Mobile 2.0 Leads to a Transformation in mLearning

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Abstract. This paper aims to delineate the impact of Mobile 2.0 on mobile learning（mLearning). Based on a thorough analysis on numerous Mobile 2.0 applications which can be used or are being used for learning purposes, the paper concludes that Mobile 2.0 brings a revolution to learning and will eventually lead to a transformation in the style of learning. The background for this conclusion includes introduction of the concept and technology of Mobile 2.0, its relationship to Web 2.0, empirical research, and actual use of Mobile 2.0 applications in education. The paper also offers a sneak peek at the future of Web 3.0 assisted learning. This Japan and China based research is also applied to other countries.

Keywords: mLearning, Mobile 2.0, learning transformation, Mobile 2.0 applications for learning, Web 3.0

1 Introduction

1.1 Web 2.0 and Mobile 2.0: Potentiality for Learning

Web 2.0 on PCs has been proved to be significantly pragmatic in education [1]. Then to what degree has Mobile 2.0 been able to extend PC Web 2.0's educational applications to mobile devices? Mobile 2.0 is a term that has been used since the appearance of Web 2.0 in 2004. Mobile 2.0 constitutes the next generation of transferring data to mobile devices and it links Web 2.0 with the mobile platform to create something new: it creates a new set of services that has greatly increased mobility and is as easy to use as the Web. These services point the way forward for the mobile data industry [2]. Without exception, all Internet giants have stepped into the Mobile 2.0 market. Google, Yahoo!, and MSN can all be adapted to mobile devices that have Internet connection. Apple's iPhone has integrated the functions of the mobile phone, PDA, GPS, iPod and TV, and all of these functions can be activated just by finger touch. Yahoo! has mobile handset-oriented pages called Yahoo Mobile! On Microsoft's mobile OS, Windows Mobile enables PC Office files to be viewable on mobile phones and PDAs. Mobile 2.0 is not device dependent: any mobile device which can be connected to the Internet can be considered to be a Mobile 2.0 carrier, including Nintendo's DS Lite and other handheld game consoles.

All functioning mobile phones, PDAs and iPods are within the realm of Mobile 2.0. Unlike Web 2.0, Mobile 2.0 is more concerned with user-led services and focuses more on the user-side than PC Web 2.0, as mobile handsets can be used almost anywhere.

Most multi-function applications developed in Java, Python, or open C/C++, run fairly well on mobile devices. This has given mobile phones qualities resembling small, handheld computers. It can also be argued that the built-in GPS, FM radio and both streaming and broadcast TV services on mobile phones make Mobile 2.0 more differential and even revolutionary than PC Web 2.0. Increasingly seamless integration of PC Internet and mobile networks has changed mobile devices into very powerful learning tools.

1.2 **Research Purpose – Exploration of Mobile 2.0 for Learning**

Web 2.0 for learning is widely practiced and has been well-researched. However, Mobile 2.0 for education has yet been to be fully explored. How can Mobile 2.0 be used for learning? What are the strengths and potential of Mobile 2.0 for learning? Are there any successful applications of Mobile 2.0 reported in education? Finally, Web 3.0 has also recently emerged. What kind of applications for learning can be predicted for Web 3.0? The above questions will be discussed in the following sections. Section 2 details the background of Mobile 2.0 for learning and delineates the actual use of Web 2.0 in education. Section 3 discusses the learning transformation that Mobile 2.0 is leading us to. The concept of Mobile 3.0 and how it can be used for education is predicted in Section 4. Section 5 provides a summary and conclusion of the previous sections.

2 Mobile 2.0 for Learning Purposes

2.1 Mobile 2.0 for Learning: An Infrastructure Background

In the last decade, mobile phone technology has witnessed incredible developments in technology: from analog to digital and from plain and simple mobile phones to the current 3G smartphones which can serve as a mini-computers, telephones, radios, televisions and cameras. This rise in technology has been so monumental that it is outpacing the devices that are currently on the market.

