Design Criteria for Mobile Phones: A Teenagers Perspective

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Abstract: *This study reports on design criteria for mobile phones as developed and implemented by students during a school research project, tasking them to create resources for their disadvantaged peers who have with no access to educational resources and traditional internet capabilities via desktop. Teaching strategies utilized, and events leading up to and culminating in students being critical creators of educational material, factors that influenced their decision making process as well as design features of the artefacts will be covered. Design criteria were negotiated, and articulated and used as a rubric for assessing and scoring entries. Findings indicate that even though they were very competent mobile phone users, they were not confident in their more traditional ICT skills but were very willing to learn. The transfer of concepts and skills from phone to desktop applications was observed.*

Keywords: Mobile Phones, Design Criteria, Multimedia, Teaching Strategies

1.Introduction and background

I am a leader by default, because nature abhors a vacuum. (Desmond Tutu)
Students become leaders when they are confident of their abilities and know what they want and how to achieve their goal. When acting as participants in the mobile design process, they are confident of their abilities and consider themselves as experts and they can identify their assets from personal experience (Mazzone *et al.*, 2008). Today's socially network connected students are not only passive consumers, they actively contribute (Batchelor & Botha, 2009). They have the opportunity, the skill, and the tools to create curriculum content that is relevant to their peers, and, in the process, to liberate their own learning. This paper reflects on students that have stepped into the vacuum created by the lack of infrastructure, educational resources and poverty that is rife in a developing country such as South Africa, by creating artefacts that enhance the curriculum and learning experience for themselves and others. In the process, they found design criteria fit for traditional desktop multimedia ill-suited to mobile phones, due to obvious limitations of screen size and resolution, audio and memory restrictions.

Low cost and affordable mobile phones in Africa are developing a new conduit for learning, and are gradually influencing the way we view instruction. Instructional design suitable for desktop computers does not transfer well to the mobile phone, as was experienced during this intervention. The keynote speaker at the IADIS Mobile Learning Conference 2007, Elliot Soloway, expressed novel ways to include making mobile tools available that allow students to be content creators as much as content users. Much has been made of collaborative work, and on encouraging the creation of content but who is setting the benchmarking for good design of content?

There has been a slow shift in focus from the advantages offered by mobile technology in mobile learning to the development of mobile learning content and the adjustment of instructional content. It therefore becomes imperative to focus on the context of learning as well as the process of learning with these mobile devices. A call has been made for research focus to move more towards articulating content design criteria suitable for educational use (Tsai *et al.*, 2005).

This study investigates the circumstance of learning, the teaching strategies employed and the subsequent design criteria as articulated by senior secondary school students in their quest to design and develop multimedia materials they deemed suitable for learning. It also hopes to understand and describe the process of knowledge acquisition, as well as knowledge creation, in a scientific environment, and the resultant design criteria articulated during the project. Factors influencing the design elements are explored and elaborated upon. It is hoped that the research findings and lessons learnt can inform future studies in the field of instructional design for mobile phones and thus help promote mobile learning.

2.Literature review

"Culture is concerned with establishing ideas. Education is concerned with communicating those established ideas. Both are concerned with improving ideas by bringing them up to date. The problem arises when new information can only be evaluated through an old idea. Instead of being changed, the old idea is strengthened and made ever more rigid." (De Bono, 1970)

A proliferation of new ideas in the arena of mobile technologies and their possible application to formal and informal learning environments has raised some serious questions regarding good pedagogic practice vs. technology research. Instead of viewing these new ideas afresh, we seem to be strengthening existing theories by expanding and amending, as seen when applying e-learning design criteria to mobile phones.

Mobile technology has allowed the traditional boundaries enjoyed by formal learning situations to become blurred with those of more informal learning scenarios. The MobilED initiative focuses on uncovering unique ways in which students use their mobile phones and converse with each other during social-constructivist collaborative events. The distinction between the use of computers with and without connectivity is particularly important in a developing country (Hodgkinson-Williams, 2006). Currently, mobile phones do not play an active role in formal education. If at all, it is for personal use alone. In many schools ,existing policy forbids the use of mobile phones in class, and they are viewed by school management as a security risk and a distraction (Batchelor & Botha, 2009). In an informal learning context, however, mobile phones are used extensively (Kreutzer, 2009).

