Designing for Mobile Empowerment in South African Education

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ABSTRACT
We present empowerment as a problem in contemporary societies. We argue it is a 'wicked problem', particularly within the resource-constrained environment of South African public education. We offer capability-sensitive design as a grounded theory-led method for the development of conceptual designs empowering teachers and school managers. The participatory elements of the method are constrained within the data gathering phase, the pluralistic analysis inscribed within the capability approach, and the empathy stage of design thinking. The method is illustrated via the *'Class Journal'* concept, developed as part of engagement between CSIR and SAP Innovation Center- Pretoria.

Author Keywords
Capability approach, design thinking, empowerment.

ACM Classification Keywords
H. m. Information systems: miscellaneous.

INTRODUCTION
Current trends, particularly in mobile, indicate that technology is transforming our lives in many subtle and unrestrained ways. Concealed sensors, wearable devices, implanted technologies and seamless social media interactions are beginning to capture the 'Big Data' of our everyday lives. Meanwhile, blended learning approaches integrate technology-based learning with traditional face-to-face classroom activities in a planned, pedagogically valuable manner. Traditional coursework is supplemented by online media, while teachers alternate between online and classroom instruction, respond to students' digital messages and offer support in online learning. Within such environment, understanding how technologies impact the teaching and learning process, and how to make the most of investments in information and communication technology (ICT); is foremost in the minds of education management.

Pervasive socio-technical experiences are becoming integrated into a new networked social fabric, offering unprecedented opportunities for sharing, collaboration, and social innovation; while at the same time releasing threats of control, and lack of privacy. The new social reality offers multiplicity of ways to be included, or excluded. Such issues are particularly prominent and acute in low-resource settings. Thereby, the solution to problems of mobile empowerment and control, inclusion and exclusion; participation and non-participation; emerges as a theme for study in the design of ICT.

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We argue that designing ICT innovations for the empowerment of teachers and school managers, within low-resource settings, in the age of 'Big Data'; falls within the class of "wicked problems", characterized as ill-formulated problems where proposed "solutions" often carry the evil quality of turning out worse than the symptoms which triggered them. The term was introduced by Prof. Horst Rittel, to stand for poorly defined innovation problems "where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing" (Churchman 1967). Design thinking (DT) is an established instrument for resolving such 'wicked' problems Participatory methods contribute to contextualizing issues of sustainability, usability, and usefulness in the design of technologies and services. On the basis of DT and the capability approach (CA), we offer capability sensitive design as a concept development method. It is heavily grounded in social theory and analysis of user research; and can be aimed at the expansion of individual, as well as community capabilities, and empowerment.

MOBILE EMPOWERMENT
The Oxford English dictionary defines the verb empower as "to enable". Enablement can be viewed as the improved opportunity for men and women to act in full consideration of the available information, to make optimal decisions and control their lives; and can be linked clearly to the capabilities approach (Kleine 2013). On the other hand, we understand empowerment as a motivational construct. Empowerment is viewed as the intersection of agency and existing opportunity structures; where agency consists of the capacity of individuals to make meaningful choices, measured by endowments of psychological, informational, organizational, material, social, financial and human assets. Empowering ICT innovations enable individuals and organizations to reflect on the choices available to them, given their capabilities in terms of information, time, education, professional resources, etc. The "wicked" problem (Buchanan 1992) of designing innovations for empowerment consists of balancing individuals' need to believe they can cope adequately with events, situations, and/or people confronting them; with organizational objectives such as transparency, governance and accountability. Individuals' power needs are frustrated when they believe that innovations are used to monitor

them, to control them and to deny them agency in coping with the physical and social demands of their environment.

People-centred approaches to innovation for empowerment are rarely consistent with of blinkered individualism. In many circumstances, individuals increase their power to make effective choices by acting collectively. Innovations for empowerment factor in by enabling collective choices, made possible by collective capabilities; and allowing actors to have their voices heard, to put things on the agenda, to negotiate and to find the 'power within themselves to challenge past customs' (Villeval 2008). Successful innovations circumvent the "wickedness" of allowing individuals or interest groups, to sway, to high-jack or to manipulate public agendas.

We consider innovations for empowerment in terms of the subjective rationalities underpinning freedom, agency and choice; captured through CA (Sen 1988; Sen 1990). By extending informational capabilities (Johnstone 2007) and available choices, innovations modify the opportunity structures. While empowerment entails reflection by autonomous individuals on choices presented to them, in terms of their human development; participative processes in the design, ensure the relevance of the available choices to subjective human values.

