

Curriculum Development for Mobile Digital Literacy Skills Acquisition Using a Design Science Approach

Judy van Biljon, University of South Africa. Email: vbiljja@unisa.ac.za
John Traxler, University of Wolverhampton / University of South Africa
Ronell van der Merwe, University of South Africa
Dalize van Heerden, University of South Africa

INTRODUCTION

Digital inclusion is critically implicated in all other operate as mediators to accessing and utilising online resources and services (Nansen, Chakraborty, Gibbs, MacDougall, & Vetere, 2013). Mobile phone technology specifically has introduced a range of new possibilities for economic development, political activism, and personal networking and communication (Walsham & Sahay, 2006). The rapid diffusion of mobile technology in all societies continues to transform the ICT landscape with major potential implications for education (Traxler, 2012). One of the challenges is the development of 21st century information and communication technology skills that enable the optimal use of mobile technology in teaching and learning in every sector, as school teachers are vital actors in the skills development chain in schools (Ford & Botha, 2010; Horizon, 2013; JISC, 2014). There appears to be an underlying assumption that teachers already have the necessary skills, knowledge and attitudes to integrate mobile technology into teaching (MacCallum & Jeffrey, 2009). Yet the frequent use of mobile devices does not mean that all students and teachers have the necessary skills (Corbeil & Valdes-Corbeil, 2007). The need for knowledge and skills development is different and even more acute in resource-constrained teacher communities. Based on a study in an informal settlement in South Africa, Steyn, Rampa and Marais (2013) found that the availability of mobile technology for personal use does not ensure the background knowledge and skills required to make use of ICT in the person's work context. Accepting the necessity for improving mobile digital literacy skills in teacher communities, this research is guided by the question: *How can a mobile digital literacy curriculum be developed using the Design Science research approach?*

Considering teachers from resource-constrained communities as the community whose skills will be enhanced, the study lies at the intersection between Community Informatics and Development Informatics. Published literature distinguishes between Community Informatics and Development Informatics particularly in relation to communication (Walton, 2014). Community Informatics focuses on the community as a complex sociological phenomenon where the term "contemporary community" can refer to real places, as well as virtual existences, and also a combination of the two (Stillman, 2010). Development Informatics on the other hand focuses on the idea that the beneficial uses of ICT need to be maximised to advance development and to gain the commitment to the project of local communities and their leaders (Johanson, 2011).

The DSR methodology was used to govern the selection and application of research methods in this study. DSR seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artefacts, and endorses relevance and rigor as part of the design process (Hevner et al., 2004).

The premise of this paper is that DSR offers an appropriate methodology to design information-based artefacts - including the curriculum itself - in a strategic and holistic way. Studying the implementation context is essential in pursuing development goals (Walsham, 2013) and is also in line with the relevance cycle of DSR. Therefore an investigation was conducted with participating teachers during a Science Week hosted by the University of South Africa. The findings represent views expressed by teachers in the Gauteng province of South Africa on their professional development needs relating to

mobile digital literacy. Having confirmed the relevance of a mobile digital literacy skills curriculum development (henceforth referred to as "the curriculum") and also having gained insights into the context, the curriculum was crafted as an instantiation of the mobile learning framework (MLF) proposed by Botha, Batchelor, Traxler, De Waard & Herselman (2012). The curriculum was evaluated by a focus group of selected experts and again at a workshop with facilitators from Gauteng schools.

Knowledge development and transfer is an essential part of Community Informatics and, sometimes implicitly, curriculum development is a part of many community development programs. Community Informatics focusses on the ability of a particular community to benefit from a particular ICT (Gurstein, 2003) but it does not commonly explore opportunities through the proactive design, development and evaluation of new ICT (Bilandzic & Venable, 2011). Examples of Community Informatics projects include the application of information technology in educational contexts (Mlitwa & Koranteng, 2013); investigating how Pennsylvania's "Classrooms for the Future" policy is implemented in a rural school districts (Stone, 2014); and the adoption of digital publishing tools by educators working in the popular education methodology (O'Reilly-Rowe, 2011). As noted previously, although these projects evaluate the benefits derived from educational artefacts (policies and curricula) they do not look at their design and development.

Realising the importance of both streams of the IS-Research spectrum, Action Research (AR) and DSR have been proposed as two methodologies that address design-oriented issues from a technical, as well as socio-cultural, perspective (Baskerville, Pries-Heje, & Venable, 2007). Considering Community Informatics research, Livari and Venable (2009) advocate a tight coupling between building, intervention and evaluation activities, and extensive participation by key stakeholders (researchers, problem owners, and system users). That is in line with DSR and justifies the selection thereof for curriculum development. Furthermore, DSR as methodology has been used in Community Informatics projects e.g. a project on establishing academic/community relations (Light, Egglestone, Wakeford, & Rogers, 2011) but its use for curriculum development in Community Informatics has not been described in any depth. Therefore the description of the use and usefulness of DSR as a research methodology for curriculum design in Community Informatics is proposed as a novel contribution.

