot on the right) and a supportive diagram for illustrative purposes. This is the visual interface / version as it appeared on a typical student's WhatsApp-enabled phone as s/he interacted anonymously or used pseudonyms

Only 6 were first English language speakers, 14 were Afrikaans speakers, 15 were Xhosa, 2 Chinese, whereas the majority (55) were Sesotho. The rest spoke Venda.

To address perceived student knowledge asymmetries, students with varied academic capabilities were clustered together, and all logged on WhatsApp using their phone numbers to ensure anonymous interactions. The lecturer, however, authenticated his presence by using his real name. The visual representations above illustrate student-peer and lecturer-student interactions as they appeared on the lecturer and student's WhatsApp enabled phones, respectively (see Figures 2 and 3). An IT researcher from another South African university maintained a social presence on WhatsApp and provided IT background information and general guidance to students upon request. The lecturer introduced him online as an independent researcher but his real name was not disclosed at that stage. The lecturer posted on E-Thutho discussion forums all questions he had discussed with other students on WhatsApp to benefit those without WhatsApp-enabled phones. However, these postings did not include the contributions from students on WhatsApp. Students reserved for lectures all the challenging questions they failed to address and the lecturer would render detailed explanations to the entire class.

The lecturer informed students on his availability on WhatsApp at any time (between 8 am and 10 pm) to address student queries although his facilitative role reduced direct involvement, which

was only necessary when students were stuck. This was to promote peer-based interaction, reduce lecturer dominance and ensure student ownership of their learning. Therefore, the lecturer's social presence on WhatsApp meant that he would summarise the main ideas only after student discussions.

WhatsApp messenger

WhatsApp messenger is a cross-platform smartphone messenger that employs users' existing Internet data plan to connect them with their learning community (WhatsApp, 2010). Online interactants are rendered visible at any given moment, allowing for random synchronous and asynchronous consultations with their social networks. WhatsApp allows for the exchange of texts in various formats, group messaging with up to 11 members per cluster, unlimited messaging using existing Internet data, cross-platform engagements and offline messaging (WhatsApp, 2010).

Research method

Personal reflections and unstructured interviews

To establish WhatsApp's potential to shift pedagogical delivery, the IT lecturer's diarised reflections were used to capture his motivations and the impacts of WhatsApp on his teaching strategy. His diarised reflections were transcribed verbatim to document his original perspectives.

The independent researcher also interviewed in depth 15 third-year IT students who used WhatsApp to establish their academic experiences of using it. Since he had been introduced exclusively as "the independent researcher" online, interviewees (students) could not directly link him to the independent researcher they had interacted with online. This potentially reduced perceived power asymmetries between them including any perceived conflict of interest in the study.

The interviews investigated student extent of use of WhatsApp, the different contexts of its use, the various learning communities that students consulted with and the academic benefits of it. Students were also interviewed on their feelings of psychological empowerment and how their academic participation was affected by WhatsApp usage. Students were interviewed in a laboratory foyer—a cozy, convenient space they were all more familiar with than privileged spaces like the lecturers' office. Each interview lasted for about 1 hour and was recorded using a digital audio recorder to capture the original utterances of research respondents. The raw data was transcribed in Microsoft Word, printed and analysed using thematic content analysis in conjunction with Koole's (2009) FRAME model.

Questionnaires

To corroborate on the evidence from interviews, a questionnaire was administered to 95 students from this third-year IT class. Research ethics involving student informed consent to participate in the research, sufficient disclosure of the research's purpose, voluntary participation and rights to withdraw from the survey without any risk were observed. These WhatsApp users were surveyed to establish their perceptions of this application's academic value. They had spent about 3 months interacting and consulting with peers and their IT lecturer via WhatsApp. The study's focus on WhatsApp usage meant that non-users were naturally excluded from the study.

A semi-structured questionnaire was emailed to them, and 77 participants voluntarily participated in the survey. Drawing on FRAME model, the questionnaire investigated the physical, technical and functional affordances of WhatsApp in relation to their pedagogical value, WhatsApp's functionalities that students conceived to cohere with their different learning styles and the nature of participation it enabled. Students either emailed back their responses or printed and dropped them into a physical drop box. The responses were analysed using quantitative analysis.

