THE STUDY AND APPLICATION OF IMS LEARNING DESIGN SPECIFICATIONS IN A MOBILE, FIRST NATIONS CONTEXT

BY

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DEDICATION

I would like to dedicate this essay and the to my family for all of their support, encouragement, and tolerance through this whole educational process as they endured my struggles down this long, winding, and entirely fulfilling road.
ABSTRACT

This essay is a study of how IMS Learning design specifications may be applied on mobile devices, specifically in the context of usability issues experienced by First Nations. The goal is to create learning modules that conform to the IMS Learning Design specifications as well as provide these modules using mobile delivery mechanisms (via the Internet, for example). A small prototype will be built using the modules designed. The learning modules will be designed with context in mind, drawing from local knowledge concepts to ensure that the content is relevant for their learning needs. With the pervasiveness of Internet connectivity, there is the ability for learners in remote communities to have access to learning materials remotely. As this is a recent development, the majority of the learning tools available are in their infancy of development. There is a need to provide learning materials that are pedagogically sound and are also able to be delivered over a medium that is low in bandwidth and sporadic in availability to devices that are mobile in nature (laptops, handheld devices, legacy systems).
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CHAPTER I
INTRODUCTION

Purpose of This Study

There are many current delivery mechanisms for the distribution of online learning materials remotely. Many of the delivery mechanisms for the distribution of online learning materials do not follow a standard methodology, and because of this, there is little or no portability of these materials between implementations. With the increase in mobile technology usage as a medium of access, the purpose of this essay is to investigate the process of using IMS Learning Design Specifications, specifically the research and possible application of these specifications in a mobile context.

Online Learning Systems

Online Learning systems are still in the early stages of the development cycle. In order to provide learning systems that are pedagogically sound, provide contextual data, and adaptability in a mobile sense, more research is needed. Malek, Laroussi, & Derycke (2006) describe the evolution of education as “a move from d-Learning (distance learning) to e-Learning (electronic learning) to M-learning (mobile learning)”. This is a concise summary of the progression of education into a new paradigm. Universities, colleges, even high schools are making the transitions necessary to allow for mobile and collaborative learning via networked media. As this transition is made, there is a cry for standardization, to allow for non-competitive educational institutions to share learning materials, for the sake of reusability, extensibility, and to allow learners to adopt a standard that they may use regardless of the environment they interact with, be it the device, the software, or the institution. If someone is learning using Information and Communications technology it can
be said that they are partaking in the process of e-learning. M-Learning or mobile e-learning is e-learning that is delivered through mobile devices such as Palms, Windows CE devices, digital cell phones, MP3 players, iPhones, etc. Mikic and Anido (2007) state that m-learning will aim at specific kinds of knowledge depending on location, situation, device, and learner. This leads to a high level of independence, as the learner is able to tailor their education into an “anytime-anywhere” lifestyle.

Sampson, Gotze, and Zervas (2007) define three main limitations to the development of m-learning:

- Device limitations – small screens, limited storage, limited processing.
- Connectivity limitations – with wireless networks, bandwidth will deteriorate as more users are added to the network
- Design considerations – there is a lack of common platform specifications

Rationale for Research

This essay explores some of the possible solutions to the issues and limitations described above, offering a relational database model that allows for the input of contextual data that is adaptable to the content, and to the users (learners and teachers) of the system. Additionally, a methodology regarding the ability to provide further adaptability with mobile devices is provided. There are a number of benefits to creating systems that are adaptable to different contextual learning environments. Much research has been initiated in the area of IMS LD template creation. This is a useful exercise as it allows materials to be created that are independent of pedagogy, which allows for many different methods of delivery. The next logical step from here, once the standardization of content creation has been established is to provide material that is highly relevant to the individual users who are accessing the material.
That is to say individually, each user may experience the learning process, navigating through learning objects, in a personalized way. This is made possible by including course content that is specifically contextual to learners in the system. If learners are accessing material online, they must have a device that allows connectivity to the material and the delivery of material through that medium (whether it be a desktop computer, laptop, PDA, cellular phone or smart phone). A system that is able to adapt to any networked device that has internet access and provide material through that medium in a meaningful way to the user fits into the much desired “education anytime, anywhere” paradigm. The more contextual and adaptable the system is to the education process, the more pervasive it will become. The purpose of the research performed in this essay is to create a prototype system using IMS LD that is contextually relevant to the users who are enrolled in a course, and adaptable to the plethora of devices, some that are mobile in nature, that may be used in an educational manner.
What is a Learning Object?

According to Zaharieva and Klas (2004) there is still no definite answer to the question of what a learning object really is. The definition provides is that a “unit” is the basic building block and ranges in length from 15 minutes to 45 minutes. Units are then put together as a “module” that corresponds to a particular “class” which may vary in length depending on the content needs of the learner and the delivery method of the instructor and/or institution. Courses may then be aggregated to constitute a program, such as a diploma, undergraduate degree or master’s degree. There are different standards proposed that attempt to define a learning object. Three of the popular models are:

- SCORM
- IEEE LOM
- IMS LD

SCORM (Shareable Content Object Reference Model) is a collection of standards and specifications for the packaging and sequencing of learning and assessment material in the form of shareable, reusable content objects. A SCORM learning object subscribes to four basic qualities; reusability, interoperability, durability, and accessibility. SCORM achieves these qualities through SCOs (Shareable Content Objects), which is a complete unit of educational material with a single, narrow instructional or educational objective (Gonzalez-Barbone & Anido-Rifon, 2008).

Strengths of SCORM:

- The Moodle IMS supports SCORM 1.2
• There are third party players and editors, such as RELOAD
• The RELOAD editor may be used to create SCORM objects
• Both the editor and player are free software (installed on LINUX platform, also free)

Weaknesses of SCORM:

• Creation of SCORM objects is not intuitive.
• Creating SCORM objects is difficult as the IEEE LOM metadata standard is complex.
• The lack of a well bounded definition of the size and granularity learning objects should have (Gonzalez-Barbone & Anido-Rifon, 2008).
• The lack of pedagogical metamodel – SCORM or the IEEE LOM have not taken pedagogy support as one of their core issues in specification (Weihong Huang, Webster, Wood, & Ishaya, 2006).

What is IMS and IMS Learning Design?

The idea of reusability is a strong driving force in the creation of units of learning. This combined with interoperability and personalization lead to the development of tools such as Educational Modeling Language (EML), developed at the University of the Netherlands. EML is a semantic notation for units of learning to be used in e-learning (Koper & Manderveld, 2004). The idea is to make education more effective by providing a standardized approach that is recognized globally. The advantages to this model include the accreditation of competencies related to employability as well as continuous access to knowledge regardless of time or place. In their research, Koper and Manderveld, (2004) determined that there are a number of learning objects in use but there lacked a learning technology specification which “provides a pedagogical framework of different types of learning objects, expresses the relationships between the typed learning objects and defines
the structure for the content and behavior of the different learning objects”. To this end, EML was developed for educational designers to be used as a framework for building learning units that are based on sound pedagogical principles with reusability and interoperability benefits. EML was developed and is owned by the University of the Netherlands. The IMS Learning Design Specification is a specification developed by the IMS Consortium which is made up of LMS (Learning Management Systems) manufacturers. A number of use cases for the standard were modeled in EML and it was chosen as the foundation for the IMS LD specification (Tattersall et al., 2003).