LITERATURE OVERVIEW

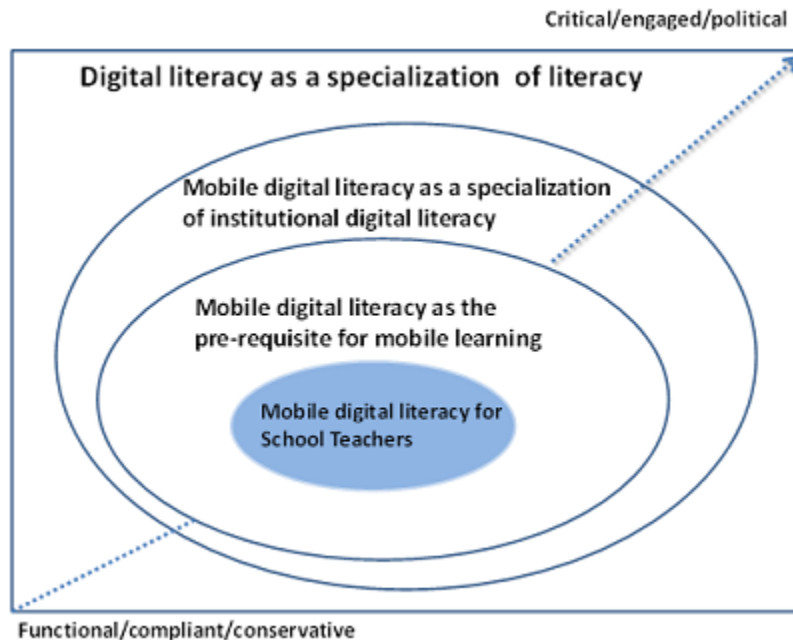
Mobile Digital Literacy

Digital Literacy has been defined as "the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyse and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this Process" (Martin, 2005). Mobile digital literacy is associated with learning with mobile devices (Ng, 2013) and with surviving and indeed flourishing in societies characterised by massive mobile connectedness. The skills and capabilities related to the use, exploitation and potential of mobile devices is a subset of the larger agenda of digital literacy. (Traxler, 2012). Unpacking mobile digital literacy even further, Ng (2011, 2012) identifies not only technical knowledge of mobile devices but also the cognitive and socio-emotional knowledge. Cheung and Hew (2009) summarize the pedagogical uses of mobile technology devices as communication and sharing, investigating, capturing data and analyses, assessing, task management, accessing multimedia and representing meanings. This confirms the technical, the cognitive and socio-emotional dimensions described previously, but on the operational level of curriculum design it is necessary to link those dimensions to a specialization. Considering mobile digital skills, we came across three different, but overlapping, definitions of mobile digital literacy specialization (Figure 1). Mobile digital literacy can refer to any one of a subset of the following:

- a specialization of literacy, the ability and confidence to manipulate a specific symbol set and tool set (not only pens and words but mobile digital technology, its signs and meanings). It is particularly important for societies characterized by universal mobility and connectedness (Traxler 2012).

- a specialization of (institutional) digital literacy (Rodrigues, 1985) and hence contributes to generic academic, social, expressive, employment skills and roles.
- a pre-requisite for mobile learning, is important for institutions taking into account the progression of e-learning towards mobile learning and co-opting mobiles into essentially conventional pedagogies.

Figure 1: Dimensions of mobile digital literacy



For any of these categories, it would be a mistake to assume that mobile digital technology merely passively contained and transmitted learning and knowledge; any technology (especially one as powerful and widespread as mobile digital technology) transforms what is known, what is worth knowing, how it gets to be known, how what is known is transformed, shared, preserved, discussed and distributed. This 'epistemological revolution' must be recognised in the development and delivery of the curriculum. Furthermore, a comprehensive definition of mobile digital literacy should see it as not only underpinning lifelong learning in a mobile society but also subsuming and extending the existing e-safety curriculum (Kritzinger & Padayachee, 2013). This is important for teachers since it builds on parts of the curriculum already in place or under preparation.

These sets of mobile digital literacy skills can be represented by a Venn diagram. Considering the activities and deliberations of the various digital literacy subsets, we find that the teacher community is at the centre of the overlapping sets. Each of these definitions can be interpreted, enacted or delivered in ways that might be functional, compliant or conservative at one extreme, or might be critical, engaged or political at the other extreme. Thus in Figure 1 we have added the dotted line as the third dimension, out of the page, to represent that.

All of the dimensions involve understanding and choice - sometimes between options and sometimes within features. To ensure optimal use, the teacher needs sufficient knowledge to make appropriate choices and connections or must find new ways of engaging with the technologies. As discussed, the need for mobile digital literacy development has been established (Ng, 2013) and MacCallum (2009) calls for research to identify the discriminating variables influencing the adoption of mobile technology by teachers. In the next section we take a closer look at mobile digital literacy curricula.

Mobile Digital Literacy Curricula

A curriculum is a comprehensive plan for an educational training programme or course to fulfil the needs of society (Pinar *et al* 1995). A curriculum is context dependent and informed by the epistemology of the people that develop the curriculum as well as the dominant learning theories that guide the expected learning. Curriculum development has often been seen as the domain of educationists, with limited involvement of stakeholders other than a few subject experts (Taba & Spalding, 1962; Tanner & Tanner 1975). Over the years there have been numerous attempts to articulate explicit curriculum development methods (for example, Brown, 1995; Driver & Oldham, 1986; Walker 1971). In the case of a dynamic, practical skill, such as mobile digital skills, inputs from all stakeholders are critical (Steyn, et al., 2013). In-depth coverage of the ontology of curriculum design is beyond the scope of this paper but it should be stated that philosophy in presenting the content is aimed at in-depth understanding and individual construction of knowledge, so the epistemology of the curriculum is interpretivist and the learning theory constructivism. Note that the philosophical paradigm of the curriculum content may not be the same as that of the curriculum design methodology. The DSR methodology as applied here included both positivist and interpretivist approaches in the relevance cycle and in the design, implementing and validation. In general, it is worth asking about the benefits or otherwise of combining or aligning the various philosophical positions. In this case where positivist and interpretivist positions are at work in these kinds of discussions; there is the possibility that they rest on conflicting or contradictory axiology or epistemology.