Theoretical models have been proposed for the adoption and implementation of Mobile learning in developing countries by Barker et al (2005). They see mobile learning as a vehicle to cross the digital divide, as PC penetration is very low in African countries, particularly in comparison to other developing regions. The concern has been raised about whether students

without previous experience of e-learning will be able to reap the full benefits that m-learning can offer.
Brown (2004) differentiated between two classes of mobile student in an African setting. One category consists of first world students with access to the latest in mobile technology, having been exposed to e-learning in the past, and the other being the third-world or remote-areas students, who have access to mobile phones ,but with limited experience in e-learning. The difference becomes more marked with students from the developed scenario often owning their own technology and seeing it as a personal commodity, whereas students from a developing perspective have access, but do not own their own phones.

There is a body of work focussed on formulating guidelines for the design of mobile learning activities and materials. Amongst these are contributions from Pehkonen, Syvänen and Turunen (2003) proposing mComponents – originating from their "Digital Learning 2" project and Ahonen et al (2003). Aspects they focus on are: continuity and adaptability; learning as a personal process; context in learning; accessibility; support for time and learning management as well as flexible interaction.

Collaboration is increasingly becoming part and parcel of teaching and learning. Owing to the proliferation of new technologies, the ways in which students and teachers can communicate with each other have increased and this can lead to spontaneous collaboration. Knowledge becomes less of a bargaining tool and more of a community property (Botha, 2006). New knowledge is created in a social-constructivist learning environment and validated by peer review. This contribution can then be released to a wider audience, and feedback can be processed, starting an iterative cycle of reviewing and contribution. Sharples (2003) indicated the advantages of engaging in a productive conversation around technology when all parties have access to a common external representation of subject matter, allowing them to identify and discuss topics. Jonassen (1995) notes that technology should be used to complete the qualities central to dynamic learning environments, and in accordance Beale (2007) noted that students instinctively maximize the benefits to be gained from technology to enhance their own learning styles. Mazzone, Read and Beale (2008) acknowledge that *"designing with children is often an inspirational activity"* and can give instructional designers a better understanding of the essence required in an artefact.

3.Project overview

Students at a private school in South Africa that have been exposed to the latest technology, teaching practices and amenities over the years, felt the need to share their learning experiences with peers that have not had the same learning opportunities. They decided to create learning objects representing their own knowledge, making it accessible on mobile phones as to their nearly ubiquitous presence. The educator facilitated this by aligning their request with the curriculum. They were subsequently tasked to capture and translate their own learning experience of anatomy dissections into learning objects, using available ICT tools and applications. These learning objects were to contain and reflect the knowledge they deemed necessary to reach the curricular outcomes as stipulated in the Assessment Standards of the Grade 11 Life Sciences syllabus. Because of their prolific mobile phone use, they see

themselves as experts, able to judge multimedia content deemed suitable for phones and were very articulate in expressing their criticism of existing materials.

Each group chose a topic of interest, sourced their own material, planned, coordinated, and executed the dissections, whilst capturing either visual or audio data, or both. They then used various self-selected ICT tools to create and convert resources that could be accessed by a wide variety of mobile technology, licensing their work using *creative commons*. In the process, they also negotiated, articulated, and adhered to their own instructional design criteria relating to media suitable for viewing on mobile phones. The final learning objects were submitted to a peer review process and assessed by the students themselves to set guidelines before being accepted for publishing.

Participants

This study was conducted over a period of 4 months during 2008. The school is situated in an affluent area and functions in a technology-rich environment and participates on an ongoing basis with national research institutions in piloting new technology. The students are well versed in mobile technology and socially aware of the disparities within their diverse society.

Engaging with students and difficulties experienced

They had robust discussions around the levels of acceptance, and through a negotiation process, agreed upon design criteria suitable for mobile phones. The multiple created artefacts were put through a peer review system, allowing a reflective formative approach. They spontaneously formed groups with differing levels of competence in order to accommodate the less ICT literate students. They identified ICT experts and could consult with them during lesson time. Even though they were very competent mobile phone users, they were not as confident in their traditional ICT skills. Context-related limitations had to be overcome, such as unscheduled power cuts which impeded their progress. Goalposts had to be moved as they became more rigid in their levels of acceptance – to comply with their agreed standards they needed more time, as they felt the pressure to do justice to their audience of underprivileged students who were relying on the accuracy of the created content. It was anticipated that difficulties experienced throughout the project would be technology – related; this proved to be inaccurate as these difficulties turned out to be logistical in nature, such as the scheduling of group activities to accommodate teenage diaries. Sourcing the organs needed for the dissections also presented a problem and was related to location in that their affluent area did not cater to or stock the required organs in their butcheries.