The LD specification was developed to standardize the delivery of learning modules. Learning Design is defined in the IMS Learning Design Specification as a “description of a method enabling learners to attain certain learning objectives by performing certain learning activities in a certain order in the context of a certain learning environment”. Breaking the IMS Learning design object down, it consists of a language for modeling units of study. Fig. 1 below shows the major elements of the IMS LD. An asterisk * means that an element may occur more than once.
Figure 1. Major elements of the Learning Design Specification

The Learning Design Specification does not require the use of any particular pedagogy, but is flexible enough to allow the educator to implement their own (Tattersall et al., 2003). With the organization of education into units, these units may be independently used and/or combined by learners to achieve their educational goals. The downside to this modularity is complexity. Tattersall, Janssen, Van den Berg, Hummel, and Koper (2007) identify the need for a guidance system that must be designed to help learners view their current competency level and the path they desire to take to achieve a new competency level. They identify the IMS LD as having the ability to sequence, select, and nest various combinations of UoL to enable the modeling of curriculum. The concept of a curriculum
processing engine is introduced which, “given a curriculum modeled using IMS LD and
information on the learner, is able to compute what remains to be done by the learner to reach
his or her educational goal”. Kalz, Van Bruggen, Rusman, Giesbers, and Koper (2007) seek
to define the concept of “positioning” in a learning network, which is defined as a process
that assists learners in finding a starting point and an efficient route through the network that
will foster competence building. The IMS LD states that it can be used to reduce the content
in a learning path to reduce the time required to reach learning objectives (Kalz et al., 2007).
This means that a learning activity may be omitted if a learner has prior knowledge of it.

IMS Learning Design Research Following IMS LD Specifications

Mikic and Anido (2007) address accessibility and device independence for mobile
learning. Specifically, they review the IMS Learner information specifications and their
suitability for mobile learning. In addition to having an IMS learning profile, they introduce
the idea of a Device Profile (DP) which includes characteristics related to the device that the
user may use for e-learning tasks. This DP then becomes part of the IMS learner profile. By
extending the learner profile, devices may be used interchangeably and the learner will still
have access to all relevant learning units that are associated with their profile. Computer-
based gaming has become one of the largest computer industries in existence. Gaming in
education is becoming popular as it introduces such elements as highly interactive hands on
processes as well as timely feedback. Moreno-Ger, Burgos, Sierra, and Fernandez-Manjan
(2007) apply the IMS Learning Design specification to a game-based adaptive unit. This unit
consists of a pre-test that is used to adapt the game to the learner’s skill level. From there,
there a game is initiated that assesses the learning process using an in-game exam. The game
is driven using the <e-Adventure> educational game engine. Information within the <e-
Adventure engine is via an XML syntax definition. Writers of the game describe the games using XML syntax. The game engine can then read these descriptive packages and execute the games. Games may be run independently but were designed to run from an LMS. As far as IMS Learning Design concepts are concerned the UoL (Unit of Learning) and game properties should be aligned. According to the researchers, this strategy produces the best results, although it is possible to provide translation rules if it is necessary.

Mobile Learning

Sharples (2000) lays the framework for mobile computing by integrating mobile technologies into the context of lifelong learning. The premise of lifelong learning is that “it is not feasible to equip learners at school, college or university with all the knowledge and skills they need to prosper throughout their lifetimes” (Sharples, 2000). With the advancement of computer technologies and its now ubiquitous nature, it is possible for an individual learner to store and access their personal information throughout their lifetime. Sharples (2000) introduces the idea of HandLeR, a hand-held software unit that is able to store the personal settings of a learner to allow for the transportability of the learner profile from hardware to hardware (for example, from a PDA to a desktop device via a smartcard). To support the concept of storing the learner profile over the lifetime of the learner, it must be possible to add on additional modes of interaction and communication, therefore a modular, extensible approach would be beneficial. Berlanga, Garcia, and Carabias (2006) state that media characteristics are more suitable to be modeled using IMS Learning Object Metadata (LOM) elements, as it is the LOM that describes these kinds of characteristics. Zaharieva and Klas (2004) introduce MobiLearn, which describes a way to structure content based on different levels of detail, and a method to deliver the content in an adaptive way that
allows rendering to various types of mobile devices (such as Notebooks, PDAs, and Smartphones). Their methodology follows the IEEE LOM specification and uses XML to define specific learning units. An XML DTD is defined with didactic elements that are relevant to learning pedagogy. The DTD is easily extensible to allow for further didactic elements. These didactic elements may be delivered over a multichannel medium, including 3 main categories of device:

- Desktop computer and laptop
- PDA
- Smartphone

The delivery mechanism is determined at run time, depending on the device detected. For example, if a laptop is detected, delivery includes big images, tables etc. If a PDA is detected, presentation is purely textual. In addition to this level of device abstraction, there is also a Level of Detail (LOD) consisting of 3 levels that allows learners to decide the level of detail for accessing learning material. These levels include an overview level (similar to slide view of lecture content), a comprehensive level (more detailed subject matter for students with unfamiliarity of the subject), as well as an additional materials level (references to external materials). All content is rendered using XML and may use different transformation processes for conversion, which allows for “delivery on the fly”.

Future work includes the need for more powerful collaborative authoring tools for rendering content.

Vavoula and Sharples (2002) introduce a mobile Knowledge and Learning Organization System (KLeOS) that allows learners to organize and manage their learning experiences and resources as a visual timeline. This system predates the final release of the
IMS LD specification and therefore the terminology differs slightly from the specification with three levels of granularity: at the lowest level are the distinct learning activities that the learner performs; at the middle level there are collections of learning activities; at the highest level there are sets of learning episodes that are related by objective, which form learning projects. With the release of the IMS LD specification, Chan, Sharples, Vavoula, and Lonsdale (2004) build on the previous work to come up with the Mobile Learning Metadata (MLM) schema which integrates learning scenarios produced by the MOBILearn project.

The goal of this research was to provide a bridge between eLearning and mobile learning. To this end, the MLM schema consists of three categories: 1) Learning Object – information describing the learning resource, 2) Learner – information describing the learner and 3) Settings – information describing the context state of the learning environment.

Bull, Yanchun Cui, Robig, and Sharples (2005) introduce TenseITS an intelligent tutoring system (ITS) for handheld computers that enables the mobile leaner to take advantage of individualized learning opportunities that would not otherwise be possible, fitting around their daily routine without disrupting other activities. A small empirical study was performed on 8 MSc students to determine the usefulness of combining learner and location/context modeling on a handheld device. 7 of the 8 students answered positively to this model. This is of course, a small group of computer literate students. More wide-ranging studies must be performed.

Mikic and Anido (2007) introduce the concept of a Device Profile (DP) to address accessibility and device independence for mobile learning devices. Their definition of a DP is that it is similar to the learning profile, but includes additional characteristics related to the devices that the learner uses for their e-learning tasks. This DP becomes part of the IMS
learning profile for that user. This allows for the standardization not only of the user information is stored, but also the devices that they employ.

J2ME is a popular mobile device application programming language that is used by a large number of mobile devices currently in use. Roy, Mitra, Bhattacharya, Biswas, and Das (2008) designed an applet in J2ME that may be used on handheld devices to determine GPS position. Their application has been designed to extract latitude and longitude information to provide what they call a “location-based service”. GPS information is easily available on most GPS-enabled mobile devices, such as the HP iPAQ, HP Blackberry devices, and the Nokia N-series. Barbeau, Labrador, Perez, Winters, Georggi, Aguilar, and Perez (2008) discuss the ability of mobile devices to collect real-time location data on GPS-enabled devices. Their algorithm for acquiring and utilizing GPS data is also written using the J2ME environment. With their research, Barbeau et al. (2008) present TRAC-IT, an application written in J2ME that is used to reduce the amount of bandwidth and resources needed to determine position through GPS data. With TRAC-IT, a request from a server to a mobile device to retrieve GPS data is used, and the appropriate contextual content is then pushed to the mobile device. Their critical point (CP) algorithm reduces the amount of overhead needed to determine location, thus reducing bandwidth needs, and also the battery life of the mobile device, as the polling of GPS data on current devices is resource-intensive.

**IMS Learning Design Players**

IMS Learning design players are still in their infancy. Players that have been developed fall into one of two main categories: client-side players and server-side players. With server-side players, the IMS LD modules are stored on a server and are accessed real-time via the
Connecting device, such as a laptop or desktop computer. Starting with server-side players, there are a number of them that have been developed in the last 10 years.


- **Reload** – tool used to draw up units of learning (UoL). Reload may also be used as a player - http://www.jisc.ac.uk

- **SLED and SLED2** – front end player for a CopperCore Run-Time (CCRT) environment

Mobile connectivity has brought the need for the development of client-side players. Connectivity via mobile devices, such as PDAs, cellular devices and GPS devices is generally low in bandwidth, and the interfaces for these devices tend to be textual in nature, which requires a different set of specifications for display.