Data analysis

Interview transcripts

For interview transcripts, thematic content analysis, which enabled the development of themes from the raw data, was employed in conjunction with concepts drawn from Koole's (2009) FRAME model as shown in Table 1. Tables 1–3 summarises the data analysis drawing on FRAME concepts and interview transcripts. Since the concepts at intersections in the FRAME model are inclusive of sub-concepts (outside intersections), the analysis concentrated on these intersections. By examining FRAME concepts' at intersections, sub-concepts within each segment were input as well. These concepts at intersections then informed the interpretations of results.

Questionnaires

Evidence from interviews was corroborated with a survey to understand student perceptions of WhatsApp to broaden understanding of its educational usefulness. A questionnaire was designed based on a Likert scale to determine: WhatsApp's usability and user-friendliness, student participation and collaborative problem solving, its potential to trigger deep reflection, collaborative creation of knowledge and its complementation of classroom learning practices.

Presentation and discussion of findings

To understand the influence of WhatsApp on student academic participation, pedagogical delivery and digital inclusion implications, the FRAME framework concepts, *device usability*, *social technology*, *interaction learning* were drawn upon to interpret interview transcriptions and the patterns of student responses to questionnaires. FRAME's concepts were also put into conversation with raw data (interview transcriptions and survey results) to provide a nuanced account of MIM's influence on pedagogical considerations and digital inclusion. The subsequent sections present the findings and the discussion based on these concepts.

Device usability

Under this theme, technological issues' interplay with student participation is discussed under the following: *device portability*, *information availability* and student *psychological comfort*. These issues are discussed in subsequent sections.

Portability

Two subcategories emerged under portability: *mobile learning* and *context free access* to learning resources. Student appropriation of WhatsApp-enabled phones for lecturer–student and peer-based consultations leveraged their participation as they redressed poor connectivity via institutional networks. Device portability coupled with affordances for anywhere anytime access to information and learning resources redressed the constraints distance, space and temporal times in access to resources.

WhatsApp-mediated learning's support for multiple access to learning resources impacted students' ability to engage with peers and the educator synchronously. Mobile devices' personalisation and adaptation to different contexts ensured persistent supply of texts, information and learning resources, which enabled networked learning and multiple peer-based feedback. The informal, convenient context for instantaneous sharing of vital academic information activated by the "porting" of learning resources across different spaces extended learning times and augmented traditional consultation spaces.

WhatsApp's affordances for asynchronous communication also directly impacted student participation. The retrievability of messages posted when students were offline, outside network coverage or when their devices were switched off implied that they could participate any time irrespective of context. Multiple interaction modes and diverse temporal times widened opportunities for student involvement without missing conversation flows.

Table 1: Device usability intersection

Theme	Category	Subcategory and examples of interview transcripts	Researchers' comments
Device usability intersection	Portability	Mobile learning / Context-free access WhatsApp application runs on my cell phone, which I can carry around. I can revisit our academic issues on WhatsApp <i>at any place</i> , anywhere, even banks and hospitals[Student].	Just-in-time learning is supported through the porting of content anytime, anywhere, and enables flexible learning Extraction of ideas from an accessible information repository is more expedient for exam preparation than navigating primary texts. WhatsApp enabled just-in-time learning.
	Information availability	Information synthesis WhatsApp keep records of all discussions that took place, so it helps during my examination preparations or reading for assignments [Student] Bridging information divides I use WhatsApp to pull together different ideas and perspectives from group members without the pressure of going to the library to read 300 page volume of texts [student] Just-in-time learning The convenience of accessing information from one central place enabled me to get just the content needed at any given time. I didn't need to read everything for my assignments [student]	
	Psychological comfort	Reducing cognitive load WhatsApp questions and answers reduce my stress because they gave me concepts and skills of answering questions. I used to fail to express myself on paper even when I knew answers [student] Minimised uncertainty WhatsApp gave me an idea of how questions can be asked on a given topic hence I have an idea of lecturer's style of questioning for examinations [student] Cognitive scaffolding My group discussions on IT concepts and problems helped me to shift from personal self-reflection to collaboration as we pooled together our collective minds. Through them, we developed our information system skills and understanding of concepts [.] [student]	WhatsApp afforded reduced the cognitive load and psychologically modeled future academic behavior. Collective intelligence was activated through student group collaboration.

