Mix and match content architecture for themes of the day

N. Dlodlo
CSIR-Meraka Institute
South Africa
Email: ndlodlo@csir.co.za

JP. Tolmay
CSIR-Meraka Institute
South Africa
Email: jtolmay@csir.co.za

S.U. Mathaba
CSIR-Meraka Institute
South Africa
E-mail: smathaba@csir.co.za

Abstract

Most of the education content in use in the South African e-learning environment is obtained from outside our borders. This would mean that our primary and secondary school learners struggle with concepts that are authored externally and therefore are not customised to their environment. The issue is to come up with ways to develop and provide digital content that is locally developed by taking advantage of the expertise of local teachers and their experiences in the local education environment and the available information and communication technologies (ICT). There are good teachers who could contribute to local education content by collaboratively working together with the government. The concept of fixed content that is delivered through proprietary software is a thing of the classroom of yesterday. Today's world is about digital content that can be mixed and matched to fit the theme of the day. Therefore it is necessary to come up with a way of how this mix and match of digital content that is generated by the teachers can be achieved. That would mean that the good teachers, sitting in their schools can develop digital content which will be stored in the Department of Education (DBE) database and can then be accessed as and when needed and put together to produce the required content for the day. This content can then be accessed by the learners for an enhanced quality of education. The population of learners that can benefit from this is quite large. The learners are encouraged to actively participate in the identification of content that would be suitable to understand concepts – a learner-centric approach to learning. This research describes an architecture that is based on a Mashup application technology. A Mashup is an interactive web page that uses and combines data or functionality from two or more sources to create entirely new and innovative services. Miniature objects that offer content are created by the teachers remotely from their various locations. This content is specific to the DBE curriculum as specified in the National Curriculum and Assessment Policy Statements for the various subjects and grades. The content is stored in a private cloud sanctioned by the Department of Education. Once a teacher creates content, the system notifies learners of the updated content via an SMS and the learners can access this content via their cell phones.

Categories and Subject Descriptors
H.4.3 Internet

H.3.4 WWW

General Terms
Design.

Keywords
Digital content, mobile education, WWW, Internet, Mashup, cloud, curriculum.

1. Introduction

The South African Department of Basic Education (DBE) is guided by "The Action Plan 2014: towards the realisation of schooling in 2025". Schooling 2025 within which the Action Plan is located represents South Africa's long-term vision for education. One of the components of the action plan is providing Information and Communication technologies (ICTs) at all levels of education. The Action Plan is also guided by the e-education white paper of 2004, which states that every child, manager and administrator should be ICT-literate by 2013. It takes into cognisance that ICT is not only about a computer in class but a variety of other technologies. Therefore the effort is to ensure that every corner of the country's schooling system has some form of ICT. Connectivity and availability of content to be delivered through ICTs are the drivers of ICT integration.

A feasibility study was conducted in 2007 on the possibility of implementation of the e-education white paper. It looked at issues that cut across the classroom of the future such as the costs of a secure infrastructure for ICT equipment, hardware and software, broadband access, curriculum support and innovation, professional development, electronic and online learning support material and support services. The Directorate of Curriculum Innovation in the DBE was set up specifically to improve schools' efficiency and functionality. They support provinces and other units of the DBE to improve the quality of teaching and learning. One of the output targets of the Unit is that 50% of the e-content should be developed locally. Unfortunately, currently the schools that have ICTs have to look outside our borders for content. The Thutong Portal, for example, has a lot of content that is borrowed from other countries. The Directorate is running a number of projects in 2011-2012. One of these is to increase the quality and quantity of locally developed electronic resources. The Thutong's access and usage as a curriculum supporting tool will be expanded. The Directorate's outlook is to put a computer laboratory in every school. The TV channel will be used for professional development and for extra lessons for learners. Mobile platforms will provide accessible mathematics tutoring for learners. Affordable technologies will be provided for blind learners, and farm and rural classrooms. The Directorate is in the process of setting up ICT resource centres in provinces. Service providers have been identified for the use of Telkom lines for toll-free curriculum downloads and interactive voice systems to download information on the curriculum.