CAPABILITY SENSITIVE DESIGN

Capability Approach

The rise of Sen's CA shifted the focus of international development efforts, away from concern with economic growth and the utility it offers, and towards a pluralistic view of human development (Haq, 1996). Within the CA framework, measuring the quality of life of individuals is consistent with an assessment of their progress towards achieving *functionings* they have reason to value. The latter are valuable 'beings and doings' which are not necessarily evaluated in terms of commodity-based accounting. They may involve being in good health or having loving relationships with others. Central to the framework is an individual's *capability* i.e. the freedom to achieve valued functionings. Capabilities are derived on the basis of existing *resources* and *conversion factors*. Capability expansion is the driver of human development because it allows people to do or to be the things that are important to them. Participatory approaches are central to the operationalization of CA, and to deriving insights about subjective human values.

A number of criticisms of the CA include its abstract, over-analytical nature and the difficulties brought by its divergent interpretations. The human development paradigm persists in viewing people from an "economistic" (Shani, 2012) perspective and extends the rationality of the market to domains which are not exclusively economic. By constructing a largely rational and liberal subjectivity, CA can overlook the contextually embedded aspects of human values and choice. By focusing on empowerment, the human development discourse can contribute to individualizing poverty and depoliticizing inequality, thereby largely divorcing it from the opportunity structures within which it occurs. In order to address the above criticisms we propose merging CA and DT into the hybrid approach of capability-sensitive design.

Design Thinking

DT emerged as a human-centered approach to innovation, re-framing organizational problems as design problems (Brown & Wyatt, 2010; Brown, 2008; Plattner, Meinel, & Leifer, 2010). DT provides a loosely-structured organizational process which enables managers to balance the resource demands of creative exploration with benefits to the bottom line (Martin, 2009). The rise of DT has considerably impacted the culture of industrial innovation. Its primary contribution is its sustained attempt to provide scaffolding for the most elusive deliverable – creativity.

DT appealed to the process-oriented culture of business organizations by introducing a 5-step innovation process: empathize, define, ideate, prototype, test. By doing so, it was able to shield innovation from the mess, conflict, failure, emotions, and looping circularity that is part and parcel of creative processes. The DT innovation process has been implemented with arguable success rates. Its key contribution to design consists of offering a de-politicized critique of innovation practice from user values point of view, as well as a process-oriented approach for addressing that critique. DT is applied through ethnographic approaches, relying on 'thick' understandings.

While DT is focused on capturing creativity and curbing management's over-reliance on analysis, it has been criticized for failing to reference wider theories of the social (Kimbell, 2011). Furthermore, even though empathy with users is fundamental within DT, the designer/researcher is often framed as the agent of change, a largely outdated perception within the social sciences. In order to remedy these shortcomings within the DT method, we propose merging it with CA.

Hybrid Approach

The actions of individuals are constantly shaped by preferences, resources and capabilities as freedoms. Human development takes place when humans do or are the things they are free to do or be (capabilities); and achieve the goals and values important to them (functionings). Adopting CA as a framework for developing body-of-knowledge of socio-economic problems, seems to be strongly compatible with adopting DT as a body-of-practices for designing appropriate ICTs. Allowing the two approaches to overlap and complement one another within the scope of ICT innovation for development, appears as a reliable strategy for operationalizing and practicing capability-sensitive design, a term originally introduced by (Oosterlaken 2009).

The new hybrid method for technology innovation (Slavova, Venter, and Baduza 2013) can be geared towards addressing the "wicked problem" of innovation

for empowerment. The theoretical underpinnings of CA are aligned with and complementary to, those of the DT innovation methodology; and blending them results in a set of research tools, behaviours and activities, for carrying out 'capability sensitive design'. The hybrid method balances CA's emphasis on reasoned value choices and its operationalization challenges; with DT's holistic interpretation of the emotional drivers of human behaviour and its process-oriented approach to creativity and innovation. The privileged position of the designer as the main agent of change, is enriched with pluralism and participatory discourse. The method is consistent with the broad capable and convivial design framework, advocated by (Johri and Pal 2012).

Understanding and reinforcing the role of ICT in empowering people in disadvantaged communities provides a valuable case for applying the method. As part of the analysis of capabilities, it is critical to define point-of-view problem statements consistent with the DT syntax: [a user group] [needs a technology] because [insight into constraints to the group's agency and the dynamics of their choice to exercise capabilities]. We demonstrate the use of the method through the *'Class Journal'* use case.