In Japan, as of April of 2008, the number of contracts with mobile phone companies (mainly NTT DoCoMo, au-KDDI, Softbank and EMOBILE) was 102,724,500 [3], which is roughly 80% of Japan's population. China, the largest mobile phone market in the world, had 575 million mobile phone users as of April, 2008 [4]. When coupled with other formats of mobile devices, such a large figure has created an enormous number of potential learners who can learn anytime and anywhere. As impressive as the increasing numbers of mobile phone users are, equally surprising is the development in wireless telecommunication infrastructure and mobile device manufacturing technology. Mobile telecommunication in many countries have entered 3G, which is a generation allowing the transmission of 384 kbit/s for mobile systems and 2 Mbs for stationary systems. Japan, Europe and North America are already moving towards 4G networks (WiMax 4G networks show transfer speeds of 3Mbs and 4G Long Term Evolution — LTE — networks are

already achieving real-world transfer speeds of 180Mbs) [5]. These increasing speeds make mLearning less problematic and even more feasible. Infrared, Wi-Fi, WiMAX and Bluetooth technology enable data communication between mobile phones and other digital devices. In the case of Japan, all mobile phones have Internet connection capability.

2.2 Mobile 2.0 Applications for Learning

Some IT technologies are best suited for particular learning activities. For example, the SMS function on mobile phones is ideal for vocabulary learning as vocabulary items are naturally short and can be easily segmented to small, individual definitions and examples [6]. A similar situation exists with the nexus between Mobile 2.0 applications and learning. For example, text blogs are helpful for training writing ability and improving social identity. Wiki is useful for promoting collaborative topic discussion and writing. Podcasting can be used for a lot of educational purposes such as content dissemination. Thorne and Payne [7] cite some educational projects utilizing Wiki technologies for learning. For instance, L.Wiki (a particular Wiki to support Unicode encoding), supported by Pennsylvania State's foreign language resource center is used by a variety of groups and courses, including Chinese, German, Russian, Spanish, English composition, and also for English as a Second Language courses.

The primary uses of iPods include individual and collaborative student authoring, course project management, and multiparty running commentaries. In the case of Podcasting (combining iPods and broadcasting) for language listening, it is worth noting that Podcasting-assisted English learning programs started in April 2004 at Osaka Jogakuin College, Japan [8]. 15-gigabyte iPods were provided to 210 newly enrolled freshmen. These iPods came installed with audio materials designed to improve learners' listening abilities.

Real-time updating alerts of learning content via RSS and ATOM

In the PC Web 2.0 world, people need to sign into their accounts to generate Web 2.0 content such as blogs, SNS (Social Network Service) and share photos and videos. After that, content developers (users) must wait for others to view their messages or choose to subscribe to new ones through RSS feeds. Passive RSS has been an important web syndication protocol. More importantly, ATOM (Atom Publishing Protocol), which has been rapidly replacing RSS as the preferred syndication format, is already actually part of every major RSS reader and email client today. This move away from RSS towards ATOM is because RSS is a technically flawed implementation of a good idea and is, in fact, incompatible with itself to the frustration of many, and that, combined with numerous problems related to g11n feeds, has given rise to ATOM. However, depending on how one publishes the information, preferably automated and using a Content Management System such as Drupal or Joomla, it is mostly trivial to implement either one or both (which is most often done as many data consumers are not savvy enough to distinguish between the two).

The primary benefit to having a syndication feed is to increase exposure of something by submitting it to be regularly crawled by a feed search engine or

community, such as Technocrati or Facebook as examples, to freely disseminate the information throughout the web to parties who are keeping abreast of trends particular to a broader interest. In the mLearning world, learning tips or new information for study (vocabulary items of the day, etc.) can be submitted to many sites that have been built for specific student populations (Moodle sites, etc.).

As a vehicle to keep students abreast of happenings, it is certainly acceptable. But trends do demonstrate that most people do not directly subscribe to such feeds in practice, and unless the originator of the feed is interested in a wider exposure to try to generate additional traffic to the original site created for the specific student population, its usefulness has more to do with the actualized relationship with the students and ironically, the better it is, the less likely they are to subscribe to the feed directly unless it is a forced subscription.