In terms of content production, this research says it would mean that the good teachers, can develop content which will be stored in the Department of Education

database and can then be accessed by other teachers as and when needed and put together to produce the required content for the day. This content can then be accessed by the learners for an enhanced quality of education. The whole population of learners will definitely benefit from this approach, and more so, those that do not have qualified teachers in their schools.

This paper reports on research the architecture of a system that can enable learners to obtain the mix and match curriculum. This concept can be made possible through Mashup applications in conjunction with technologies such as the private cloud, mobile applications and a learner-centric approach. Mashups define applications that use and combine data, presentation or functionality from two or more services to create new services. This means that the teachers can mix and match curriculum content for specific subjects and grades to match the themes of the day.

The next section in this paper is on the methodology adopted in this research. The next section thereafter gives an overview of the relevant technologies such as the cloud, Mashup applications, learner-centric education and mobility in applications. The following section describes the architecture of the mix and match technology. The next section is a discussion on the impact of the architecture, followed by the conclusion.

2. Methodology

The research is in the area of design in a laboratory set-up.

2.1 Purpose of study

The question that this research answers therefore is “What technology can make it possible for content that is to be delivered to primary school children to be developed locally, easily accessible and available and of the right quality”. The objective therefore is to design a technology that will enable the teacher to mix and match content that meets the theme of the day.

2.2 Process

The paper develops how the architecture of a technology that will enable qualified teachers to develop curriculum content from their remote stations, upload it into the DBE for storage in a private cloud. Learners are notified of the new content that has been added by the teacher via their mobile phones. The learners search for content that is related to the curriculum of the day automatically. This research designs a technology of ensuring that teachers can search, and mix and match the educational content for the day and learners can access it. The technology is based on Mashup application technology, Also included is mobile technology in the form of cell phones. To store the contents generated, a private cloud that is owned by the DBE is utilized.

ISBN: 978-0-620-51918-2

3. Related work

3.1 Mashup applications

Mashups are simple web-based applications that result from the integration of content, presentation and application functionality stemming from disparate web sources to provide new functionality. In mapping Mashups, for example, data about things and activities are mashed onto maps. Search and shopping Mashups use combinations of business-to-business technologies to aggregate comparative price data. Various Mashup tools such as Yahoo pipes, Google Mashup editor, igoogle, WS02 Mashup server, IBM Mashup Centre 3.0, ARIS MashZone, Convertigo and Microsoft's Popfly facilitate the mashing up of components via simple graphic or textual user interfaces, sets of predefined components, abstractions of technicalities and similar. A Mashup application is architecturally composed of three different participants that are logically and physically disjoint, separated by both network and organizational boundaries. These include providers of content being mashed, the Mashup site where the Mashups is hosted and the client's web browser.

The challenge that Mashup developers face is deriving semantic meaning between heterogeneous data sets. Mashup developers and content providers also need to address security concerns. One of the biggest social issues facing Mashup developers is the trade-off between the protection of intellectual property and consumer privacy versus fair-use and free-flow of information, Daniel (2009: 45-60). The current scenario in the development of Mashup environments is usually characterized by two main challenges: (i) the definition of mechanisms to solve composition issues such as interoperability of heterogeneous components or their dynamic configuration and composition and (ii) the provision of easy-to-use composition environments.

The educational purposes of Mashups are to, Nash (2011):

- Enhance instructional content
- Engage with the material on a deeper level
- Explore and uncover previously unsuspected aspects of data
- Open up a new world through new ways of seeing familiar things
- Discuss, debate and share insights and resources of information
- Develop analytical skills

3.2 Cloud

The emergence of very large "data farms", that is, specialised data centres that host thousands of servers has created a surplus of computing resources that has come to be called the cloud. The cloud is the term for networked computers that distribute processing power, applications and large systems among machines. It refers to a 'remote data centre". That is, computing is no longer on local computers but on centralised facilities operated by third party that hosts computing and storage facilities, Foster (2011). Cloud computing transforms once-expensive resources like disk storage and processing cycles into a readily-available cheap commodity. Cloud computing is the delivery of scalable IT resources over the Internet, as opposed to

ISBN: 978-0-620-51918-2

hosting and operating those resources locally, 7 things you should know about cloud computing (2011). Those resources can include applications and services, as well as the infrastructure on which they operate. Cloud-based applications do not run on a single computer; instead, they are spread over a distributed cluster, using storage space and computing resources from many available machines as needed.