Adapted from Nielsen, 1993; Koole, 2009.

Table 2: *The social technology intersection*

<i>Theme</i>	<i>Category</i>	<i>Subcategory and examples of interview transcripts</i>	<i>Researchers' comments</i>
The Social Technology intersection	Device connectivity	Sustained connectivity I use a 3G sim card for mycell phone so I do not rely on University networks to access WhatsApp postings because they can go down any given time [Student] Convergence of networks Our campus premises have wireless connections so if my Samsung Galaxy tablet's 3G network fails to connect, I can quickly switch to the WiFi to refresh my memory on the latest questions from peers [Student]	Mobile connectivity complements institutional networks by providing access to content when institutional networks fail. Networked access to content across different spaces and platforms
	System connectivity	Limited connectivity At times WiFi networks puts me off because these networks tend to be slow hence negatively affecting my access to WhatsApp queries and answers. Its different from broadband where access is usually faster and down time is limited [student]	Slow connectivity

Adapted from Koole, 2009; Shneiderman & Plaisant, 2005.

Table 3: The interaction learning intersection

Theme	Category	Subcategory and examples of interview transcripts and personal reflections	Researchers' comments
The Interaction Learning intersection	Interaction	<p>Instructor-instructor My interactions with the independent researcher who tracks my students' engagements on WhatsApp has helped in multiple facilitation of discussions and team-based coaching of students. (Lecturer's personal reflections).</p> <p>Leamer-learner, learner-content The multiple clusters have supported the emergence of peer-based mentors that coach and support students through critical questioning, advice and support in my absence (Lecturer's reflections). Zone of proximal development In lectures some students are too talkative and want to run the show. To the contrary, in online discussions we all engage with peer's ideas, views and perspectives (student transcript)</p>	<p>Collective facilitation of discussions and team-based coaching suggest shifts from instructivist approaches. Peer-based coaching and networked learning are all expression of social constructivist learning.- Active, collaborative learning can be contrasted with lectures' transmission mode.</p>
	Social cognition	<p>Authentic context and audience Working with different technologies creates multiple support systems. Those students without WhatsApp-enabled phones receive the same question via E-Thutho and they don't lag behind. (Lecturer's reflections)</p>	<p>Different technologies provide authentic learning environments that suit different learners' academic circumstances and learning styles.</p>
	Learning communities	<p>Dialogue, problem solving, community of practice My dialogue with my colleague who is more experienced in online learning helps in re-thinking the different ways in which I can improve the delivery of the course on WhatsApp. Our engagements based on our mutual observations of student interactions on WhatsApp create a shared learning community around common interests for us (Lecturer reflections).</p>	<p>Sharing experiences, social practices and communicative repertoires foster a community of practice.</p>

Adapted from Koole, 2009; Moore, 1989; Vygotsky, 1978.

Information availability

Information availability comprised three subcategories: *information synthesis*—that WhatsApp's digital trails and discussion threads were more accessible, user friendly information repositories than IT textbooks. The *information divide*, describes a social phenomenon in which off campus students with limited access to the libraries after hours, conceived WhatsApp as breaching information asymmetries they encountered due to their remote locations. It also rendered *just-in-time learning* through broadening access to navigable concepts and response summaries especially when students were under pressure to complete multiple tasks simultaneously or during last-minute preparations for examinations.

Psychological comfort

WhatsApp also enhanced student psychological comfort in three main ways: reducing *cognitive load*, *minimising exam uncertainty* and *cognitive scaffolding*. The lecturer and students' posting of problem-based questions that tested understanding of the practical application of concepts and theoretical issues taught in class empowered students with critical assessment skills. Through these questioning practices, students gradually acclimatised to the educators' style of questioning about IT concepts, allowing them to comfortably speculate/anticipate particular styles of questioning in exams. This modelling of particular questioning styles about concepts reduced their cognitive anxiety about being "caught off guard" and heightened student participation.