There is no South African Qualifications Authority (SAQA, 2014) accredited unit standard for mobile digital skills development. Non-accredited, vendor-related mobile digital skills agendas abound, but the cost and location constraints make these inaccessible for teachers in resource-constrained environments. Furthermore, these may not have sufficient generality, criticality or impartiality for use in education. Towards developing appropriate mobile digital skills curricula for the South African context, Botha et al. (2012) proposed a framework for mobile learning to empower and cultivate an ethical mind set. The following outcomes can be abstracted from their framework:

- Acquire domain knowledge, i.e. understand mobile technologies in education and the relevant issues for active participation.
- Develop skills to enable mobile learning practice, i.e. demonstrate how a bouquet of mobile technologies can enhance teaching practice.
- Understand the role and impact of domain knowledge in relation to the application context, i.e. appreciate the challenges associated with creating content, evaluating mobile technologies and its use in a given context.

The framework is presented modularly so that it can be adapted for different contexts. The fact that it was developed for a South African context makes it particularly relevant to our intended use and therefore it was chosen as a point of departure for the curriculum.

The Design Science Research Approach

According to Hevner et al.(2004), the Information Systems research is characterized by behavioural science and design science paradigms. While the behavioural science paradigm seeks to "develop and verify theories that explain or predict human or organizational behaviour", the design-science paradigm seeks to "extend the boundaries of human and organizational capabilities by creating new and innovative artefacts" (Hevner et al., 2004) . In a seminal DSR paper, Marc and Smith (2014) identify four design *artefacts* and two design *processes* produced by DSR. The artefact is defined in terms of the following elements:

- **constructs** (e.g. vocabulary and symbols) that characterize a phenomenon,
- **models** (e.g. abstractions and representations) that describe tasks, situations, or artefacts,
- **methods** (e.g. algorithms and practices) that show how to carry out activities toward a goal,
- **instantiations** (e.g. prototype systems) are physical implementations.

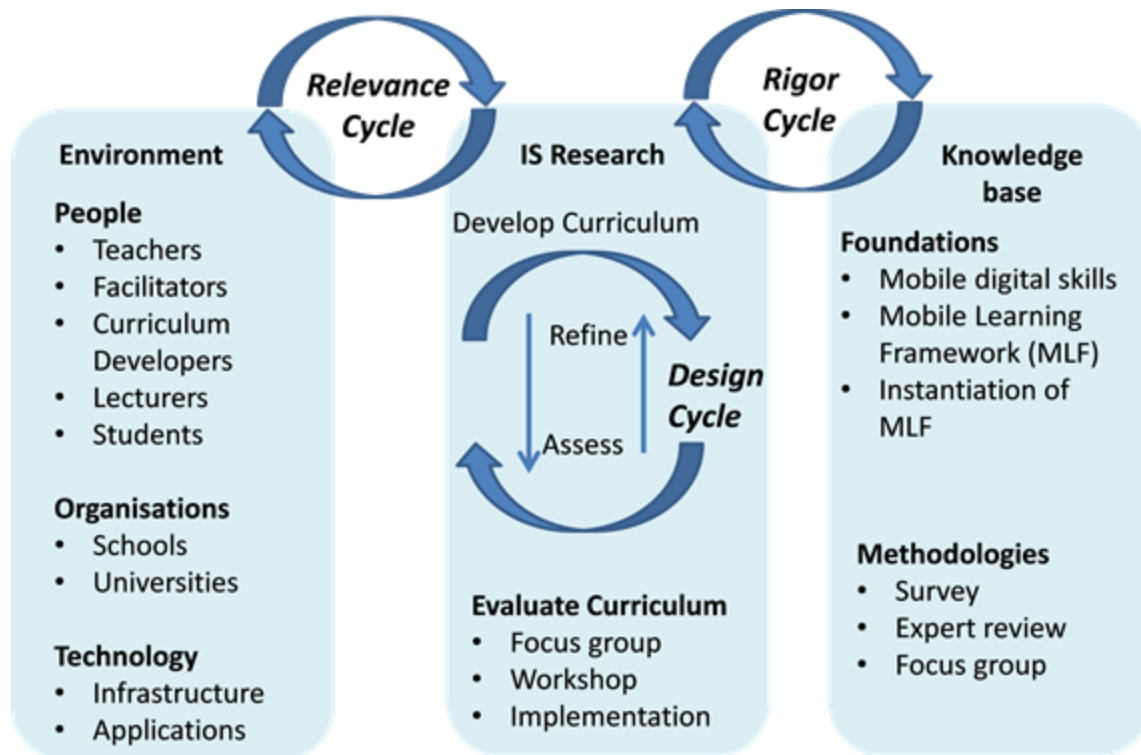
Many IS researchers interpret the explicit guidelines and evaluative criteria for DSR (Hevner & Ram, 2004) as a 'recipe' and hence think of DSR as a 'method' - as opposed perhaps to a methodology, but the purpose-driven creation of artefacts and the introduction of these artefacts into otherwise natural settings shows that DSR has its own particular facets (Baskerville, et al., 2007). Weber(2010) maintains that DSR is a research approach, something between a hands-on research method and a more general philosophy of science, or research paradigm. This means that there is flexibility to use different research methods within a DSR project. The clarity of structure, designated relevance-and-rigor cycles and the flexibility of selecting the data capturing methods made DSR seem an appropriate methodology although it has not often (if at all) been used for curriculum development in Community Informatics.