A public cloud refers to deployment models in which the control and management of cloud resources resides with the providers and are outside any customer's firewall. Private cloud offerings are those in which the control of the cloud resources is located within a particular firm – inside its firewall, Kushida (2010). With external cloud offering , the physical cloud computing resources are located outside the customer's premises. Internal cloud offerings entail the management structure and infrastructure residing within the customer's physical buildings.

In a private cloud, the infrastructure for implementing the cloud is controlled completely by the enterprise. Typically, private clouds are implemented in the enterprise's data centre and managed by internal resources. A private cloud maintains all corporate data in resources under the control of the legal and contractual umbrella of the organisation. This eliminates the regulatory, legal and security concerns associated with information being processed on third party computing resources.

3.3 Learner centric education

ICT-enhanced learning promotes increased learner engagement and "just-in-time" learning in which learners can choose what to learn and when they need to learn it. It also encourages interaction and cooperation among learners apart from real-world interactions, How can ICTs help transform the learning environment (2011).

Instruction changes from being teacher-centred and content-driven to learner-centred and learning-process driven. The student's role changes from that of being a passive recipient of the teacher's knowledge to that of an engaged learner and active agent in the learning process. The instructor's role expands from that of a knowledge-laden teacher who disseminates factual information, to that of a mediator or facilitator who assumes the role of designing learning tasks, coaching students, evaluating student outcomes and creating an environment that is conducive to student participation. In the learner-centred paradigm students spend less time being "instructed" and more time engaged in learning activities that involve them doing activities other than writing notes, The case for learner-centred education (2011).

A learner-centred approach to teaching incorporates teaching strategies that focus on the needs, preferences and interests of the learner. This approach is desirable because it helps learners to become actively engaged in the learning process, take responsibility for their learning and enhances their skills to learn "how to learn". One way to help learners learn "how to learn" is to develop learning tasks that actively engage them and help them develop high order skills such as problem-solving and critical-thinking skills. Active learning is grounded in the constructivist theory that emphasises hands-on, activity-based teaching and learning during which students develop their own frames of thought. Constructivist theory assumes three basic principles that include: (a) learners forming their own presentations of knowledge; (b)

ISBN: 978-0-620-51918-2

learning through active experience and exploration that uncovers inconsistencies between current knowledge representation and their own experiences; and (c) learning within a social context, with interaction between learners, peers and other members of the learning community Keengwe (2009: 11-22).

The benefits of learner-centred education according to, What is learner-centred education? (2011) and Learner-centred education (2011) are:

- The instructor is a facilitator and coach, not a teacher
- The students are responsible for their own learning
- Emphasis is put on the learning process rather than the content
- The learner is an active participant in the learning process
- Emphasis is put on the ability of the learner to judge and evaluate
- Learners gain a strong knowledge base and develop learning skills and independent decisions. Students construct knowledge through gathering and synthesizing information and integrating it with the general skill
- Emphasis is on communicating knowledge effectively to address enduring and emerging issues and problems in real-life contexts
- Learners are motivated to actively participate in the learning process
- Different learning styles are accommodated since the learner-centred classroom offers a tailored program for each student
- Each learner's contribution is an integral part of their classroom experience

Constructivism is a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in. Each of us generates our own rules and mental models, which we use to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences, Constructivism (2011). Constructivist teaching is based on the belief that learning occurs as learners are actually involved in a process of meaning and ante knowledge construction rather than passively receiving information. Constructivism draws on the developmental work of Piaget. Piaget, Gray (1997), asserts that learning occurs by an active constructing of meaning rather than passive recepience. He explains that when we, as learners encounter an experience of a situation that conflicts with our current way of thinking, a state of disequilibrium or imbalance is created. We must then alter our thinking to restore equilibrium or balance. To do this, we make sense of new information by associating it with what we already know, that is, by attempting to assimilate it into our existing knowledge. When we are unable to do this, we accommodate the new information to our old way of thinking by restructuring our present knowledge to a higher level of thinking.