Sampson et al. (2007) introduce the SMILE PDA Learning Design Player, which is an open source software implementation that allows the execution of IMS Learning Design activities via mobile devices. When designing the SMART system for these devices, the categories of limited internet connectivity, lightweight design, and display limitations were all taken into consideration. They discuss current server-side players that fall short in one or more of the categories listed above. To this effect, the SMILE PDA was designed as a client-side IMS Learning Design player, eliminating the issue of limited internet connectivity, size, as it is smaller than 1MB, using HTML and Flash as the delivery medium. In a follow-up paper, Sampson and Zervas (2008) presented initial evaluation results from evaluation
workshops on a group of students using the SMILE PDA Learning Design Player. The workshops were performed at two institutions with a total of 40 participants and feedback was very positive for both experienced and less experienced learners. This research is lacking in vocational and technical, and/or high school user groups (total of 13% vs 87% Higher Education/Masters level. First Nations learners in the present context have a higher percentage of learners that fall into the vocational/technical and high school user group. The research also does not discuss the process of connectivity to a central device in order to upload/download new learning modules, as well as the process of feedback from tutors to learners. The client-side information must be transported in some format to the tutor. It is not discussed what this format would be and how the transport would occur.

**Empirical Examples of Mobile, IMS LD Delivery Using Contextual Data**

The tying together of IMS LD, multiple mobile device technologies, contextual data into templates for delivery using a database structure consisting of IMS LD major elements, as described in the “IMS Learning Design Best Practice and Implementation Guide”. Please refer to figure 1 above to see the major elements for the IMS LD specification. There has been research performed that incorporates parts of this idea, but none in the area of First Nations contextual data. The research has mainly focused on third world and developing countries, rather than our own population. Using the elements shown in figure 1, additional elements must be incorporated to allow for interchangeability between mobile devices, contextual data that will change between different groups of people (First Nations band structure as an example), as well as physical location (for example, geographical location, organized by watershed). There has been recent research performed on prototyping IMS Learning Design. The majority of these are XML related.
Hagen, Hibbert, and Kinshuk (2006) introduce Voyager, a prototype web-based learning management system that follows the IMS Learning Design Specification model. Voyager is implemented as a database-driven system, rather than XML. To this end, Voyager strays slightly from the logical schema of the IMS LD specification to a relational model to allow for implementation using mySQL. The system fully supports IMS LD level A and some of level B. Sticking to the functionality required by the IMS Learning Design Specifications, the researchers found that the complexity of the model meant that designing functionality to play learning designs that cover all possibilities was a big challenge. A large number of records in the underlying databases must be created.

Current Remote Delivery Mechanisms

Shareef and Kinshuk (2006) introduce a hybrid model for the remote delivery of learning materials for students in the Maldives. The model they introduce consists of a three-tiered model: a student module, a regional module and a headquarters module, with information gathered from students at the regional module and forwarded to the headquarters module for processing, and vice-versa. With newer inexpensive technologies available that are able to provide a significant increase in storage capabilities, such as Flash Devices, and in wireless devices with increased distance capabilities, this model is still a practical model in delivering remote content. Ideally, it would be a real-time model without the need for the physical movement of data via physical devices such as flash cards. Mobile device delivery is also not addressed.

Siadaty et al. (2008) present an ontological framework, mLOCO, (building on the work done by Jovanovic, Gasevic, Knight and Richards, Ontologies for Effective Use of Contexts in e-learning Settings) which uses mobile devices as content delivery media in a
context-aware learning environment. Siadaty et al. (2008) define a mobile learning context as “all the situational information about the learners, learning objects, and learning activities, captured with regards to its delivery medium”. mLCO builds on LOCO by adding in mobile context (what they call a “delivery media repository”) to the already established ontological framework of LOCO, which includes a Learning Object repository, a Learning Design repository, as well as a Learning Object context data repository.

Graf et al. (2008) define an infrastructure for developing problem-based pervasive learning environments using multi-agent systems (MAS). Their system provides pervasive and mobile learning as well as problem-based learning. It also attempts to provide personalized and adaptive support for students. Cooperative software agents are used to support the system. For example, a student modeling agent is responsible for obtaining information about the learner, including learning styles, location, context, behaviors, actions, and performance. The agent then makes this information available to all the other system components. Together all of the agents, models and services proposed provide an adaptive an pervasive learning environment.

**Portability Between Design Mechanisms**

Klamma, Spaniol, and Cao (2006) discuss mobile enhanced learning, which introduces the idea of delivering multimedia learning resources onto mobile end devices using the MPEG-7 and MPEG-21 multimedia metadata standards. In addition, a community adaptation process is introduced that lists contents for preview based on the user’s query and the current community context, which is determined based on learner location. The user model for the research is architects, which means that the community context is determined by the buildings that are associated with a particular community, or urban area. Of course,
due to the nature of architecture, the material to be studied is visual, such as buildings and other urban structures, hence the need for multimedia delivery. If a learner lives in a particular urban area, that area becomes part of their user profile and is integrated into the contextual content adaptation process. This is accomplished through a distance (or similarity) metric which guides the grouping process (of learners) and a clustering algorithm which re-organizes groups as learners leave or as new learners enter. A next logical step would be to incorporate localization technologies, such as GPS into the mobile clients. As (Klamma et al. 2006) state, this would help to combine existing information “with the existing community context into a more powerful information system combining community and place”.

**Contextual Awareness**

The danger of TEK research from a First Nation perspective is that it may be used as a tool for western science. The knowledge from the community is worked into facts and figures that a biologist may then use to further their cause. With this type of approach, there is a loss of context as the information is distilled, distorted, and manipulated to make it fit into predetermined, external data requirements (Menzies, 2006). Therefore, one of the big challenges towards developing TEK learning modules is to ensure that the context of the knowledge that is used is not altered or lost.

Syvanen, Beale, Sharples, Ahonen, and Lonsdale (2005) discuss the MOBIlearn system, a generic, adaptive system that supports learner groups in mobile, informal learning situations. The goal of the system was to provide adaptive and context aware systems to support a variety of learners. They state that there is one clear characteristic in mobile learning and that is that learners seek information more freely from different domains (both
physical and virtual) and construct knowledge based on this information. Context-aware computing brings in the research of human-machine interfaces into mobile computing.

Yuan-Kai Wang (2004) states that “mobile devices and sensing equipment may be combined to provide physical and environmental context in mobile applications”. For example, in a First Nation context, the GPS co-ordinates of a mobile device may bring up contextual information regarding traditional use information related to the geographical area around the current waypoint position. Temperature may also be considered to provide contextual seasonal information. For example, in the spring, the information may be around seasonal migration of animals in the area, and in mid to late summer, it may be focused on berry types and include descriptions of traditional berry picking spots and the type of berries that may be found. It is important to take into consideration not just the context of the learner’s knowledge, but also the social context as well as other contextual information.

Malek et al. (2006) introduce what they call a “new research field”, mobile learning. They state that education from a distance can be “characterized as a move from d-Learning (distance learning) to e-Learning (electronic learning) to M-Learning (mobile learning)”. Context-aware mobile learning is an extension of mobile learning. In this case, contextual elements refer to the environment in which the learner is most comfortable learning, not just the cultural context. The research here is focused around identifying the contextual elements relevant to mobile learning and then building middleware that supports the context for managing and adapting to these contextual elements. Elements identified include internal (ex. the learner) and external environments (ex. social, physical and temporal environment), shared individual contexts of teamwork members, as well as the collaborative work environment.
Zipf and Jost (2006) combine the terms “ubiquitous computing” and “GI services” into one umbrella term “UbiGIS” which helps to describe their area of research. They define the concept of adaptation and context-awareness using mobile devices focusing on what they consider the “two most important factors for adaptation: (a) context as the representation of the current situation and (B) the user itself”. The question asked is how do you dynamically derive information on the users’ properties? Ontologies are used for the formal descriptions of classes, and to provide the sharing of this knowledge. Content is extracted using a user-aware SpatialQueryContext. Practical applications of this methodology include tour guiding and pedestrian navigation systems. This research only discusses the potential of such technologies. As far as real prototypes in the area of First Nation’s contextual data, there is currently little to no research to be found.