The platform also enabled student cognitive scaffolding through group sharing of information and eased the pressure of individual problem solving and reflection (see cognitive scaffolding category in Table 1 and the responses to statement d in Table 4). The statement under cognitive scaffolding in Table 1 suggests a shift in work ethic from individual accomplishment to collaborative co-construction of knowledge. As Rambe (2012) suggests, the seamless integration of social practices, devices and platforms (eg, mobile phone platforms and texting culture) affords recursive engagements that potentially impact students' meaningful learning and (academically productive) connections.

Wider ownership of WhatsApp-enabled phones contributed to broadened participation through sustaining a critical questioning culture and information seeking practices (see responses to statements e, f and g in Table 4). WhatsApp anonymous communications bolstered the confidence of shy students who conceived lectures as intimidating, hegemonic spaces that disrupted transparent communication. The statement "*As a shy student, the exciting thing about WhatsApp is its anonymous interactions. My confidence to post questions has improved because I just post questions and nobody ever knows*" bears testimony to this psychological empowerment. WhatsApp, therefore, entrenched "participatory cultures" (Jenkins, 2010), which strongly support individual content creation, sharing and efficacy of personal connections.

Social technology

To unravel how student connectivity on WhatsApp can be harnessed to bridge exclusion in poorly networked communities, student access to mobile networks was interrogated under the social technology theme. Under this theme, *device connectivity* and *networked connectivity* were the main categories.

Device connectivity

Under this category some students emphasised the erratic nature of institutional networks (LMS), which triggered their dependence on mobile networks especially WhatsApp. Other students complained about wireless connectivity's heavy reliance on the strength of connection signals across campus, which compelled some to switch to their networked handhelds or walk in labs to access networks thus reinforcing the networked divide. This convergence of institutional and private

Table 4: Student responses to questionnaires

Nature of question	Category				
	SA	A	NS	D	SD
a. I enjoyed the flexibility of WhatsApp online discussion interaction forums compared to classroom face-to face interaction forums.	(27%)	(62%)	(7%)	(4%)	(0%)
b. My participation in learning activities on WhatsApp virtual classroom was more effective than in face-to-face lectures	(20%)	(55%)	(1%)	(14%)	(10%)
c. Receiving questions from my lecturer and colleagues anytime and anywhere frustrates me because am not given time to rest.	(3%)	(10%)	(12%)	(21%)	(55%)
d. WhatsApp online interaction forums facilitate collaborative learning better than face-to-face lectures and tutorials	(25%)	(35%)	(32%)	(8%)	(0%)
e. My ability to communicate was limited in a classroom compared to WhatsApp online interaction forums.	(38%)	(32%)	(16%)	(3%)	(12%)
f. WhatsApp interaction forums allowed me to have more time to reflect deeply before giving my opinions	(55%)	(36%)	(9%)	(0%)	(0%)
g. Knowledge creation is higher in WhatsApp online interaction forum than in face-to-face classroom environment.	(35%)	(43%)	(12%)	(4%)	(7%)
h. My participation level was higher in WhatsApp interaction forums because the technique promoted layback learning	(53%)	(29%)	(8%)	(9%)	(2%)
i. WhatsApp online interaction forums encouraged me to construct knowledge instead of acquiring it passively from the lecturer	(48%)	(42%)	(7%)	(4%)	(0%)
j. WhatsApp virtual classroom limited my expression of ideas	(0%)	(5%)	(13%)	(53%)	(29%)
k. WhatsApp online interaction forums can supplement face-to-face classroom learning.	(34%)	(66%)	(0%)	(0%)	(0%)
l. WhatsApp online interaction was a wastage of time.	(0%)	(0%)	(0%)	(64%)	(36%)
m. WhatsApp messaging is cost effective.	(45%)	4 (55%)	(0%)	(0%)	(0%)
n. The opportunity to experiment with new things on-line was possible on WhatsApp	(49%)	(49%)	(0%)	(0%)	(3%)
o. I would recommend the online forums for all my courses	(10%)	(33%)	(20%)	(22%)	(16%)

Key: A = Agree; D = Disagree; NS = Not Sure; SA = Strongly Agree; SD = Strongly Disagree.

networks presented by switching between networks challenges binary conceptions of the digital divide.