USE CASE: 'CLASS JOURNAL'

Background

The ICT4RED project of CSIR, is aimed at investigating how mobile multi-media devices can support teaching and learning in rural schools; and build skills for the 21st century among educators and learners. It is operational in the Cofimvaba district, Eastern Cape and prepares teachers to integrate technology into classroom teaching strategies through a 10-month gamified, professional development course, where they earn skills 'badges' and the right to a personally assigned tablet device.

As powerful multimedia devices, tablets can support education in a myriad of ways. Introducing them into schools affects profoundly the teaching and learning environment. The Public Cloud 4RED collaboration between CSIR and SAP Innovation Center- Pretoria, is aimed at leveraging the ICT4RED initiative and demonstrating the viability of public cloud architectures for the delivery of e-government services in resource constrained rural environments.

CA: Contextual Findings

SAP Innovation Center- Pretoria, carried out an extensive capability study during the first half of 2012, in collaboration with the Centre for Democratising Information (CDI). The research focused on the capabilities found in primary schools in 5 disadvantaged South African communities (CDI 2013); located in five provinces (Randfontein, Gauteng; uMthwalume, KZN; Bushbuckridge, Mpumalanga; Thabazimbi, Limpopo and Joe Morolong, Northern Cape). The sites of the study were selected so that the studied populations include people with varying socio-economic status who can be classified as poor, less poor or upwardly mobile. The leading methods were in-depth interviews of experts and circuit managers (44) and focus group discussions with teachers (11), parents (9), students (14) and school management (12).

In terms of established functionings, overcrowding emerged as the biggest challenge facing teachers in the classroom. It significantly influenced their approach to teaching. Since overcrowding drained teachers' creativity, teaching strategies were often reduced to lecturing, 'chalk and talk' and focusing on top performing learners. Teachers were familiar with, but rarely used constructivist learning methods such as collaborative learning, situated learning, learning by play and learning by doing. While learner attendance was high, it was often intermittent and affected negatively performance.. Furthermore, teacher absenteeism often disrupted teaching and derailed curriculum delivery plans.

The functionings of school managers consisted of consistently meeting the minimum administrative requirements such as recording teacher and learner attendance, monitoring curriculum progress, collaborative planning, etc. Nonetheless, within an environment with strong legacy from Bantu education and constantly changing curriculums, school managers struggled to offer to teachers adequate professional development opportunities. Parents observed inadequate decision-making capabilities and ineffective school management:

"I think the leadership is not united […] in terms of pushing the goal which is the education for kids, it seems like they are not equipped and even if they say that they are calling a person to equip them, they are afraid of taking their stand. They are afraid of making decisions." Parents, Randfontein

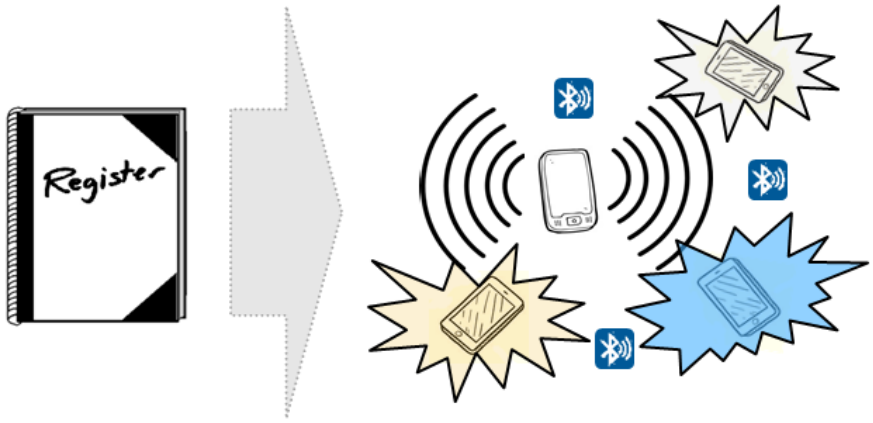
Overall, the contextual research showed reduced capability of teachers to provide learners with quality classroom interactions and personalized attention. Additionally, findings showed reduced capability of school managers to make decisions on the basis of recorded information. Two of the point-of-view statements derived through the analysis, are as follows:

- Teachers need an interactive solution because they cannot provide quality interactions in overcrowded classrooms
- School managers need data about teaching and learning processes, because they are challenged in making management decisions

DT: Solution Concept

The representative contextual findings were transferred to a setting where tablets were being introduced within the education environment. The technology design challenge for the Public Cloud 4RED project emerged on the basis of the exploratory research, as well as within the technology constraints of ICT4RED. The design challenge consisted of capturing changes in the classroom environment and the interactions occurring within it, due to the introduction of tablets. The challenge sought to empower teachers to take initiative in the classroom; and to empower school principals to ensure full advantage is taken of investments in tablet technology.