The cycles of iterations had to be halted, as students exhausted themselves redoing their work, trying to improve it. It culminated in one student spending hours reanimating a cartoon created in flash that contained a spelling error after the source files had been lost.

A greater transfer of skills was expected from one medium to the next – from more traditional ICT skills to mobile phone skills, and in most cases it turned out to be the other way round as their conceptual knowledge of mobile phone skills guided them in their negotiation and

acquisition of the relevant traditional ICT skills. Students reported being far more comfortable and secure while working on mobile phones than when working on the PC.

4.Design criteria for mobile phones

Students were asked to reflect and evaluate their own design experience. They described the objective as follows: *"We had to create rich multimedia deemed suitable for mobile phones in which we had to look for specific design features."* All documented reflections were collected, coded and themes were identified. The themes below are elaborated as obstacles encountered as well as design criteria suitable for mobile phones.

Lack of storyboarding

Because they had never seen anything like what they were trying to create on mobile phones before, they were confounded as to how to go about planning, selecting relevant materials and subsequently executing the artefact .The design of the artefact became a process of trial and error, reflected as "*learning as we go along*." This sentiment was captured as follows:

" It was extremely difficult to envisage what would be valuable at ***that*** *point in time to know what type of photos to take and what to capture during the dissections ,because we didn't (at that time) know what we would need to make a successful learning object. Our coping strategy was to take as many photographs as possible and then to use only what we deemed useful."*

At the time when these videos were made, the national power grid of South Africa failed habitually due to infrastructure limitations. This proved to be a major problem and impacted their group work schedules, resulting in the timelines having to be extended. Students navigated this by rearranging the group work activities during these blackouts, and relied mainly on their mobile phones for continuing their investigations.

Audience (burden of responsibility)

Their main aim was to keep the target audience in mind constantly and therefore they wrote a short profile of the student at whom their work was directed at. This rich profile description included stereotypical rural learning conditions, desired learning language, levels of difficulty and perceived existing instructional methods, and the lack of learning resources, but with the bonus of access to mobile phones.

They chose a style suitable for their age and made it *"zippy and content rich"* with the added sentiment of "*giving them a worthwhile experience – don't waste their time and show them something they cannot do themselves. Also embed enough content – teach them the correct terminology"* and "*try not to be too obvious, but also include values such as ethics of dissections and safety precautions."*

File size/ length

Student users frugally look after the available space on their phones, negotiating the possible gains of content to the space that it would occupy. This feature trumped all others and was rated as the most important feature, even above content integrity. Shorter clips are easier to download and view, therefore all raw data was compressed before compilation of the artefact. An estimation of 2 MG was judged to be the average file size, as the majority of teenage users were willing to invest that amount of memory. A length of approximately 1 minute was judged sufficient, as the load of new terminology and content covered could lead to *"too much information"* if the length was much longer. It was felt that brevity allowed for quick viewing and efficient learning.

Content

To accommodate the file size limitations and still cover all the required content *"a desired design feature was in creating many separate objects so that quality was good and so that the content could be split up logically into sections but vary the approach to be less predictable." (sic)* The burden of accuracy and validity of created content weighed heavily, as observed in: "*You must be the master of the content otherwise you cannot tell someone something you know very little about."* A short summary was provided to reinforce the content covered.

Attention span

The students indicated that it would be important to grab their attention early on with a captivating title. This resulted in many creative introductions and titles. They accommodated their limited attention span by alternating between voice and music ("*give them a mini break")* to regroup their thoughts and process the new information. This was also evident in the length of the videos which could best be described as *"short and sweet."* The intention was to enable repeated viewing. To achieve this, they did not show images for too long, as the video clip could be paused and they did not want to *"bore"* their audience.

Language and Voice

English was chosen, as most secondary schools in South Africa use it as the language of instruction. They felt a need to practise narration before recording, and spoke slowly, articulated well, and concentrated on correct pronunciation. They preferred a female voice "*as a male voice gets lost when audio is too low and the female voice travels well over small mobile phone speakers."*

Text and commentary

Text needed to be adequate and large enough in relation to the screen size. It had to contrast starkly to the background and therefore a black background with white text was mainly used. It had to be easy to read in a "*large, clear not-too-fancy font."* Minimal writing was required, with only essential terminology used, as "*too much writing is time-consuming to read on a small screen."*

Images

Diagrams or images had to be simple and large so that they could be understood and seen clearly on the limited screen of the phone. They captured the original photograph in bright light so that when compressed, it was still clear.