RESEARCH DESIGN

As stated, the research presented here is guided by the question: How can a mobile digital literacy curriculum be developed according to the Design Science Research methodology?

Ethical clearance was obtained from the Ethics committee of the School of Computing at the University of South Africa. All research participants completed an informed consent form (which allowed permission to use the data) before taking part in the data capturing activities (survey, focus group and workshop). We should of course recognise that research with fluid, powerful, complex and abstract technologies amongst 'naïve' subjects from outside the academy is problematic notwithstanding processes of formal approval (Traxler 2013). The objective of developing an artefact (such as a curriculum) while producing a knowledge contribution (such as testing the DSR methodology in a new context) fits the design science paradigm. Design is proposed as one of the primary modes for engaging in educational research (Sloane, 2006). There are many similarities between DSR and Design Based Research (DBR) (de Villiers & Harpur, 2013) but DSR was preferred due to the detail provided on how to structure the study and implement the different steps. The three successive design cycles namely the relevance, design and rigour cycles advocated by (Hevner et al., 2004; Hevner, 2007) are depicted in Figure 2. The study was designed in terms of a relevance cycle as explained in Section 3.1 and a rigor cycle as explained in Section 3.2 with the design cycle as the basis of the process.

Figure 2: Framework adapted from Hevner, Marc, Park, Ram (2004)



Relevance Cycle Design

In the Relevance Cycle contextual factors relevant to designing a mobile digital literacy curriculum for school teachers were investigated. A survey was used to capture data regarding the teachers, the school and the infrastructure (including technology). Given the importance of technological feasibility (Corbeil & Valdes-Corbeil, 2007) it was necessary to consider the mobile devices that teachers are using when engaging in teaching activities and also for personal use. The survey questions (provided in Appendix A) focused on the following:

- whether primary and secondary level teachers are interested in educational /
- interventions to promote the use of mobile technology in their teaching environments
- the extent to which primary and secondary level teachers use ICT in their teaching
- teachers' attitude towards mobile technology in teaching and learning

Data was gathered at a mobile learning session during a Community Engagement Science Week hosted by the university - a general invitation was sent to all the schools in the area. The Science context might have introduced some bias towards technology, but on the other hand perhaps this group of teachers (who are expected to be early adopters of technology) might voice a need for mobile digital literacy development that could apply to the rest of the teaching population from whence they come. Fifty-three educators responded (43 teachers, 5 school facilitators who were previously teachers and 5 university lecturers). The gender distribution was 43% male and 57% female. The session started with an overview of mobile technology affordances followed by a discussion on specific applications relating to video, audio, images and presentations on mobile technology. Finally an interactive session, using Twitter and Socrative (www.socrative.com) occurred. This was admittedly a format driven by technological perceptions as opposed to sociological perceptions but this matched the expectations of the group. Data was captured during the Socrative session where respondents completed the online questionnaire to introduce them to the application and then created their own questionnaires. Data capturing was limited to closed questions but the participants were observed during the session and the three authors present subsequently discussed

their observations to improve their interpretation of what occurred. The results from the survey are presented in 'Results', below.

Design Cycle

The development of the curriculum as part of the Design Cycle supports a connection between the construction and evaluation of design artefacts and processes (Hevner et al., 2004). The mobile digital literacy curriculum was designed as an instance of the mobile learning framework (MLF) (Botha, et al., 2012). Using the MLF constructs we crafted a curriculum accommodating distance learning and the needs of the teacher community. The first design was followed by two evaluation iterations consisting of the following activities.

Focus Group of Domain Experts

Open and targeted invitations were extended to individuals, ten of whom volunteered their time and expertise for an expert review. These included domain experts in: Open Distance Learning (ODL); ICT provision; curriculum development; facilitators and teachers at Gauteng schools; and lecturers at the university. The procedure was as follows:

- The mobile learning curriculum framework was presented to representatives from the different contexts, namely ODL, technology provision, university lecturers, the Gauteng schools facilitators and teachers.
- The workshop started with an overview of the MLF (Botha, et al., 2012) followed by a presentation of the curriculum as an instantiation of the MLF.
- One representative for each perspective gave feedback in terms of the appropriateness of the curriculum and a reflection on the findings followed.

Workshop with Education Specialists and Facilitators

Subsequent meetings were held with the education specialist in e-learning and curriculum designers from the Department of Education to discuss the practical implementation of the proposed curriculum. The findings are presented below.

RESULTS

Survey Findings

Are primary and secondary level teachers interested in any educational intervention to promote the use of mobile technology as a tool in their classrooms and teaching environments?

According to the responses, 43 of the respondents (81%) replied 'yes' (Appendix A, question 8) and therefore we conclude that there is a need for formal mobile digital literacy courses. To contextualise the course development and decide on the entry level, one would have to take cognizance of the mobile technology used by the teachers. Therefore the next section analyses general ICT use based on the responses from the respondents.