Figure 1: Solution concept



The *'Class Journal'* concept was developed as consistent with a vision of a classroom register for the 21st century. It offers a student-centred classroom management solution for capturing sensor and device data via Beacon technology. The concept is contextualized to the resource constrained rural environment, and device sharing behaviours characteristic of it (Johri and Pal 2012). It takes advantage of context-aware services in order to record in-person, digital and hybrid interactions occurring in the classroom. In-person interactions are fuelled by sensor data such as proximity data which enables the seamless headcount of learners' classroom attendance; motion sensor data which enables monitoring of physical activity levels (e.g. number of steps by teacher) and environmental data which captures classroom characteristics (e.g. heat, light, noise). Digital interactions may include records of device properties, applications used, and users' time spent working with specific documents on the system (e.g. lesson plans). Context aware services are capable of assisting teachers' professional development by guiding them towards digital interactions which can be instrumental to attaining additional skills badges. Hybrid interactions transform classroom dynamics by merging sensor data and monitoring data. For example, once students' attendance in the classroom is recorded, they are able to issue assistance requests to the teacher. Alternatively, the attendance information can be used for forming ad-hoc student groups and for enabling teachers to push content and/or assignments to the learners present in the classroom.

The *'Class Journal'* concept includes a dashboard, presenting all interactivity metrics for the benefit of school principals and circuit managers. The collected interactivity metrics are pushed to the cloud, via available connectivity resources; and relevant analytic results are made available in order to facilitate and speed up decision-making.

'Class Journal' Proof of Concept (PoC)

The PoC for the *'Class Journal'* consists of a cloud application, which makes available to education leadership classroom data, captured via the teacher's tablet and Beacon technology. This data is loaded from the teacher's tablet to the central school server via Wi-Fi, and pushed to the cloud for access at the district level.

The *'Class Journal'* pilot implementation captures via Beacon technology characteristics of students' attendance, classroom presence of tablet devices and their properties (e.g. battery life, bandwidth use, storage), and of the classroom environment. The proposed PoC is based on the assumption that students share use of the tablets and are able to log-in. When the devices enter the geo-fenced classroom area, a proximity-based service is triggered. A student attendance map (Figure 2) and a device map (Figure 3) are generated with minimum manual input from the teacher. Additionally, tablet sensors collect information regarding the classroom environment (e.g. noise, light, heat). The captured data is collected on the teacher's tablet, and subsequently synchronized with the school content server. The benefits of Public Cloud 4RED services in resource constrained environment are demonstrated by making classroom data available to district administrators via the Internet.

Figure 2: Attendance map

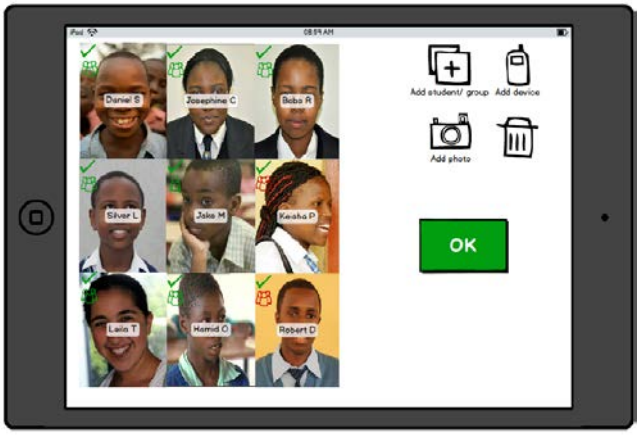
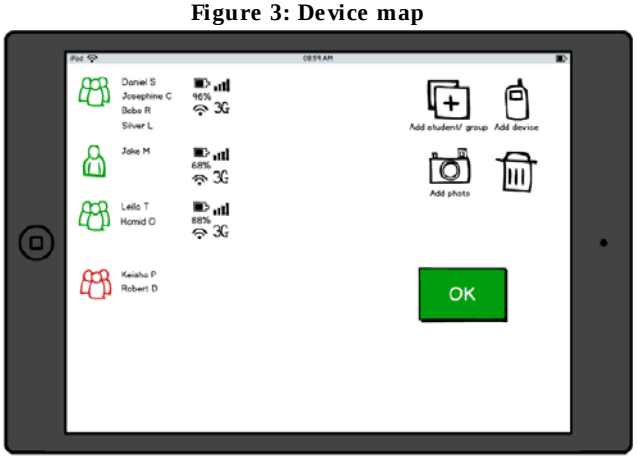


Figure 3: Device map



DISCUSSION

The *'Class Journal'* concept empowers users by adding to their capabilities. Students and teachers are empowered to keep accurate records of their participation in face-to-face, and digital interactions; and to experience innovative hybrid interactions. The application also empowers school managers to make valued choices with respect to device and classroom management. Teachers are empowered to learn through digital interactions and earn additional badges towards their professional development.