There is limited research that has been performed in the area of First Nations traditional knowledge and IMS learning design modules. As mentioned in an earlier section, a lot of the research has been done in third world and developing countries rather than developed countries. Spaniol et al. (2008) use educational gaming as a medium for preserving traditional knowledge information in the Bamiyan Valley area of Afghanistan. Preserving the knowledge of previous generations is a difficult and challenging process due to a number of reasons such as a lack of well-educated people and the knowledge of how to implement a system of safe storage. Their research is from a perspective of third world and developing countries. There is an andragogical (learning for adults) similarity between story telling and educational gaming, which means that there are parallels between the role of storytelling and the role of educational gaming. For example, with motivation as the andragogical theme, story-telling is used to relive real life tasks. With educational gaming,
there is a preparation for real-life tasks. In this case, the researchers attempt to connect the structural properties of story-telling with a gaming engine using XML as the binding mechanism. This type of methodology may be useful to tie together the storytelling learning methodology (the contextual piece) with IMS Learning Design concepts, mobile computing concepts, as well as the contextual data.

First Nations Traditional Knowledge and Indigenous Knowledge

“We were born there and raised there and we understand the area.” (Stanley Sam, nu-Chah-Nulth Elder from Ahousaht).

Indigenous peoples of the world have long-standing relationships with their environment. In the past 15-20 years there has been a movement towards recognition of these relationships (N. Turner, Ignace, & Ignace, 2000). This traditional ecological knowledge and wisdom of indigenous peoples has been recognized as a fundamental piece of the management of local resources. In recognition of this ideal, a number of initiatives have arisen to facilitate what is referred to as “indigenous knowledge” by the World Bank. An example initiative is the World Bank Indigenous Knowledge for Development Program that was launched in 1998. Indigenous knowledge is not confined to indigenous peoples alone – all communities have developed their own body of knowledge over generations (Gorjestani, 2000).

In a Canadian context, Berkes (1999) defines traditional ecological knowledge (TEK) as “a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission”. With the forcing of First Nations communities onto reservations, the assimilation of first nation peoples into residential schooling, and the failure to provide an alternative cultural support many of the
cultural traditions and knowledge are not being passed down from generation to generation system (Barman, Hebert, and McCaskell, 1986). With the forced move to a reservation style of living, there is also a generational disconnect from the land. Many First Nations youth have not acquired the traditional knowledge from elders, and there is no mechanism in place to retain this information. Scientists and western academia in general have been slow to adopt this view, therefore the storage and assimilation of this knowledge is left to First Nations communities themselves. According to Berkes (1993) the growth of traditional ecological knowledge as a discipline has been rapid but the growth has come from interdisciplinary scholars rather than from ecology and resource management professionals. Decisions about lands and resources are still made by centralized government bureaucratic structures that tend to have the least amount of localized knowledge. These decisions tend to be based on such things as a movement towards market economies of the dominant society and by the escalating ecological destruction and forced assimilation of homelands and resources. With this destruction, the indigenous knowledge of a community has diminished as assimilation and environmental change have escalated (N. Turner et al., 2000). Overwhelmingly, this indigenous knowledge is deemed important. After determining that indigenous knowledge is important to a community, the information must be archived in a digital format. This is just the first step. The next step is then to put the information into a meaningful knowledge management system. The definition of meaningful here being that the community is able to access the information in a context that is meaningful to them. The final step in the process then is to provide the ability for the community to access and to collaborate on the information that is contained, to learn from it and to add to it, as this knowledge is constantly in the process of changing and evolving
(Aikenhead, 1997). To take it one more step, the utilization of indigenous knowledge helps to increase the sustainability of development efforts as it provides for mutual learning and adaptation, which in turn contributes to the empowerment of local communities.(Gorjestani, 2000).

The Generation Gap

Dyson, Hendriks, and Grant (2007) state that aboriginal learners value their place in a group, and if there is cultural relevancy in the learning tasks that are assigned to the group, in other words, contextual data relevant to the learner’s life or cultural experience, the learner will be that much more motivated. Dyson et al. (2007) also state that aboriginal learners are quick to pick up ICT technologies and adapt them into their lives and that “the combination of using ICT tools to support educational needs, together with programs developed with aboriginal pedagogical qualities at the forefront, will empower aboriginal communities to become self-determining in their educational experiences”. Lastly, this research suggests that m-learning may be highly successful with aboriginal students from other cultures. This is another clear indication that contextual learning tasks are essential. Storytelling solves several constraints on information storage, one of which is the finite nature of experience (Scalise & Sugiyama, 2001). It is next to impossible for a single individual to acquire all of the knowledge necessary for survival and continued existence. Through storytelling, knowledge that is not acquired through first hand experience may be acquired. The problem that arises in First nations communities, indeed in most indigenous communities is the disappearance of these stories because of the aging of elders and the disconnect from the land. Knowledge is acquired through every day activities such as harvesting, trapping, travelling, fishing, and hunting (Brody, 1981). These experiences are consolidated through
the sharing of historical stories, songs, and dance. This information is passed from generation to generation by the elders, and the stories are augmented with contemporary information as the circumstances around the stories change (Kuhn & Duerden, 1996). Kuhn and Duerden (1996) also state that there is hesitation from first nations about sharing their traditional knowledge information with “outsiders” due to their historical role as one of subservience to the dominant Western group, both culturally and economically. Johnson and Ruttan (1992) undertook a pilot project on the assimilation and storage of traditional ecological knowledge through a participatory research approach. The traditional ecological knowledge of the Dene people was determined the top priority because the knowledge was “fast disappearing with the passing of the elders”.

One of the major obstacles identified by Johnson and Ruttan (1992) was the lack of experience to draw upon for this type of project. With the apparent lack of research and compilation of this kind of indigenous knowledge, there is no defined standard on how this traditional knowledge should be stored and accessed, and how it should then be organized and presented for future generations of first nation communities. It has been identified that this information is important and that it is in the hands and minds of a dwindling number of community elders. The opportunities for the younger generations to spend time with their parents, grandparents and other knowledgeable community members have diminished, as have the opportunities for direct contact with the habitats and the resources that make up their traditional community territories. This issue must be addressed to ensure that traditional knowledge is not lost (N. Turner & Berkes, 2006).
The Reasons for IMS LD

IMS LD is the appropriate platform for designing units of learning for First Nation and other remote community individual learning as it independent of pedagogy, and it allows for personalization of learning both in an adaptability sense, as well as personalized learning. Burgos, Tattersall, and Koper (2007) discuss the ability of IMS LD and adaptability, specifically the ability of IMS LD to allow for the use of adaptation and personalized learning for modeling learning experiences. The idea of adaptation in education is that the best learning performance comes from personalized instruction. If a student has the privilege of having adaptability to conform to the context of their individual lives, then they will be more encouraged to participate and ultimately have a higher level of involvement and stimulation. With IMS LD, adaptation may be modeled inside a Unit of Learning (UoL), specifically environment, method, roles and activities (Towle & Halm, 2005). Various pedagogical designs may be specified using IMS LD. The possibility of incremental adaptation and reuse of UoLs is considered very valuable, as educators do not have a common language in which education designs can be expressed (De Vries, Tattersall, & Koper, 2006). Applying this concept of a common language to TEK means that the UoLs may be applied to any repository of First Nations TEK, regardless of the group in question, and the specific knowledge to a group may be extracted as part of the contextual data, also allowing for different educational context according to the learning styles of individual learners, which may differ in pedagogy from one group to another and from one learner to another. This is because IMS LD is considered generic. “Different tooling can by its design and specific features specially suit different educational contexts: there is no size that fits us all” (De Vries et al., 2006). With IMS LD, the learning objectives may first be designed. The
IMS LD approach separates learning objects from the educational method used in the unit of learning. This allows instructional designers to say who should do what, when and with which support facilities in order to reach learning objectives (C. Tattersall, 2006). For example, in a small remote First Nations community with a broad range of learner levels and varying levels of connectivity and hardware, a particular UoL may be delivered using different entry points based on student knowledge of the subject matter, as well as student learning preference, and connectivity level (for example, intermittent connectivity vs. broadband). Flexibility is the strength of IMS LD in this type of environment.