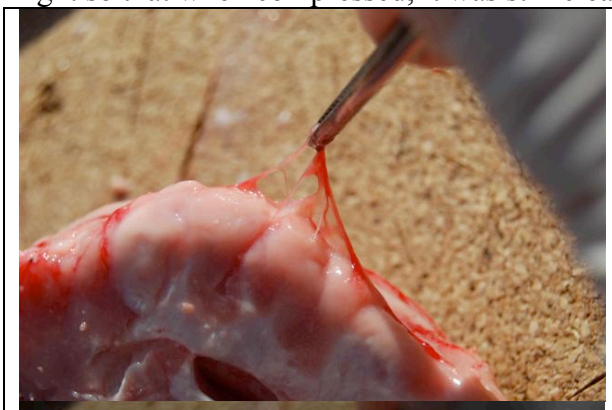

Figure 1
Manipulate photos to highlight specific areas and darken backgrounds to enhance specifics that were being spoken about.

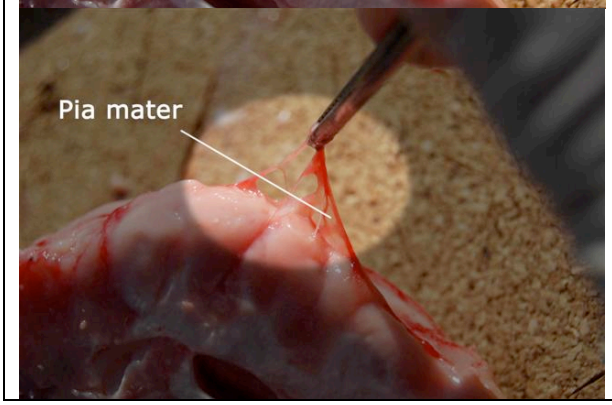

Figure 2
Focus in on areas under discussion by fading or darkening the background.
Write label, and reinforce by pronouncing correctly.

Fun

The fun aspect was crucial, and they used animations or cartoons for introductions and conclusions to make if more entertaining and fun, as well as serve as a trigger for recollecting work by association. It had to be interesting and eye-catching, and they used contemporary music with limited lyrics to minimize distraction from content. It was essential to ensure that all enhancing effects were relevant and to the point being conveyed.

Copyright

They used *Creative Commons* to license and protect their created material, but "*made it available to others for use but also so that they cannot steal from you or provide income to another party."* (sic) They were encouraged to address issues pertaining to plagiarism by acknowledging all sources.

5.Unexpected outcomes

Students were very proud of their work and carried it on their phones to share with their friends, building their own databank of videos. Some of the unexpected outcomes were that a German exchange student copied all resources and took them with her on her return to

Germany and one of the students took some of the videos to a clinic where her father does community service. These were shared with the nurses who, in turn, spontaneously used the video clips to educate their patients in the waiting room. Students also presented their process, work and accomplishments at the e-Summit at CSIR (2008), targeting teachers interested in promoting the use of ICT in their teaching and learning. A reflective comment from one student on the whole experience was: *"This can be the start of something completely new and different – a really great way to learn and grow."*

6.Discussion

Benchmarking good design for mobile phones in creating content for educational purposes proved to be a greater challenge than expected, with a "*few hit and miss"* attempts. It was only by finding out what did not work effectively that the design criteria could be formulated. They established a fine balance between the use of text, audio, and images, whilst constantly keeping the file size and relevant content in mind, creating a memorable learning experience. An added bonus was that they also became aware of their own learning process, as expressed in: *"Ultimately they were study tools, and being students ourselves, we had firsthand knowledge of easy ways to remember things or materials, and thus transferred this knowledge to others by means of diagrams, labels, and explanations."*

Findings indicate that even though they were very competent mobile phone users, they were not confident in their more traditional ICT skills, but were very willing to learn. The transfer of concepts and skills from phone to desktop applications was observed.