System connectivity

Student accessed WhatsApp through either WiFi-enabled networks or private virtual networks. Such mobile connections often provided slower connectivity compared with institutional networks. Student frustration with slow networked connectivity resonates with variations in the networked access to collectively generated resources. Notwithstanding the aforementioned drawbacks, productive device usage was not exclusively network dependent as collaborative learning communities and language of discourse were deeply implicated in productive engagements, affecting intensity and persistence of online interaction.

ESL learners who struggled to articulate themselves in English occasionally used street English and “code switching” (switch from English to their vernacular languages) on WhatsApp. This

unintended digital inclusion is embodied in the system's accommodation of their linguistic challenges. However, lecturers' personal reflections suggested that students without WhatsApp-enabled phones were subtly excluded as the postings on E-Thutho were not necessarily as conversational as those on WhatsApp.

Contradictions also emerged with regard to possibilities for WhatsApp's wide-scale implementation across different courses. Although participants unanimously agreed that using it for teaching and learning was invaluable, only 33 (43%) of them recommended its implementation in all their subjects. Mindful of WhatsApp's cognitive demands, inferences were made about student fears of increased workloads through responding to peers' queries, giving critiques based on in-depth understanding, including the pressures of collaborative engagements.

Interaction learning

To address the question on the potential of WhatsApp to shift pedagogical delivery in informal learning contexts, the intricate interplay of interactants, situated m-learning contexts and in situ collaborative practice were explored under interactive learning category. Subcategories *interaction*, *social cognition* and *learning communities*, which merged through conversations with raw data, are elaborated below.

Interaction

WhatsApp Interaction unfolded in three main ways, namely *lecturer–lecturer*, *learner–learner* (student–peer) and *student–content* interactions. Lecturer-level engagements revolved around the IT lecturer's consultations with the guest lecturer (independent researcher) on WhatsApp-mediated course design, tracking and interpreting students' learning trajectory via WhatsApp-enhanced interactions. Although the guest lecturer was marginally involved in supporting student clusters, his constructive dialogue with the lecturer supported social constructivist interpretations of student engagements. Both educators conceived these knowledge-sharing practices on online course design and student learning trajectory as team-based coaching that mutually benefited their pedagogy. The IT lecturer's online teaching strategy was also transformed by his personal reflections. These strategies helped transform pedagogical delivery from an authoritative, instructivist mode to a collaborative, connectivist approach.

At student–peer levels, the IT lecturer discerned peer-based mentoring and student constructivist construction of knowledge through their intra-cluster collaborations on WhatsApp. The students were more directly involved in knowledge construction and negotiation of perspectives as information seekers, knowledge givers, information synthesisers and knowledge brokers. The lecturer's facilitative role through the summarisation of the main themes emerging from student discussions suggest relaxed authority and a shift from transmission approaches of delivery to constructivist approaches. These practices enabled students to assume more control and ownership of the learning. For example, students who normally relied on private individual study and avoided collaborative engagement found their "lone wolf" (Bacon, Stewart & Stewart-Belle, 1998) mentality being subverted by WhatsApp's demands for collaborative problem solving.

Survey data suggests that 57 respondents (74%) preferred participating in WhatsApp virtual forums to traditional classroom interaction. The higher preference of WhatsApp to in-class discussions can be attributed to the anonymity of the online interactions, which potentially democratised participation of shy and less confident students. WhatsApp "virtual classroom's" anonymous interaction, flexibility and affordances for personal reflection (see responses to statements e, f and g) potentially liberated these subverted voices through provision of reflection time. As Ng'ambi (2011) aptly observes, didactic teaching creates inadvertent barriers to communication as individual students are often expected to speak aloud while the entire class listens, a practice that mutes other voices (*ibid.*).

Social cognition

This encapsulated the situated context of social technology usage and mental modelling of participating audiences in WhatsApp-mediated interactions. Content delivery via the LMS and WhatsApp created authentic situated contexts for knowledge sharing that were accommodative of students' varying circumstances and asymmetrical access to networks. Questionnaire responses affirmed that 69 participants (90%) preferred the flexibility and spontaneity of WhatsApp discussions to pre-packed content and inflexible lectures.