Once the templates for creating UoLs for First Nation traditional knowledge have been created, then they may be reused from community to community allowing for specific community contextual knowledge to be applied. This represents a shift from focusing on learning objects to emphasizing learning activities. According to Dan Yu, Weiping Zhang, and Xinmeng Chen (2006), IMS LD revolutionizes e-learning by capturing the “activity” of education, rather than simple collection of ordered contents to learn. Traditional e-learning delivery mechanisms such as Moodle allow for the distribution of traditional print material in digital format without altering the mechanism in which they are delivered, therefore not allowing for the interactive group-oriented collaborative learning scenarios in conventional education. Other popular specifications up for consideration for the development of structured learning modules include the Shareable Content Object Reference Model (SCORM), IEEE Learning Object Metadata (LOM), and the Dublin Core. Currently, most courses that are offered via an LMS mechanism do not provide much, if any, information about the didactical methods and models they use (Boticario & Santos, 2007). Predefined
settings are laid out for a particular course, which is often referred to as the classic computer-assisted instruction approach (Brusilovsky & Vassileva, 2003).

According to Boticario and Santos (2007) adaptation is bound to be a permanent issue inasmuch as learning, by nature, is a personalized and adaptive process. To this end, IMS LD provides increasing levels of detail and possibilities for adaptation, including the ability to adapt to learner preferences at run time which is the result of user feedback on their own personal preferences. With other leading open e-learning specifications, such as SCORM, LOM and Dublin Core, this adaptability is not easily incorporated, if it is even possible at all. SCORM is based on the assumption that learning content can be decomposed into discrete, context independent entities. The result of this focus is that the actual learning process is limited to the consumption of the created content (van Es & Koper, 2006). SCORM is also described as being currently centered on a single learner model (C. Tattersall, Burgos, Vogten, Martens, & Koper, 2006).

Bailey, Zalfan, Davis, Fill, and Conole (2006) state that with SCORM, branches and decisions can be made within the sequenced components of the model, but there is a lack of user model which limits the amount of personal adaptability that a SCORM lesson can provide on its own. IMS LOM and Dublin Core are meta-data specifications that are used to describe elements that are then used to assemble learning objects, which is similar to IMS LD, but they are too limited to describe the action between the elements (van Es & Koper, 2006). This means that there is no room for adaptability by providing element addition, deletion or sequencing based on an individual learner’s preference. IMS LD on the other hand is able to describe units of learning based on different theories and models of learning.
and instruction together with the learning objects used, and can be adjusted to personal needs, therefore allowing for a far greater array of learning process (Lukasiak et al., 2005).

IMS LD places learning activities rather than learning content at the heart of its model (C. Tattersall et al., 2006). One of the keys to this model is that services that are to be used by the learner (for example, an email, conference or another type of announcement) may be created generically and resolved at run-time when required. In addition, IMS LD allows for different learning routes according to the values that defined properties (Level B) have at run time (Santos, 2006). According to Santos (2006) this is a real issue for SCORM and web-based content for all. The SCORM run-time environment (RTE) is based on scripting, specifically Javascript, which means if courses are assimilated to web content, using WCAG 1.0, pages must function with scripting disabled, thus effectively eliminating the RTE. Current mobile devices also do not have scripting capabilities, therefore disallowing the anytime and anywhere approach to learning.
CHAPTER III
METHODOLOGY

The ability to allow a learner of a mobile device to use location-specific information, such as GPS, to extract contextual information according to the criteria listed earlier, such as proximity learners, those learners who have similar contextual requirements as the current learner. IMS-LD provides the methodology to allow for the delivery of pedagogically independent material that is contextually adaptive to individual user needs, including the ability for these users to connect using the devices listed.

Proposed System

As a first step, IMS LD level A is used to create units of learning for a particular topic. Again, the advantage of using IMS LD is the ability to provide contextual data to personalize and engage the learner in the learning process by allowing for the addition of contextual information. For example, a community learner has a device such as a computer, laptop, PDA or cellular phone and is able to access an internet site containing all of the system information (such as a website). Before the interface for the site is loaded (such as a web page), runtime code detects the device type and references a database of contextual device data in order to successfully load the appropriate interface. In addition, the user must enter in their user identification and are validated by the system. Once validation has been successful, the relevant contextual data is loaded (for example, the user’s home community, family lineage and/or family territory). Once the user is identified, other criteria, such as home community are then used to access a data repository to extract relevant contextual data for the identified learner. This contextual data may then be used with the IMS units of learning to provide relevant contextual information for a community member. The actual traditional
knowledge data may be defined by the community and held in a separate repository.

Examples of additional contextual information to aid in personalization may include the following:

- **Geographical location** – the location of the knowledge item in a geographical sense, such as GPS location.

- **Date or Season** – The time of year may impact the type of information that is relevant in a particular location. For example, seasonal migrations of animals, or the ripening of a particular berry.

- **Watershed** – a physical grouping of area based on geographical formations. May be used as a grouping of family territory, or as a possible migration route for an animal species or a natural boundary of a particular plant species

- **Elevation** – the altitude of a particular spot, which may be an indication of the types of activity that may occur.

To allow for the ability of learners to find other community members, there may also be a database of contextual information that allows for learners to collaborate during the learning process. For example, the grouping of learners may be based on the following:

- **Family Lineage** – the family that they belong to

- **Community Location** – The geographical location of the learner’s community of habitation

- **Original Territory** – The traditional territory of the learner (For example, it may be watershed-based)

- **Clan** – The organization of the community based on the clan they belong to

Fig. 2 offers a visual representation of the proposed system.
A user of the system accesses the learner system by way of a URL. When the URL is first accessed, an application is run to detect the type of device that is being used (referred to as Device Discovery). The process refers to a database of device characteristics. The appropriate user interface is then loaded according to device type. For example, a PDA device would load a smaller and simpler interface than a laptop or desktop system. An example of previous work in this area was undertaken by Zaharieva and Klas (2004) in creating the MobiLEARN system. They referred to the concept as “device profiling” where the device is detected and the appropriate interface is loaded according to the “learning unit” laid out in a document type definition (DTD). The learning unit is rendered at runtime after device detection according to the result of detection (PC, PDA, Smartphone). Once the device type is detected, an additional detection application is run to detect if a particular device is GPS-enabled. The initial entry page would be simple HTML, allowing the user to
login via a username and password. At this point, the learner discovery process is initiated, and the user’s preferences are loaded from the associated data sources, including all IMS LD Level A data, as well as the relevant units of learning according to the user’s current level of knowledge (if known). The next step is to provide the contextual information that is relevant to the individual user, according to the criteria listed above. Again, the criteria may be defined by individual communities, as each community may have different priorities as far as determining what is contextually important to them. The contextual data is stored and referenced using a relational model described in a later section, providing a standard way of creating and accessing the contextual data. Once the contextual data has been determined, the relevant traditional knowledge data may then be accessed according to the contextual requirements of each individual community. Textual data may then be stored on the device as HTML, XHTML, or XML data. The advantage of applying this model to mobile devices is that once the information is stored on the device, the user may move locations, and as long as the GPS coordinates are known (through the device itself, if it is a GPS-enabled device. GPS enabled devices may be included as part of the device detection process described earlier) or through any other location-detection system, the information may be retrieved according to the current or desired location, and any algorithms or processes may be run to retrieve, disseminate, or alter the data that is stored on the device.

Boticario and Santos (2007) recommend the following methodology:

- First, course materials were developed as a set of learning objects.
- Second, metadata were added to those learning objects in order to be properly used in the course.
• Third, instructional design (pedagogical support) guided by learning objectives was defined.

• Finally, the fourth step was to build an adaptive scenario for the course, which allows delivering the course adapted to the individual learner needs from the combination of design and runtime adaptations. The latter step is crucial to support the required adaptations at runtime. Its construction process consists of a sequence of steps with increasing levels of detail and possibilities for adaptation (differential, material and situated analysis).”