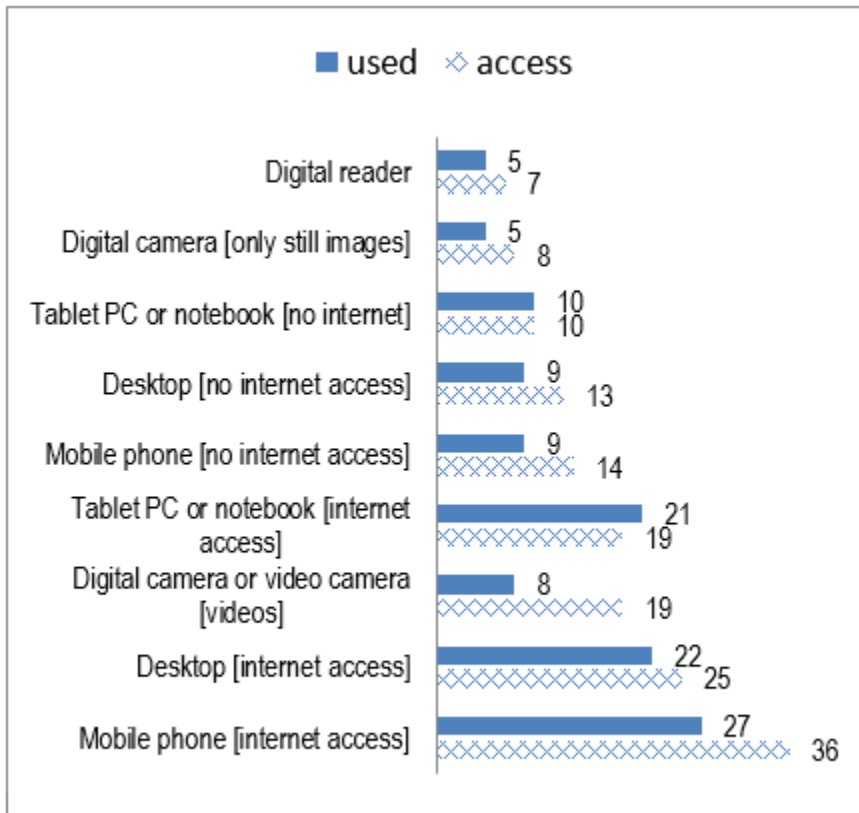
General ICT Usage by Teachers

Concerning the availability of ICT in the school: 37% of the respondents replied that there was a computer laboratory in their school supplied by the department of education; 17% replied that there was a computer laboratory in the school funded by the school's government body and 24% replied that there was a combination of a private laboratory and a laboratory supplied by the department of

education. The fact that 21% skipped this question (a higher percentage compared to that of other questions) might indicate some confusion about the ICT service provision in the school.

Figures 3 and 4 depict the technologies that were available versus the technologies that were said to be used in the classroom. For all the types of technologies, except for Tablet PC or notebook without internet access, the number of technologies used is always less than the number available.

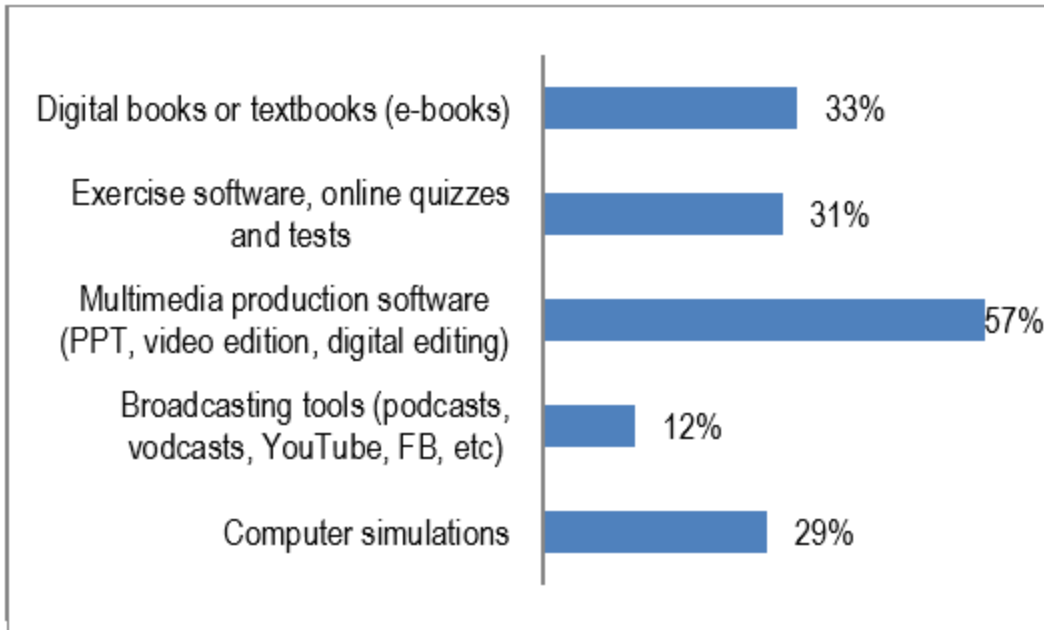
Figure 3: Access to available versus technologies used in the classroom.



ICT Usage for Teaching

To what extent are primary and secondary level teachers using existing ICT as tools in their teaching? Figure 4 depicts technologies used in the classroom and shows that multimedia productions (57%), including presentation software such as MS PowerPoint, are used more in teaching than other technology such as computer simulations (29%) or the creation of broadcasts (podcasts, vodcasts and videos) (12%).

Figure 4: Technologies used in the classroom



Teachers' Attitude Towards the Use of Mobile Technology

Considering the question, 'What are teacher's attitude towards the use of mobile technology as a tool in teaching and learning?' A large majority (81%) of the respondents believe that mobile technology can be used for teaching. This is in contrast with the fact that only 37% allow mobile devices to be used in the classroom. We ought to observe however that any formulation of these kinds of questions has a built in bias - a question that might be logically equivalent is: "Why should mobile technology be excluded from the classroom and from learning in spite of its universality outside the classroom?" but this would presumably elicit a rather different response. The reason for this discrepancy is not clear but one can speculate that a lack of mobile digital skills may be one reason why teachers are not using mobile devices for teaching and learning, despite the fact that they agree with the principle. In summary, the findings confirm the relevance of designing the curriculum for mobile digital literacy skills development and provided some insights on what technology teachers were using (as presented in 'Workshop with Facilitators', below).