The strongest motivating factor during the project was the prospect of redressing social injustice by making a personal contribution to the liberation of their underprivileged peers as "*our tools had to leave a long and lasting educative message."* One student reflected on the process as follows: *"Personally, I believe this is the most valuable project we have been required to do, as it is not only a mark, it is a life-changing learning tool which could eventually help many children in our community."*

In the design of learning events, it is always imperative to place the needs of the students first. Skills need to be mastered and the curriculum needs to be completed in a set period of time. This requires extensive planning, as the event must be completed, independently of functioning technology. Teachers often know less than students about technology and applications, but are masters of the curriculum so they complement each other to create a dynamic teaching and learning environment. This requires both parties to be honest and open about their limitations and these need to be communicated in advance. Students often have greater respect for teachers who admit their own lack of proficiency in the area of technology. They still require validation as a form of acceptance. Even though teachers might not always be equipped to help with the technology aspects, the students will not think less of them, and they remain invaluable in confirming the work and accomplishments of the student.

7.Conclusion

The ability to connect to a wider world makes teaching more relevant to current local needs, resulting in increased awareness by student of local and global trends. The relationship between students and teachers has become inversed, challenging traditional knowledge structures, with students becoming active participants in co-constructing knowledge. They are skilled in accessing and navigating large quantities of information, filtering, reworking, and scripting it to suit their own curricula. The students in this study presented themselves and their work on a world stage and promoted their own work with a resultant pride in their teachers and in their own capabilities.

They rose above their own limitations through the use of technologies, liberating themselves from the role of student to that of expert teacher. They also liberated themselves from their mostly passive teenage perspective as well. They were able to question and evaluate existing multimedia design on mobile phones without blindly following criteria as observed - because there was no anchor they had to set the benchmarks for themselves.

A student went even further, reflecting on long-term prospects of the project, remarking: *"It is a project also suited to preparing for the future, as eventually books will be replaced by technological devices; it gave us a chance to become more computer literate and allowed us to expand our knowledge of the subject itself."* In allowing the students to create new knowledge using the tools of their choice and evaluating them to contribute to the learning of others, their own learning acquired new meaning. **Preparing for an unknown future with unknown technologies is ultimately the goal of education.**

We would like to thank and acknowledge the students from whom we ultimately learned the most.

References

Ahonen, M., Pehkonen, M., Syvänen, A., & Turunen, H. (2003). *Mobile learning and evaluation. Digital learning 2*.

Barker, A., Krull, G., & Mallinson, B. (2005). A *proposed theoretical model for m-learning in developing countries.* Paper presented at the M-Learn, Cape Town.

Batchelor, J., & Botha, A. (2009). Liberating learning. *Educational Association of South Africa*. Amanzimtoti, South Africa.

Beale, R. (2007). Ubiquitous learning or learning how to learn and you'll never have to learn anything again? In I. Arnedillo Sánchez, M. Sharples & G. Vavoula (Eds.), *Beyond mobile learning workshop* (pp. 64-69): Trinity College Dublin Press.

Botha, A. (2006). The use of mobile phones to mediate a design experiment in a secondary school: University of Pretoria.

Brown, T. (2004). The role of m-learning in the future of e-learning in Africa. In D. Murphy, R. Carr, J. Taylor & W. Tat-Meng (Eds.), *Distance education and technology: Issues and practice* (pp. 197-216). Hong Kong: University of Hong Kong.

De Bono, E. (1970). *Lateral thinking*. London: Penguin group.

Hodgkinson-Williams, C. (2006). Revisiting the concept of ICT's as 'tools': Exploring the epistemological and ontological underpinnings of a conceptual framework. *ITFORUM*.

Jonassen, D. H. (1995). Computers as cognitive tools: Learning with technology, not from technology. *Journal of Computing in Higher Education, 6*(2), 40-73.

Kreutzer, T. (2009). *Generation mobile: Online digital media usage on mobile phones among low-income urban youth in South Africa.* Unpublished Dissertation, University of Cape Town, Cape Town.

Mazzone, E., Read, J., & Beale, R. (2008). Understanding children's contributions during informant design, *Workshop at HCI*. Liverpool BCS.

Pehkonen, M., Syvänen, A., & Turunen, H. (2003). *Fragmentation in mobile learning.* Paper presented at the mLearn, London, UK.

Sharples, M. (2003). Disruptive devices: Mobile technology for conversational learning. *International Journal of Continuing Engineering Education and Lifelong Learning, 12*(5/6), 504-520.

Tsai, I. H., Young, S. S. C., & Liang, C. H. (2005). *Exploring the course development model for the mobile learning context: A preliminary study.* Paper presented at the IEEE (ICALT'05).