The proposed system builds on this methodology by using IMS LD as the standard modeling mechanism for the delivery of learning objects. The adaptability is provided by accessing the database that contains the user’s profile, which includes context, as well as the device parameters that provide the runtime delivery context according to the parameters of the device that may be obtained using J2ME.

Database Architecture for Contextual Learning Design Templates.

Fig. 3 shows the underlying architecture of the proposed learning system. This architecture has been designed to account for contextual data to be included into IMS learning design templates.
Each activity may be created independently of other activities. A course becomes a collection of activities that fulfill the objectives of the course. A simple course requires the sequential
completion of the activities from start to finish. It is the course_activities table that associates activities with a course. Participants may enroll in a course. With IMS LD, there are roles that may be assigned. For example, there is a learner role as well as a teacher roll. The course_participants table allows an individual participant to enroll in a course according to a role or roles. It is possible with IMS LD that a student may participate in a course in more than one role. An important part of the system is to provide the ability for contextual data to be added according to the context that the participant has chosen. Therefore, as participant is associated with a context that they are participating as (contextID). As a student completes activities successfully, their progress is tracked in the participant_progress table, which tracks the courseID and activityID that a student has accessed, and whether the activity has been successfully completed. Contextual data is included at the resource level. When a resource is loaded, the data is loaded into the associated resource module depending on the context in which it is required. The contextual identification of the learner is provided upon registration in the system as a participant, and is tracked by the contextID field. To associate the context with a resource, an associated table has been created to allow a particular piece of contextual data to potentially be included with many resources. As data is added to the system by the designer, they choose a context or contexts to associate the data with (data_context table). In this way, a piece of data may be included in any context that is specified. To allow for a hierarchical contextual system based on general contexts, working towards specific contexts, an integer field may be used to group the inheritance hierarchy based on the context of the user. Bitwise shifting may be used to separate general contexts from specific contexts. Using a 16-bit integer as an example, the first 8 bits of the 16-bit field may be used as general context fields and the final 8 bits as specific context fields.
Table 1. Layout of inheritance hierarchy based on bitwise shifting.

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>General Context</th>
<th>Specific Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7</td>
<td>8 9 10 11 12 13 14 15</td>
<td></td>
</tr>
<tr>
<td>Bit Value</td>
<td>0 0 0 0 0 0 0 0</td>
<td>0 0 0 0 0 0 0 0</td>
</tr>
</tbody>
</table>

Referring to Table 1 above, the first bit (Bit 0) is reserved for all contexts, meaning that a data object is used in all contexts and is not context-specific. Bit 1 to bit 7 are then reserved for general contexts. To further expand on the example, bit 1 may be reserved as “First Nation” and bit 2 may be reserved as “Chinese”. From there, more specific context may be applied on a general context. “Haida” may be applied as a specific First Nation context and would be assigned bit 8, the first bit in the specific context section. Data that is created for Haida would then be assigned the following 16-bit value:

01000000 10000000

This value is then stored as an integer in the database and associated with the data. When a participant signs up for a course, they may choose a context. This context is then stored in the database and associated with that participant. When the participant accesses a particular activity, the full context is retrieved from the database and queried against any data that matches the full context. The participant is compared against the next level of the context hierarchy using a logical AND operation to determine the more general context:

01000000 10000000
AND
11111111 00000000
01000000 00000000
In this way, the specific context data may be applied, as well as the more general context. IMS_LD learning activities are the fundamental units of learning and are shown in Figure 2 as activities, with a title, description and an identifierRef field, which is a pointer to the actual file that is to contain the activity data. The activity file is then filled with the appropriate resources according to the context (contextID) and resource type (resourceID). Resource type allows for device context, which is explained in the next section.

Device Context – Detecting Mobile Device Capabilities

The resource type identifier allows for the selection of device appropriate data depending on the type of device that is being used by the learner. For example, if it is a mobile phone that is being used and the device display parameters are 320x240, only data types that are appropriate for that resolution (for example, smaller images, textual data) are loaded (according to resourceType). It is therefore important to make sure that there is contextual data for each activity that may be used for all resource types. At its simplest form, components of an activity may be included as textual data (as resourceType =1), and as the device visual and bandwidth parameters increase, the ability for the device to load additional resources increases. Using the logic that any device can load resources that are of resourceType = 1, other resource types may be loaded as the capabilities of the device increase. This baseline is important to create each resource in a way that the fundamental learning process is not impacted by excessive time for the loading of learning activities.

Device Requirements - Using J2ME

According to the J2ME specifications provided by Sun (located at: http://developers.sun.com/mobility/apis/articles/location/) in order to utilize GPS components of a mobile device, programmers may use the location-based service (LBS) library, which is
part of the J2ME library, specifically JSR 179. The JSR 179 specification includes a set of
generic APIs that can be used to provide location-specific information. This information may
be programmed using one of the following methods:

- Mobile phone networks
- Satellite positioning
- Short-range positioning beacons

Once the positioning has been determined, the positioning data may be forwarded on to a
server for processing according to the data. For example, if the device is using satellite
positioning, in other words, it is GPS enabled, the latitude and longitude may be determined
using the JSR 179 API and the resulting data is forwarded to a server and compared to a
database to retrieve the appropriate information, perhaps in the form of a web page and this
information is then returned to the device for display. As far as the iPhone is concerned,
Apple does not appear to have any interest in working with Sun Microsystems to come up
with a Java solution to allow J2ME APIs to run on the iPhone. The iPhone does come with
location specific information as part of the device and the information is accessible through
the Apple SDK. “Core location” is the name of the specific API that contains the following
location-specific information:

- 3D geographical coordinate for the device
- Latitude and longitude (includes horizontal and vertical accuracy)
- Altitude (vertical accuracy)
- Time at which the last location was determine
- The previous location that was determined
Screen Resolution Requirements

With the plethora of mobile device options available, it is very difficult, if not impossible, to provide screen resolution solutions to all that are available. With that in mind, 4 standard screen resolutions will be included in the methodology of this essay:

- 320 x 240 pixels (current standard resolution for mobile phone devices)
- 480 x 320 pixels (current standard resolution for PDA devices such as the Blackberry Storm)
- 800 x 600 pixels (current standard resolution for legacy devices)
- 1280 x 800 pixels (current standard resolution for laptop devices)

4 different CSS templates may then be used that provide varying levels of access depending on a device resolution detection algorithm that is to be written using J2ME.

Figure 4. Conceptual Device Detection Model

J2ME uses a configuration which defines the minimum resources for a class of devices. Currently there are two main configurations for J2ME-compliant devices:
• **Connected Device Limited Configuration** (CDLC) – used with resource-constrained devices (limited memory, processing power, and graphical capabilities.) such as mobile phones, pagers, and personal digital assistants (PDAs).

• **Connected Device Limited Configuration** (CDC) – a superset of the CDLC configuration that includes more capabilities for more resource-loaded devices.

Most mobile devices today are CDLC compliant. Using J2ME and CDLC, a simple application may be written to extract the device type, device resolution, and device coordinates. These values may then be passed to a PHP web page on a server using a GET or POST command. Once the coordinates have been passed to the server, PHP may be used to query a database and extract the correct file name for the CSS file that must be loaded in the mobile device browser. The device browser is dependent on the operating system (OS) of the device. Example operating systems that support J2ME include Symbian, Blackberry and Windows Mobile. As CDLC is compatible with most current devices, the MIDlet has been written to conform to CDLC specifications, and is simple in nature.

Over-the-Air (OTA) provisioning may be used as a method for loading the MIDlet application from a web server. A device can install a MIDlet suite from a remote server using the device's built-in browser. By entering the URL of the suite's JAD file into the browser address field the installation process is initiated. Once the MIDlet application is loaded on the device, the URL of the site is included as part of the application, negating the necessity of the user entering in the URL of the site, which is not pleasant using a typical T9 keypad.