Social cognition also manifested in students' claim that addressing the lecturers' questions on WhatsApp helped them to gain transferable assessment skills like his style of questioning about concepts and their corresponding responses. The statement "*WhatsApp enabled meaningful learning because the lecturer's posts on concepts allow us to understand how to respond to different concepts in the final exam*" suggests student inductive discovery through critical questioning practices.

To cross-check these student claims about knowledge creation and transfer, survey questions solicited responses on WhatsApp discussions' potential to engender knowledge generation, reflection and communication. Students' affirmative responses were knowledge creation (77.9%), deep reflection (90.9%) and meaningful communication (74%), suggesting WhatsApp's forums' potential to foster "affinity spaces." For Gee (2004) "affinity spaces," are discursive spaces driven by common endeavours to bridge (participation) differences linked to interactants' interests, skills and capabilities.

Learning communities

This category had *dialogue* and the *community of practice* as its subcategories. The lecturer-lecturer dialogic interactions involved the sharing of experiences, social practices and communicative repertoires, thus fostering a community of practice and learner-centred teaching approaches. For students, transformative learning played out in their critical engagement with learning resources. Questionnaire data affirmed that 70 respondents (91%) believed that WhatsApp discussion forums allowed them to reflect "deeply" on questions and queries before giving their opinions. This is potentially attributable to forums' asynchronous nature that mitigated the pressure of instant, spontaneous responses immanent in lecture interactions. However, WhatsApp digital trails (questions and answers) could have been more useful if they were archived to augment students' memory and allow for recursive interaction with old and new content organically.

Distraction technology

Despite the academic value of WhatsApp, 10 participants (13%) expressed some reservations about receiving learning material 24/7. These participants were predominantly adult learners with families who conceived the mobile application's blurring of contexts as "anti-social" and disruptive of family life. However, since these adults were a minority, about 54 respondents (70%) supported the reception of academic material after hours. They indicated that such queries and responses enabled them to revisit and revisualise their lectures and saved them from looking up for materials from libraries and books during late hours.

Study implications

- The study reported student ambivalence about WhatsApp's wide-scale roll-out in different disciplines due to the additional student responsibilities involved in these interactions. Educators should redesign WhatsApp by incorporating third-party applications for sorting discussion threads by themes/topics to reduce the cognitive load on students or incorporate the Frequently Asked Questions tool.
- Educators must adjust discussion times after hours to accommodate mature, married students with family responsibilities, by installing software that they trigger to join conversations when they are available to engage.

- Given that contributors to discussion postings may delete them and content may migrate once groups are closed, educators need to harvest (mine) and archive these artefacts to support students/institutional memory when the need arises.
- Students' WhatsApp discussion summaries should be posted on E-Thutho to prevent the reproduction of disadvantage for those students without WhatsApp enabled phones.

Research limitations

Given that some students had no smartphones, it was impractical to establish and capture all student participation on WhatsApp. Students with Web-enabled phones, who struggled to download the application did not benefit from the study too.

Conclusion

The academic appropriation of WhatsApp afforded the convergence of student individual traits (abilities, skills and capabilities), situated contexts and the conversational technology, which triggered their meaningful involvement in learning. WhatsApp's anonymous, asynchronous collaborative learning allowed shy, less confident students to engage more productively. Although participation online was higher than classrooms participation, some students became more vocal on WhatsApp than in classrooms as WhatsApp afforded democratic expression through information seeking, critical questioning and information sharing practices. Generally, the provision of questions and responses in different formats attracted the attention of students to participate more. Although anonymity often raises uncertainty about learner's assumption of responsibility for their perspectives, this was mitigated by the educator's knowledge of all group members. Mature adult learners with families, however, expressed ambivalence about WhatsApp due to the contradiction between demands for unhindered access to learning resources anytime, anywhere, and competing family commitments after-hours.

WhatsApp also transformed pedagogy by fostering social constructivist environments for lecturer–student and peer-based co-construction of knowledge. The lecturer's role was transformed from an instructor to a facilitator and mentor providing guidance on demand. Student roles were also transformed from information receivers to information generators, collaborators, information seekers/givers, critical thinkers and group leaders.

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