Focus Group Findings

The respondents focused on the issues that they consider important; in each case the main insight is mentioned as supported by quotes from the participants where applicable:

Open and Distance Learning (ODL):

The importance of considering the ODL context.

- "Strive for open time and open access but keep it manageable."
- "Consider having portfolio's instead of examinations."

Technology Context:

Many challenges mentioned relating to the stability of the system providing internet connectivity, the lack of ICT support and the power hierarchy in approving changes.

Teachers' Context:

A mind shift is needed as many teachers are wary of using technology for teaching and technology is not an unqualified good.

- "Not all doom and gloom, some teachers are positive about going the cell phone route."
- "Wi-fi is essential as paying for data is a problem."
- "Hands-on how-to course is what teachers need."

Lecturer's Context:

The focus should be on practical issues such as infrastructure and accessibility.

- "The medium is the message."
- "Consider future proofing versus usefulness."

Facilitators' Context:

Many school principals have adopted mobile devices for personal and professional use but there seems to be a lack of adoption at facilitator's level and that was suggested as a good place to start.

- "A mind shift is necessary to see phones in a more positive light."
- "Taking leave to attend lectures may be a problem, online distance learning may be better."

As evident from the quotes, the feedback was on an overview level. Despite the attendees being knowledgeable, positive and responsive, the session facilitator was unable to obtain more specific and detailed inputs. On a methodological level this raises questions about the usefulness of a focus group for evaluating an artefact in detail. Alternatively the use of decision support tools to guide the process could be considered.

Workshop with Facilitators

Meetings were held with the e-learner specialists and facilitators and the following information was obtained:

- Mobile devices have been delivered to some primary and secondary schools in Gauteng for the use of the learners; all are Android devices.
- The devices have WiFi and 3G connectivity. The cost of the 3G connectivity is covered by the state.
- Amongst others, Google applications (gmail, google docs, google sheets and google drive) are preloaded onto these devices.
- The devices have photo and video camera facilities.
- The Google educational sites are available to teachers and learners.
- In most cases the technology was delivered without any training on how to use it.

The current practice of providing technology for teaching and learning without providing skills development initiatives highlights the need for such an organized effort. Clearly stated access and cost implications are important, particularly for financially constrained community development courses.

DISCUSSION

Contribution in Terms of DSR Guidelines

Since the curriculum meets the requirements for an artifact (DSR guidelines proposed by Hevner et al. (2004)), the process of creating the curriculum (might) be seen as being DSR.

Table 1: Application of the DSR guidelines

| Guideline | Application in this study |
|---------------------------|--|
| Design as an Artefact | The mobile digital literacy skills curriculum is the artefact crafted and offered for the first time during the second semester of 2014. See Appendix B. |
| Problem Relevance | <p>This investigation into the professional development needs of teachers regarding the optimal use of mobile technology in their teaching environment revealed the respondents' awareness of the importance of using mobile technology. This is in sharp contrast to the low levels of actual use of mobile technology in their teaching. The fact that the majority expressed interest in a professional mobile technology literacy course indicates that a lack of mobile digital literacy could be an important reason for the discrepancy between the intention to use and the actual use of this technology. This finding is supported by an Australian study which found pedagogically grounded and adequately contextualized professional development vital for time-poor staff, who expressed a desire to set up a professional community of practice (Pegrum, Oakley, & Faulkner, 2013). The following observations and deductions are also noteworthy:</p> <p>Despite teachers expressing an awareness of the need to use mobile technology, the use of that technology in the classroom and learning environment is limited. In some cases participants were unsure about the facilities provided and that may indicate a lack of awareness, lack of infrastructure or lack of technical support.</p> <p>The findings is supported by a study on the acceptance of E-learning by educators in South African secondary schools based on data collected from schools in the Tshwane District of Gauteng province in South Africa. The study found that lack of integration of E-learning in the South African curriculum and poor infrastructure plays significant roles in the educators' acceptance of E-learning (Kabe & Kalema, 2014). Identifying a lack of ICT infrastructure (service providers and available mobile technology devices) and the inadequate skill set among the population of developing countries might be stating the obvious. However, the mobile digital skills deficiency is important in terms of the implications it has for teaching. The devices used are often privately owned so that the infrastructure becomes less important but the skills required remains critical (Dada, 2006).</p> |
| Design Evaluation | The design artefact was demonstrated in a focus group, workshop and by implementing the curriculum. The workshop participants agreed that the curriculum should be offered in a format that allows them to implement it in specific situations in a classroom (see quotes). Throughout the session the participants highlighted that the ICT boundaries, such as internet availability and the limitations of delivery platforms, need to be taken into consideration in the development and implementation of the curriculum. The course was offered for the first time in the second semester of 2014. There were many requests for information on the course but the fact that teachers had to pay was problematic. The course is priced the same as the other short courses but for the other courses funding is less of a problem since the students are funded by corporate training funds. Parts of the course have been offered pro bono but then that is situation based and it defies the objective of being online. During the first implementation three students registered and two completed successfully. |
| Research Contributions | The crafting of a curriculum according to the DSR framework (Hevner et al., 2004) as depicted in Figure 2 contribute to validating the use of DSR in the curriculum development context. We found the MLF (Botha et al.) useful in providing a platform for developing mobile learning curricula in specific contexts but the themes had to be prioritised for the context. Therefore theme 2 (impact of mobiles on the economy) and theme 3 (impact of mobiles on learning) were omitted due to limitations on the notional hours of the module content. |
| Research Rigor | The curriculum was subjected to two evaluation cycles (see Section 3.2) to ensure rigor and it has also been implemented. |
| Design as a Search | The curriculum as an artefact was designed with adequate effectiveness and reference to the laws in the problem environment (DSR requirement) to be approved by the short course learning committee at the University of South Africa and was offered for the first time during the second semester of 2014. |
| Communication of Research | The artefact proved acceptable to technology-oriented audiences and content experts as represented in the focus group. The artefact proved effective to management-oriented audiences since the open distance learning offering provides an effective and efficient solution to mobile digital skills development without disrupting their teaching environment. |