**Discussion and Synthesis**

A detailed example is provided in this section in order to illustrate the functionality of the system. For the purpose of this example, there are 4 different users that will be used:
• user1 – general first nation contextual user, learner role
• user2 – specific first nation contextual user, learner role
• user4 – general Chinese contextual user, learner role
• teacher – all contexts user, teacher role

A general UML use case diagram is shown in fig. 5 for the system. Each of the two main roles is shown as they are able to perform different actions. Both roles are able to log in and are associated with the appropriate context. The learner role however is not able to update any of the course information whereas the teacher role can.
Figure 5. Use Case Diagram for the System

The contextual system was developed using PHP, mySQL and XHTML, and includes an authentication screen, shown below in fig. 6 that is used to validate users and to assign them to their specific context.
Once a user has been authenticated, a number of steps take place that associate the user to the appropriate environment:

1) The user’s context is determined
2) The user’s role is determined
3) All courses that the user is enrolled in are determined (using IMS LD terminology, in the simplest sense the user is either a learner or a teacher.)

Once the courses have been associated with the user (extracted from the mySQL database), they are presented as choices to the user, as shown in fig. 7.
For this sample learner, their context is as first nation general, which is a general first nation context, and they are enrolled in one course. Each course has a number of activities that are associated with it, which follows IMS LD specifications. The IMS LD XML template for the course being used in this example is in Appendix A. Using an individual activity as an example, each activity consists of resources that are associated with it, and the references to these resources is stored as a pointer in the mySQL database, as shown in fig. 8.

**COMP 696 ESSAY COURSE PROTOTYPE**

**COURSE:** Office Productivity  
**ACTIVITY:** Section 1  

**RESOURCES:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP Objectives</td>
<td>OP/activity81.obj.html</td>
</tr>
<tr>
<td>OP Section 1 Notes</td>
<td>OP/activity81_notes.html</td>
</tr>
<tr>
<td>OP Section 1 Readings</td>
<td>OP/activity81_readings.html</td>
</tr>
<tr>
<td>OP Section 1 Exercises</td>
<td>OP/activity81_exercises.html</td>
</tr>
<tr>
<td>OP Section 1 Answers</td>
<td>OP/activity81_answers.html</td>
</tr>
</tbody>
</table>

Figure 8. Resources for an activity for the office productivity course example

From here, the learner may choose a resource for the selected activity. The appropriate reference page is loaded and an SQL query is run against the mySQL database to extract all of the contextual data for the activity that is relevant to the logged in learner, as shown in fig. 9.
Figure 9. Resource contextual data for logged in user (user1)

As you can see, the currently logged in learner is of type “2:First Nation General” context, and as such, the data for the resource is loaded according to that context. To more clearly show the contextual loading of data, another contextual user (user4) is presented in the figure 10 and the data for this user (user4) may be compared to the original user (user1).
Comparing fig. 9 to fig. 10, the information presented to user4 is contextually different from the information presented to user1. To illustrate the hierarchical possibilities of this system, one more example of a specific user context is shown in fig. 11. In this particular example, the learner (shown as user2) is of a specific first nation context, and as such, additional contextual information is loaded according to this specific contextual type.
**Figure 11. Resource contextual data for logged in user (user2)**

<table>
<thead>
<tr>
<th>Context ID</th>
<th>Name</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Using Internet Explorer</td>
<td>Launch Microsoft Internet Explorer by double clicking the Internet Explorer icon located on the windows desktop. Creating Bookmarks: Creating bookmarks is a useful procedure to save websites that you plan on viewing again at a future date. Bookmarks are also referred to as &quot;Favorites&quot;. When first creating bookmarks, it is common practice to create generalized folders to store your bookmarks in. To create a bookmark folder: 1. Open Internet Explorer 2. Click on Favorites/Add Favorites 3. Click the &quot;New Folder&quot; button 4. Type in the name of the folder you wish to create 5. Click Add. The new folder is now available for storing Favorites 6. The new folder will be created.</td>
</tr>
<tr>
<td>2</td>
<td>Create a Folder and Add Bookmarks</td>
<td>1. Create a folder called &quot;OP 1 Resources&quot; 2. Add 5 relevant sites that contain First Nation Governance information 3. Add 5 relevant sites that identify prominent First Nation legal cases dealing with land settlements 4. Add 5 relevant sites that identify rural and community development issues.</td>
</tr>
<tr>
<td>18</td>
<td>FN specific IE</td>
<td>Type in the site: <a href="http://www.fna.bc.ca">http://www.fna.bc.ca</a>. Press Enter. Scroll down the page to find the link to First Nation Specific 1. Click on a recent editorial to view the information on First Nation issues that are currently in the news.</td>
</tr>
</tbody>
</table>
In order to ensure that the data is also presented in the proper sequential order, a sequence field has been included (not shown). The profile contains the context of the participant in the course as shown in fig. 12. The context is stored as part of the participant’s profile. Additional contexts may be added or deleted as needed according to the needs of the participants who are enrolled as part of the system.

![COMP 696 ESSAY COURSE PROTOTYPE](image)

**Participant Profile:**
- **Context:** First Nation General
- **First Name:** User
- **Last Name:** One
- **Email:** loeurj700@gmail.com
- **Actions:** EDIT | DELETE

Figure 12. Example participant profile containing contextual information

When a teacher is assigned a course, they have the ability to add contextual data to the course. As the data is added by the appropriate course management personnel (for example, the teacher), it is entered into the database in the sequence that is selected, as shown in fig. 13. The contextual choices in the list box are extracted from the database according to the contextual information that has been provided about the learners who are enrolled, or who may enroll, in the course.
Once the data is entered into the system as contextual data, the data may be associated with any resource (for example, a web page called Section1Exercises.html), and from there any resource may be associated with an activity (for example, Section 1 of a course). Each activity in IMS LD consists of a list of objectives and various tasks, readings and exercises that are used to achieve those objectives. By building the system in this way, there is a high level of granularity that may be used advantageously to provide reusability of data, resources, and activities across many courses and contexts. As the course template is standardized and generic, there is a high level of reusability. Once the initial setup has occurred to create the learning units, the only new material that needs to be added is the contextual data for the contextual users that are added to a particular course. For example, if a course in office productivity is generated, the original course designer has the task of setting up all of the learning units for the course. Once that has been accomplished, then only the new contextual
data for a particular context (for example a community) needs to be added. The contextual
data for the community now becomes integrated into the course template, adding to the
generic data that is already present. In this way, the original meta-data is added to and built
upon as a course evolves. Using the template in Appendix A as an example, each learning
object references a resource, or resources, such as an HTML page. Once this template has
been created, it does not need to be revised as contextual data is added. The original HTML
page is used, and as contextual data is created, it is retrieved, sequenced, and added to the
HTML page, thus building on the data that is already there, without the need for changing the
overlying template.
CHAPTER IV

ISSUES, CHALLENGES, AND TRENDS

Issues and Challenges

As mentioned earlier in this essay, there is hesitancy from many First Nation communities about sharing traditional knowledge information, as there is fear that the establishment may use this information against communities in land title cases and similar situations. There needs to be an assurance that the information provided is secure.

Another potential problem is the lack of mobile standards. Most devices in production use some form of J2ME as a solution. However, one of the current major producers of mobile devices, Apple, does not. This adds a possible layer of complexity to the proposed solution. New devices may be produced that do not allow for the usage of J2ME or Java-type solutions. As an example, there is a very definite divide between what Apple produces as mobile products and software and what manufacturers such as Research in Motion (RIM) produce. The popularity of non-compliant devices such as the iPhone has also complicated matters as there is no J2ME support for the iPhone device. Any application that is developed for use on a non-J2ME compliant device, such as the iPhone, must be developed independently from a J2ME-compliant device.