Teachers' empowerment within the classroom is characterized by increased transparency and control within overcrowded and often noisy classrooms. Meanwhile teachers' empowerment within school management is characterized by the transfer of power from individual teachers to the collective capabilities of the teaching body. Even though teachers as a group have a strong voice in school management, their inclusion in management is strengthened by the capture of classroom interactivity metrics. Teachers are empowered to signal to management more clearly classroom needs. Collective capabilities are incorporated by aggregating micro-data about classroom interactions and making it meaningful to school leadership. The success of teachers' capability expansion as empowerment, depends on their will as development actors and is contingent upon their managers as 'uppers'. The choice to not use the system is not given to teachers and learners, due to assumed benevolence of their managers.

The proposed solution concept adds to understandings of empowerment in terms of educational capabilities of educators, learners and managers by offering a transformation of traditional education values to education for the 21st century. The *'Class Journal'* concept expands teachers' and students' capabilities to interact among themselves, and with managers in new ways. In developing the concept further it remains critical to recognize the potential power imbalances to avoid propagating them via the capture of extensive personal data. For example, even though interaction data is personalized, managers are able to access only aggregated and anonymised metrics.

CONCLUSION

Translating empowerment into French brings hesitation among *auto-determination* (self-determination), *emancipation* (emancipation), *habilitation* (enablement), and *autonomisation* (the process of becoming autonomous) (Villeval 2008). The difficulty arises from divergent understandings of what the concept is, or could possibly be; as it blends emotive responses to power (or the lack thereof) and utilitarian notions of individual autonomy and intrinsic value. We have developed an integrative conceptual method which answers the question *"How to design empowering innovations?"* and enables ICT innovation for human development.

REFERENCES

Buchanan, R. 1992. "Wicked Problems in Design Thinking." *Design Issues* 8 (2): 5–21.

CDI. 2013. *The South African Community Capability Study: The Context of Public Primary Education*.

Churchman, C. W. 1967. "Wicked Problems." *Management Science* 14 (4): B–141–142.

Johnstone, Justine. 2007. "Technology as Empowerment: A Capability Approach to Computer Ethics." *Ethics and Information Technology* 9 (1): 73–87. doi:10.1007/s10676-006-9127-x.

Johri, A., and J. Pal. 2012. "Capable and Convivial Design (CCD): A Framework for Designing Information and Communication Technologies for Human Development." *Information Technology for Development* 18 (1): 61–75.

Kleine, Dorothea. 2013. *Technologies of Choice?: ICTs, Development, and the Capabilities Approach*. Cambridge, Mass.: MIT Press.

Madon, S. 2004. "Evaluating the Developmental Impact of E-Governance Initiatives: An Exploratory Framework." *EJISDC* 20 (5): 1– 13.

Oosterlaken, I. 2009. "Design for Development: A Capability Approach." *Design Issues* 25 (4): 91–102.

Sen, A. 1988. "The Concept of Development." *Handbook of Development Economics* 1: 9–26.

———. 1990. "Development as Capability Expansion." *Human Development and the International Development Strategy for the 1990s* 1. http://tek.bke.hu/regikorok/sen/docs/development.pdf.

Slavova, M., E. Venter, and G. Baduza. 2013. “Towards Applications of Capability Sensitive Design of Technologies.” In Ocho Rios, Jamaica.

Villeval, Philippe. 2008. “Towards a Policy Framework for the Empowerment of Social Movements.” *Development in Practice* 18 (2): 245–57. doi:10.1080/09614520801899085.

Wilkinson, Adrian. 1998. “Empowerment: Theory and Practice.” *Personnel Review* 27 (1): 40–56. doi:10.1108/00483489810368549.

Zheng, Yingqin. 2009. “Different Spaces for E-Development: What Can We Learn from the Capability Approach?” *Information Technology for Development* 15 (2): 66–82. doi:10.1002/itdj.20115.