3.4 Mobility

Mobile technology is, as the name implies , a technology that is portable. Examples of mobile devices include laptops and computers, digital assistants, mobile phones, global positioning systems (GPS) and wireless debit/credit card payment terminals. Mobile devices are enabled by a variety of communication technologies such as Wi-Fi, Bluetooth, 3G, GSM, GPRS, dial-up services and virtual private networks.

ISBN: 978-0-620-51918-2

The expansion of networks and the decreasing price of handsets are key drivers to more people using mobile phones. SMSs have become part of everyday life and improving communication. Thanks to SMS technology, farmers in rural areas can obtain market prices for their goods using mobile phones. Mobile phone users get SMS reminders to take antiretrovirals (ARVs). A lack of other communication channels such as fixed lines and computer has led to the rapid adoption of SMS in Africa.

Mobile technology has mobilized human interaction in all dimensions by supporting mobile collaboration [3]. As collaboration is key to learning in today's educational environment, mobile technology has the potential of supporting and improving education and its delivery. Mobile education can be defined as " using any service or facility to provide a learner with general electronic information and educational content that aids in the acquisition of knowledge regardless of location and time". educational material can be delivered via SMS using mobile devices. The delivery of educational materials through mobile can eliminate time and space constraint in learning and provide freedom for learners.

Three reasons to focus on mobile technology are:

- Mobile applications are easier to adopt. Designing applications for mobile devices result in high-level focus on core functionality due to constraints of the platform (e.g. small displays, low-processing power, small keyboard)
- PC penetration continues to be poor in comparison to mobile phone penetration. In South Africa, PC penetration is 16% while mobile penetration is 100%.
- Mobile Internet access is higher than broadband access.

Some of the unique properties of mobile devices that make them appealing for education use among others include: portability, social interactivity, availability, context sensitivity, connectivity and individuality The portability permits the learners' mobility and makes information access more convenient for the learners. The availability of the devices for learners can offer the students opportunities to work on academic projects individually, to support group projects or even explore work with fellow students. Mobile devices can both gather and respond to real and simulated data unique to the current location, environment and time, thus they can be context sensitive.

4. Proposed architecture

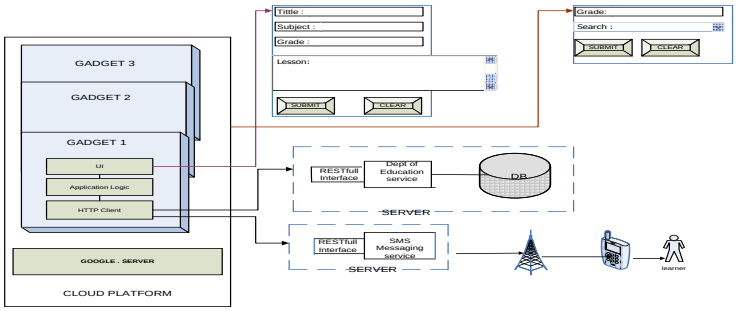
The proposed architecture of the mix-and-match system is depicted in Figure 1. The architecture is based on igoogle. Igoogle is a "portal service" that hosts a Mashup application or gadgets. It is a customised Google page, that sits on a Google server and which allows a user to create a custom page by having or adding various gadgets to produce a completely different functionality. In this case the developers create the gadgets. Gadgets are miniature objects that act as a template to the content that can be captured. The teachers load these various gadgets onto their customised igoogle pages. Each teacher uploads multiple gadgets onto their i-google customised page to produce a completely different service. Fields in the

ISBN: 978-0-620-51918-2

gadget guide the teacher as to what content they can capture. The teacher logs onto i-google and adds content through this template or user interface (UI). The template or user interface looks like a form with a title field, grade subject, lesson, submit and clear fields. The filled in template is submitted to the DBE server. The application logic in the gadget has an http client. The http client connects to the DBE database through a restful interface to put the captured content into the database. Although the teacher sees the user interface to the gadgets, the gadgets themselves sit on the Google server. The Google server is on the Google cloud and the DBE server on a DBE private cloud.