Another issue is the overhead for setting up a course is more intensive than without contextual information, as information must be added for each context that is included as part of the course data. For example, if there are 3 potential contexts for a particular course, there needs to be 3 separate pieces of contextual data for each learning activity that requires contextual data. This model adds relevancy and engagement to the learner’s experience at the expense of making original course creation more intensive for the course designers.
There are limitations with current mobile devices and GPS connectivity. Many devices do not come enabled with the J2ME JSR 179 API, which is needed in order to write applications that take advantage of a mobile phone’s GPS capabilities. Over time, it is anticipated that more and more devices will have GPS capabilities and therefore will be accessible using the JSR 179 API.
CHAPTER V

CONCLUSIONS/RECOMMENDATIONS

First Nation communities desire the ability to learn from within their own communities. This desire leads to the need for Internet connectivity for remote learning as there are limited resources in many of these remote communities. The delivery of learning modules must be contextually relevant and generic enough to allow for different learning pedagogies to be applied according to individual learner needs. The accumulation and storage of First Nation traditional knowledge is important to many First Nation communities. Incorporating First Nation traditional knowledge as contextually relevant material, along with the mobility context of each learner according to their connectivity requirements will lead to a more personalized and relevant learning experience that will stimulate and engage community learners. Using IMS Learning Design to create templates for learning according to the requirements listed above will afford the flexibility needed to fit these requirements. This system proposes some possible steps towards providing a solution that is both contextual to the user and adaptive to the device in usage. The application of this system is beneficial to any group or community who has a repository of unique information. Once the repository has been created, it may be shared with other similar groups or communities. The data is stored in a database then retrieved according to IMS LD specifications, which allows for the opportunity to build on the knowledgebase that has been created. Multiple skill sets are needed in order to take further steps towards providing a comprehensive solution.

Recommendations

The system framework is a starting point for providing a generic contextual template. As the system is built on a standardized model using standardized learning modules, specifically
IMS LD templates, it may be applied in many different situations. In other words, there are many different applications for this contextual model: business knowledge, community knowledge, academic knowledge. The knowledge is stored in a repository (in this case in a database) and is retrieved according to the individual user contexts that are given. As an example, contextual data for a business may be stored in an organization-wide knowledgebase. Once that data is entered into the system, an IMS LD template may be created to allow new employees who are coming into the organization to access the knowledge in a course-format according to the context that they have been assigned (which may be associated to a job description). The entry, access, and retrieval of the data allows for the standardization of the content that is associated with a certain context. The advantage in this scenario is that the perspective of the user in the system is tailored to the role that they have within the organization, so their accumulation of the organizational knowledge is extracted specifically for the role that they have been given within the organization. This allows for the movement from implicit knowledge, knowledge that is held by people within the organization but is not shared, to explicit knowledge, which is knowledge that may be accessed and used in a learning environment. This move from implicit to explicit knowledge allows for the continual growth of an organization-wide knowledgebase. More and more contextual data may be applied to an individual role, increasing the knowledgebase for that role.

**Future Research**

There are a number of directions that future research may undertake on this particular topic. To progress to a full blown application there are three main processes that must be addressed. Firstly, more detailed steps for the inclusion of GPS data to allow for location-specific
information to be included. JSR-179 which is part of J2ME may be used to allow for the extraction of GPS data from any GPS-enabled device. Once the information is extracted, the appropriate algorithms may be run to allow for:

- Finding participants that are within a certain geographical limit to allow for the grouping of participants.
- Determine location-specific data that may be included as part of the inclusion process for contextual data.

Secondly, further development of the mobile application is required. Many current mobile devices use the J2ME development environment. An application must be created that polls a mobile device for its display requirements, then is able to load a mobile browser application that connects to a web page and loads the contextual learning system with an appropriate CSS page that sets the dimensions of the page according to the polled device requirements.

Thirdly, the application of IMS LD Level B to the proposed model is an additional step that would allow for a higher level of adaptability. IMS LD allows for different learning routes according to the values that defined properties (Level B) have at run time (Santos, 2007). Using IMS LD Level B, conditions may be applied to the learning material, providing an even higher level of adaptability. The results of this research show that the type of proposed system is desirable and feasible as a tool for providing context and adaptability on a standardized learning platform, IMS LD.
REFERENCES


Dyson, L., Hendriks, M., & Grant, S. (2007). Can information communication technological tools be used to suit aboriginal learning pedagogies? In L. Dyson, M. Hendriks & S. Grant (Eds.), () IGI Publishing.


Tattersall, C. (2006). *Using IMS learning design to model collaborative learning activities*


APPENDIX A

SAMPLE IMS LD

<?xml version="1.0" encoding="UTF-8"?>
<!-- This example created by John Loewen Athabasca University Student 2009-->
<!-- Based on the IMS Learning Design Best Practice and Implementation Guide (v. 1.0)
example by Colin Tattersall, Open University of the Netherlands -->
<ims:manifest xmlns="http://www.imsglobal.org/xsd/imscp_v1p1"
xmlns:imsld="http://www.imsglobal.org/xsd/imsld_v1p0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.imsglobal.org/xsd/imscp_v1p1 imscp_v1p1p3.xsd
http://www.imsglobal.org/xsd/imsld_v1p0 IMS_LD_Level_A.xsd"
identifier="OfficeProductivity_UOL">

<imsld:organizations>
  <imsld:learning-design identifier="Office_Productivity" uri="URI" level="A">
    <imsld:title>Office Productivity</imsld:title>
    <imsld:learning-objectives>
      <imsld:item identifierref="OP-lo" identifier="OP-lo">
        <imsld:title>Learning Objectives</imsld:title>
      </imsld:item>
    </imsld:learning-objectives>
  </imsld:learning-design>
</imsld:organizations>

<imsld:components>

  <imsld:roles>
    <imsld:learner identifier="student"/>
    <imsld:staff identifier="teacher"/>
  </imsld:roles>

  <imsld:activities>

    <imsld:learning-activity identifier="LA-introduction">
      <imsld:activity-description>
        <imsld:title>Introduction</imsld:title>
        <imsld:item identifierref="intro_desc" identifier="RES_Intro"/>
      </imsld:activity-description>
    </imsld:learning-activity>

    <imsld:learning-activity identifier="LA-section1">
      <imsld:activity-description>
        <imsld:title>OP Section 1</imsld:title>
      </imsld:activity-description>
      <imsld:learning-objectives>
        <imsld:title/>
      </imsld:learning-objectives>
    </imsld:learning-activity>
  </imsld:activities>

</imsld:components>

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<imsld:learning-objectives>
<imsld:title/>
<imsld:item identifier="S4_obj"
identifierref="LA_obj_section4" isvisible="true"/>
</imsld:learning-objectives>

<imsld:item identifierref="S4_notes" identifier="res_S4_notes"/>
<imsld:item identifierref="S4_readings" identifier="res_S4_readings"/>
<imsld:item identifierref="S4_handson" identifier="res_S4_handson"/>
<imsld:item identifierref="S4_answers" identifier="res_S4_answers"/>
</imsld:activity-description>
</imsld:learning-activity>
</imsld:activities>
</imsld:components>

<imsld:method>
<imsld:play identifier="PLAY-Office_Productivity" isvisible="true">
<imsld:title>Office Productivity Essentials</imsld:title>
<imsld:act identifier="ACT-individualized-learning">
<imsld:role-part identifier="RP-individualized-learning">
<imsld:role-ref ref="student"/>
<imsld:activity-structure-ref ref="AS-Office_productivity"/>
<imsld:role-part>
<imsld:complete-act>
<imsld:when-role-part-completed ref="RP-individualized-learning"/>
</imsld:complete-act>
</imsld:role-part>
<imsld:complete-play>
<imsld:when-last-act-completed/>
</imsld:complete-play>
</imsld:act>
</imsld:play>
</imsld:method>
</imsld:learning-design>
</imscp:organizations>

<imscp:resources>
<imscp:resource identifier="intro_desc" type="webcontent" href="intro_desc.html"/>
<imscp:resource identifier="S1_obj" type="webcontent" href="S1obj.html"/>
<imscp:resource identifier="S1_notes" type="webcontent" href="S1_notes.html"/>
<imscp:resource identifier="S1_readings" type="webcontent" href="S1_readings.html"/>
<imscp:resource identifier="S1_exercises" type="webcontent" href="S1_exercises.html"/>
<imscp:resource identifier="S1_answers" type="webcontent" href="S1_answers.html"/>
<imscp:resource identifier="S2_obj" type="webcontent" href="S2obj.html"/>
</imscp:resources>