Even so, feeds are generally disregarded, as they need to be in constant motion to demand attention. Because of this, the learning situation would probably be better served by emailing updates to the students and having the same release available on the mLearning or e-learning website for syndication. The teacher would tend to get more attention out of the email than the feed and theoretically raise its urgency as opposed to a feed which is entirely passive and, unless it is part of a collection of topically relevant feeds that provide important information for the course and considered part of the requirements, it would likely be ignored by the majority of the students. Thus, we return to RSS/ATOM's actual value; pushing the feed to Google, or some other central source to broaden the mLearning/e-learning audience beyond a finite group and as a general promotional vehicle rather than an active resource.

The problem is that in order to perform all these functions (signing into their accounts to generate Web 2.0 content such as blogs, SNS, sharing photos and videos, etc.), users must be near a PC. This is not a restriction for Mobile 2.0 users, as they can send updated information to subscribers via mobile-based mail systems, which can be accessed in real-time. Mobile 2.0 can also spread information more effectively than Web 2.0 by utilizing existing mobile phone numbers.

Registered or un-registered Mobile 2.0 sites.

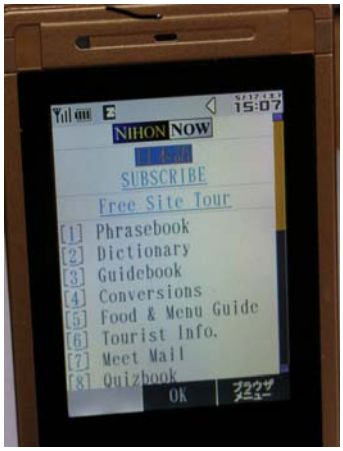

Fig1. An example of registered Mobile 2.0 learning site

The URLs that are built into mobile phone menus are known as *registered* sites. In Japan, these sites must sign contracts with mobile telecommunications companies and pay a fee in order for them to be incorporated into the phones. Further, the content of registered mobile sites is investigated thoroughly by mobile phone companies. For example, NTT DoCoMo, au KDDI, Ezweb, and Softbank Yahoo! Mobile have a large number of mobile sites registered with them. Users merely need to scroll through their menu lists to find their desired sites.

Most learning sites on mobile phones are registered sites, providing a surfeit of Mobile 2.0 services. Sites such as the one in Figure 1 offer online quizzes, message posting, Wikis, RSS feeds, photos and video sharing services (see Fig. 1, the front page of a registered Mobile 2.0 learning site.).

Some well-known examples of registered learning Mobile 2.0 sites in Japan include: English Forest <www.eigonomori.com/keitai.php>, from which mobile phone users can do listening exercises, download texts, and take online quizzes; and English People <http://eigojin.net> enables mobile phone users to learn English words though games and BREW (Binary Runtime Environment for Wireless) applications. Learners can download and run programs from the site for playing games, sending messages and sharing photos.

These registered learning mobile sites are mostly run by schools and other related companies for a profit. The obvious drawback of these sites is that users pay for the time they spend online and for the use of the learning site. For this reason, it may not be advisable for teachers to put time and money into building a registered site. In the case of Japan, it is also unlikely that an individual mobile site will be approved by the major mobile phone companies.

As a result of the drawbacks noted above, teachers may have to turn to *unregistered* mobile sites. These sites work much like a majority of sites on the Internet: they are made by users who have no affiliation to any specific site or company, and they are made for a user community with a specific purpose. Thus, teachers can take advantage of this option, as it is a much cheaper and more user-friendly option than registered sites. A further advantage of unregistered sites is that they are built to have exactly the same functions as the registered sites. In fact, the only added burden on the user of these sites is that he or she must manually input the URL of the site into his or her mobile phone. In fact, as more and more digital cameras built in mobile phones can “read” URLs and email address in QR (Quick Response) codes, the input of URLs has become easy.