Contribution in Terms of Community Informatics Research

The use of the DSR paradigm for curriculum development provides structure to the research process and was found useful in informing a Community Informatics methodology where design and the evaluation of the artefact is involved. As noted, there are specific guidelines in DSR which often cause it to be seen as a method rather than a methodology or a paradigm. This can be considered restrictive for community development research projects. However, where community education is planned to lead into formal qualifications there is a top-down-meets-bottom-up interface where bottom-up community needs meet top-down qualification certification and that is where the DSR the guidelines and process requirements were found useful in managing the interaction.

The linking of digital skills development in a community with formally accredited qualifications is important in validating the quality of the learning and thereby adds credibility to the qualification.

Considering the two evaluation cycles, it was noted that the focus group of domain experts continuously diverged into new questions instead of focusing on the detail of the curriculum presented for evaluation. The dynamic, lively, yet somewhat unfocused discussion generated useful data but did not meet expectations in terms of evaluating and answering specific questions. In the words of one participant: 'Getting these people to focus on the questions is like herding cats'. Although the participants did not evaluate the curriculum in the detail expected, the general discussions supported the outcomes identified for the curriculum and the syllabus.

This raises a question on the usefulness of focus groups for assessment and the suggestion was made that individual expert reviews may be a better assessment method. Underlying differences in epistemology is a reason why researchers from different disciplines often find it hard to work together (Burrell & Toyama, 2009); that could also have been a disrupting factor in this group. However, given the necessity of getting different perspectives during evaluation (Light, et al., 2011), the inclusion of people from different disciplines will have to be managed through the data capturing strategy rather than avoided.

In summary, DSR was found useful as an approach in guiding the research and allowing the flexibility to choose research methods. However, that flexibility harbours the possibility of choosing an inappropriate method and as such researchers should be mindful of aligning the methods with the expected outcomes. For example, the method should support the outcome, i.e. diverging outcomes (as in exploring and unpacking) or converging outcomes (as in confirming and evaluating). Given the realisation that research from a technical perspective into design-oriented issues should be brought on par with the socio-cultural perspective in Community Informatics (Bilandzic & Venable, 2011) the exploration into the use and usefulness of DSR in Community Informatics with education as application area seems a timely contribution to the discourse on research methodologies in Community Informatics.

CONCLUSION

Curriculum development is a Community Informatics concern. Based on literature and the findings from our survey the teaching community in South Africa is in need of mobile digital skills development. Curriculum design as an iterative process driven by community feedback and the criteria of relevance and rigor fits the design science research paradigm and therefore DSR was used as the methodology. The practical contribution to digital inclusion is the mobile digital literacy skills development curricula in the distance education context. The survey for capturing data with the teachers was appropriate as was the workshop with facilitators but the focus group for evaluating the curriculum with domain experts was less fruitful due to the continually diverging discussion. The use of a decision support mechanism may have been useful in addressing that problem. More research is needed to determine the long term satisfaction of the students who successfully completed the course and employers of the graduated students. The curriculum has been successfully crafted and some important insights have been gained by implementing it, especially regarding the effects of financial constraints. Therefore we propose that DSR be included as one of the methodologies in the Community Informatics research toolkit.

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APPENDIX A: ONLINE QUESTIONNAIRE USED IN TEACHER SURVEY (RELEVANCE CYCLE)

1. In this last year, which of the following devices did you have access to – not necessarily used it in the classroom? (Tick all that are relevant)

| | |
|--------------------------|--|
| <input type="checkbox"/> | Desktop computer, without internet access |
| <input type="checkbox"/> | Desktop computer, with internet access |
| <input type="checkbox"/> | Laptop, tablet PC or notebook without internet access |
| <input type="checkbox"/> | Laptop, tablet PC or notebook with internet access |
| <input type="checkbox"/> | Digital reader (portable device to read books, newspapers, etc. on screen) |

2. In this last year, which of the following devices did you have access to – not necessarily used it in the classroom? (Tick all that are relevant)

| | |
|--|---|
| | Mobile phone without internet access |
| | Mobile phone with internet access |
| | Digital camera that can take only still images |
| | Digital camera or video camera that can take videos |

3. In this last year, which of the following devices did you have access to and used it in the classroom (or used it to create tasks, homework) (Tick all that are relevant)

| | |
|--|--|
| | Desktop computer, without internet access |
| | Desktop computer, with internet access |
| | Laptop, tablet PC or notebook without internet access |
| | Laptop, tablet PC or notebook with internet access |
| | Digital reader (portable device to read books, newspapers, etc.) on screen |