The SMS messaging service alerts the learner when new content is added by the teacher into the DBE database. The SMS messaging service is on an SMS server and provides the service through a restful interface. A restful interface is a particular protocol that interfaces with the server. The client software on the gadget uses an http client to connect through this restful interface. The client software on the widget uses http to connect through a restful service to put content onto the SMS messaging service.
The learner's gadget to search for contents of the day also has a user interface that has the grade, search, submit and clear. The learner's gadget is accessed through their cell phone.

Figure 1: The proposed mix and match architecture



5. Discussions

Content is better understood by learners if they can identify with it. Therefore the issue of e-content being predominantly obtained from sources outside our borders poses a challenge for South Africa and its learners. It does not mean though that we haven't got the human resources to develop our own customised content, but it is a question of mobilizing those resources. This research is a step in that direction.

So much effort has been put in by the DBE to ensure an ICT-centric learner and teacher. The Action Plan, the e-education white paper, the establishment of the

ISBN: 978-0-620-51918-2

Directorate of Curriculum Innovation, professional teacher training in ICT integration, and the like all need to be complemented to produce a learner and teacher who take full advantage of technology. This research complements these efforts.

South Africa has a mobile penetration of 100%. Mobile usage is currently a youth-centric culture. It is for the same reason that this research takes advantage of mobile technology in its proposed architecture. The experiential learning approach suggested in this research is a vital tool for learners to create their knowledge.

The paper uses open source environment for the development of the system. This cuts down on the costs of development of the system.

6. Conclusions

The paper proposes an architecture that will enable learner to mix and match content that will meet their requirements to understand the lesson of the day using cell phones. The content is produced by expert teachers who sit in different locations. The system that is proposed in this paper has not been fully implemented yet, but some of its components are functional.

7. References

Constructivism, Available http://www.funderstanding.com/content/constructivism, (accessed 10 April 2011).

Daniel, F., Matera, M. 2009. Turning web applications into Mashup components: issues, models and solutions. In *Proceedings of the 9th conference on Web Engineering ICWE 2009, Berlin, pp. 45-60*

Foster, I., Zhao, Y., Raicu, I., Lu, S., Cloud computing and grid computing 360-degree compared, (accessed 10 April 2011)..

Gray, A. 1997. Constructivist teaching and learning. SSTA research centre report #97-07, Available http://saskschoolboards.ca/research/instruction/97-07.htm, (accessed 10 April, 2011).

How can ICTS help transform the learning environment into one that is learner-centred?, Available http://uva-weblearn.net/learner-centric-technology.asp, (accessed 10 April, 2011).

Keengwe, J., Onchwari, G., Onchwari, J. 2009. Technology and student learning: towards a learner-centred teaching model, AACE Journal, 17(1): 11-22.

ISBN: 978-0-620-51918-2

Kushida, K.E., Breznitz, D., Zysman, J., Cutting through the fog: understanding the competitive dynamics of cloud computing, The Berkeley Roundtable on the International Economy (BRIE) Working Paper 190 (Beta), May 1, 2010.

Learner-centred education, Available http://socyberty.com/education/learner-centered-education/, (accessed 10 April, 2011).

Nash, S.S., 2011, Educational uses of Mashups, Available at www.nmc.org/.../Educational%20Uses%20of%20Mashups-nash-v2.ppt, (accessed 10 April 2011).

Sheng, h., Siau, K, Nah, F.F. 2010. Understanding the values of mobile technology in education: a value-focused thinking approach. *The DATA BASE for Advances in Information Systems.* 41, 2, 25-44.

The case for learner-centred education, Available at http://www.oncourseworkshop.com/Miscellaneous018.htm, (accessed 10 April, 2011).

What is a learning-centred education?, Available at https://www4.nau.edu/assessment/assessment/liberal/documents/What_is_Learning_Centered.doc, (accessed 10 April, 2011).

7 things you should know about cloud computing, Available at http://www.educause.edu/Resources/7ThingsYouShouldKnowAboutCloud/176856, (accessed 10 April 2011)..

ISBN: 978-0-620-51918-2