Do-it-yourself: Free Mobile 2.0 sites for teaching purposes

A popular and free Mobile 2.0 site builder for teaching can be found at Winksite <http://winksite.com>. The site claims that it makes it easy to create mobile Websites and communities that can be viewed worldwide on any mobile phone. Winksite allows users to build their own blogs, chat forums, conduct polls and create journals on mobile phones.

It is truly user-friendly in that it does not require the user to download or install any software, and allows users to build and manage a mobile community over which they have total control [9].

Teachers can easily avail themselves of Winksite’s functions. For example, teachers can make announcements to students, post homework assignments, give quizzes, and discuss tasks assigned in previous lessons. The use of mobile phones for

these activities offers a multitude of educational opportunities for learners, as it promotes interactivity and gives them quick and easy access to discussion and timely feedback from teachers. Further, teachers can encourage learners to work collaboratively on writing assignments, read e-magazines, and conduct group work, all via their mobile phones by customizing services from this site

Fig. 2. A Do-it-yourself Mobile 2.0 site using Winksite

In Japan, there are several mobile page providers, such as HP Maker <http://hp.0zero.jp >, Forest Page <http://id.fm-p.jp>, and FHP <http://fhp.jp>, which all have similar services to Winksite.

Learning through mobile blogs, SNS, tags and games

Beginning with mixi <http://mixi.jp> in 2004, SNS in Japan has become extremely popular. As of May 15, 2006, Mixi had 4 million registered users and 130 million page views (PV) per day. Another popular blog site in Japan, Livedoor, had 8.6 million registered users by the end of April, 2006 [10]. Both sites can be accessed by mobile phones, with both having a large contingency of foreign community users. Japanese language learners using these mobile sites have access to everyday Japanese use at their fingertips. In addition to language communities, there are numerous other learning communities in many different fields. Community members raise questions, propose solutions and exchange ideas. Some regularly read and comment on the blogs on the sites. Mixi members can always find a community to meet his or her learning interests.

In the first half of 2004, SNS providers simply transferred their services from PCs to mobile phones without considering the special features of mobile phones. From the winter of 2004 to 2005, Japanese providers using SNS started to embed mobile phones with unique functions like GPS and mobile games. Coupled with these, Mobile Social Software (MoSoSo) can facilitate social encounters by allowing users to see others who are in the same geographic location as them. The implications for learning are clear: Mobile 2.0 users can easily find out who, in their community, is nearby and available to talk and/or learn simultaneously.

Mobile SNS integrated with online games is another new tendency in Mobile 2.0. One successful integration of SNS and online games in Japan can be found at Mobage-town < http://mbga.jp >, a free mobile site offering free online games and a wide variety of community functions such as blogs, email, chat, and message boards. The site has some English games on it that can be used by learners to gain a different perspective on English language learning. After all, teachers often employ games in their classrooms, so extending them to mobile phone usage is another facet of Mobile 2.0 that can greatly assist the learner.

One of the Mobile 2.0 features is "I am not a number, I am a tag." In Web 2.0, tags are essentially a classification system. Tags are different from keywords as keywords have to appear in the content, but tags can be created by the bloggers and page makers to reflect their thoughts about the content. Educators can use tags to associate specific learning references, class events and learning topics. Learners can make the best use of tags to look for desired blog entries, images, and other web publications for certain learning topics, as search engines can index tags to make relevant materials searchable in a uniform way. By using the above Mobile 2.0 community tools, mobile learners can be ubiquitously involved in content editing and sharing in mobile communities. Pedagogical research shows that mobile communication can significantly increase student extrinsic motivation without increasing the pressure on them [11].

Learning via animated media on Mobile 2.0 phones

Since Flash Lite 1.0 was released by Macromedia in 2004, it has been supported by most mobile phone companies. Flash Lite is very popular with mobile users who buy discount contracts with their providers, as they can usually view as many flash movies as they like for the same price each month. For learning, Flash Lite can be used for creating flash cards to review foreign language vocabulary and grammar: a very popular method of learning new words with many learners. Science teachers can use Flash Lite to create flow chart to indicate an experiment process and solving process of mathematical problems. Students who use smartphones can download Flash Lite software from the Internet and install it on their mobile phones. Learners can also choose to view flash movies by connecting to a Mobile 2.0 site. In Japan, <http://freedom-mobile.jp> is a good example of how flash can be used to provide rich format contexts on mobile phones.