4. In this last year, which of the following devices did you have access to and used it in the classroom (or used it to create tasks, homework) (Tick all that are relevant)

| | |
|--|---|
| | Mobile phone without internet access |
| | Mobile phone with internet access |
| | Digital camera that can take only still images |
| | Digital camera or video camera that can take videos |

5. Indicate which of the following online communication methods do you use (tick all that are relevant):

| | |
|--|--|
| | Send and receive emails |
| | Chatting online (FB, Twitter, BBM, WhatsApp or MXit) |
| | Use online dictionaries or encyclopedia (e.g. Wikipedia) |
| | Search online for practical information (e.g. latest movies, airline tickets, shopping, etc) |
| | Learning with educational software and applications, games and quizzes |

6. Indicate which of the following technologies you have used in your classroom (tick all that are relevant):

| | |
|--|---|
| | Digital books or textbooks (e-books) |
| | Exercise software, online quizzes and tests |
| | Multimedia production software (PowerPoint, video editing, digital recording) |
| | Broadcasting tools (podcasts, vodcasts, YouTube, FB, etc) |
| | Computer simulations |

7. Indicate which of the following methods do use to communicate online with your students and other friends (tick all that are relevant):

| | |
|--|---|
| | Black Berry Messaging (BBM) |
| | WhatsApp |
| | MXit |
| | SMS |
| | FaceBook (FB) |
| | part of the department of education's computer labs, such as Gauteng online |
| | private computer lab operated by the school and SBG |
| | Combination of the two |

8. Answer only *yes* or *no* to each of the following.

| | | |
|-----|---|--|
| 8.1 | Mobile Technology should be used as a tool for teaching and learning | |
| 8.2 | I use Mobile Technology should be used as a tool for teaching and learning | |
| 8.3 | Should a formal course teaching you about the use of technology in the classroom be available, would you pay to do such a course? | |

APPENDIX B: SUMMARY OF THE MOBILE DIGITAL LITERACY SKILLS CURRICULUM

| Short Course in Mobile technology in Teaching and Learning | |
|---|--|
| <u>Target group</u> | People who wish to gain skills in the use of mobile devices to enhance teaching and learning. Applicants require basic mobile phone-, Windows-and Internet skills. A teaching qualification is recommended but not mandatory. |
| <u>Background and need for the SLP</u> | Educationists, teachers and lecturers need knowledge, skills and values to make optimal use of mobile technology in teaching and learning. Currently there is no formal module where this knowledge and competencies are presented, taught and examined in a comprehensive, coherent and complete way. |
| <u>Purposes of the SLP</u> | The main purpose of empowering the person with knowledge and skills to use mobile learning is: <ul style="list-style-type: none"> • To introduce the educator to the unique affordances of mobile technology in the educational context; • To empower the person in educational situations to harness the unique affordances of mobile technologies in an effective and efficient manner; • To critically investigate mobile technology and applications for their usefulness in a given educational context. |
| <u>Tuition method</u> | The UNISA open and distance method for blended learning will be followed. Study material will be provided according to the model for blended learning. At least one compulsory assignment has to be submitted for evaluation and feedback. Feedback will ensure interaction with learners and this may be re-enforced through the use of online discussion sessions and social media technologies. |
| <u>Kind of assessment</u> | Formative assessment will be used in the feedback on assignments. Summative assessment will be implemented in the evaluation of a portfolio. |
| <u>Duration</u> | Semester (6 months) |
| <u>Language medium</u> | English |
| <u>Total credits</u> | 12 |
| <u>Notional hours</u> | 120 |
| <u>Admission requirements</u> | <ul style="list-style-type: none"> • Senior Certificate or an equivalent NQF level 4 qualification • Internet access • Mobile phone (smart phone with Internet access) |
| <u>Level of the SLP</u> | NQF level 5 |

Specific outcomes:

The specific outcomes that a student should reach are:

- To demonstrate a clear understanding of mobile technologies in education
- To demonstrate skills in the application of a representative bouquet of mobile technologies to enhance their teaching practice.

- To show an appreciation for the challenges associated with user created content, evaluating mobile technologies and institutional use and usefulness in a given context.
- To show an awareness of the roles and responsibilities of educators in promoting the ethical use of mobile technology.

Assessment

The specific outcomes are assessed by various methods in identifying, evaluation and applying the gained knowledge.

- Formative assessment will provide the student the opportunity to improve their knowledge by engaging with various forms of assessment that include a portfolio including written essays, peer assessment and projects. These formative assessments contribute towards the semester mark.
- Summative assessment is a compulsory two hour fully online test that is conducted at UNISA.

Syllabus

The syllabus is a combination of different types of knowledge (concepts, processes, contexts) skills and values, and includes the following topics:

Orientation and awareness

- Definition and examples of mobile devices used in teaching and learning. For example the types of devices (e.g. Smart phone, feature phone, low end).
- Best practices in using mobile devices (Mobiquette).
- Ethical and legal considerations in using mobile devices (Creative Commons etc.).
- Cost considerations including infrastructure, operating cost and maintenance.

Exploration of mobile technologies in teaching and learning

- Locating appropriate content
- Creating appropriate content
- Evaluation and sharing content

Applications

- Engaging with content
- Communication

Practical implementation of the use of mobile technologies in teaching and learning in a specific context

- Assessment of the students teaching and learning context
- Development of a mobile technology teaching and learning profile consisting of appropriate services and applications.

Exploration of the educator's roles and responsibilities in the ethical use of technology

- Identify ethical issues in the use of mobile technology in education
- Identify issues in their own context of using mobile technology in education