Video possibly has more power than any other medium for learning. It has the power to engage, enlighten, and fascinate learners. With this in mind, YouTube is representative of Web 2.0 applications that are currently being widely used for various educational purposes. Teachers can post their lessons to the site for students to review. Science teachers can post recordings of experiment processes, language teachers can upload video clips, interviews, or selected clips from educational TV programs to YouTube for their class to view. In fact, learners can always find video clips which are perfectly, or at least partially, relevant to the topic being taught on YouTube. Mobile YouTube has been available on many specifications of 3G mobile phones that support 3GP video format since 2006 in Japan. As the digital streaming video from mobile networks is still quite expensive for viewers, Mobile YouTube is not yet as popular in education as PC YouTube. The same reason applies to Second Life. Second Life is an online community, which has been in the headlines lately for creating a virtual community, whereby users pay for virtual goods and services. Some

companies are providing game players with a virtual cell phone that works within the game and enables voice, SMS and basic mobile content services. But there are very few studies on, or practices that use Second Life on mobile phones found in education.

SMS integrated with instant* messengers *(IM)

SMS for learning has been gaining in popularity as of late. Levy and Kennedy [12] sent Italian words, idioms and example sentences to students ' mobile phones as SMS messages. The project proved successful for aiding in language learning and demonstrated that the use of SMS in learning is a pedagogically sound technique.

Instant messengers (IM) are also valuable tool for learners. Time and place-independent communication is one of the fundamental tenets of mobile assisted learning. Like SMS, has the potential to greatly enhance communication between learners and instructors. The integration of SMS and IM, which is advancing in the Mobile 2.0 world, serves as a connection between mobile phone users and PC users. Moreover, it connects mobile phone users even more closely to each other, giving them an advantage over conventional PC users. In China, people can send SMS messages to mobile phones using QQ, the most popular instant messenger with Chinese youth. Skype, Yahoo!, and MSN also allow users to send SMS to mobile phones by typing in the users' mobile phone number. Instant messengers like MSN and Yahoo! messenger are available on most mobile phones with, and mobile phone users can easily enter communities like mobile blogs from their phone's IM mode. Users can chat online with mobile phones partners or PC users. This allows potential learners to exchange information much more conveniently when they are on the move.

Li and Erben [13] report that learners are capable of increasing their intercultural awareness with prolonged use of instant messenger services. Li and Erben argue that these services can assist in boosting self-reflection capacities, critical thinking skills and create a greater sensitivity and respect for intercultural differences. In a time and age when these skills are so important for survival in an increasingly globalized world, teachers and learners cannot afford to overlook the benefits of acquiring these qualities.

Mobile search

In July 2006, Japan-based au-KDDI, in cooperation with Google, started a mobile search engine service that is available on their phone's menu bar. Then, the Japanese giant telecommunications company NTT DoCoMo, which was the first company in the world to create a mobile phone with Internet capability, embedded a whole host of Internet search engines onto its i-mode service: Google, R25, CROOZ! SeafTyy, and mobile Goo. Clients using these search engines can also obtain content from unregistered mobile sites and the original PC sites. Further, since the summer of 2006, Softbank has led the growing trend of Mobile 2.0 in Japan. Every Softbank mobile phone is now embedded with the following Yahoo! Products: search; calendar; mail; messenger; animated cartoons; comic books with their popularity ranked by readers; games, and news. As these services are quite new, many learners do not yet possess a concrete knowledge of them. Instructors can utilize these services in their classrooms by demonstrating how they work and by introducing potential peers with whom their learners can communicate.

Location Based Service (LBS) for context aware and adaptive learning.

GPS navigation service allows people to find out a precise physical location with a high degree of accuracy. In Japan, by 2006 GPS functions had been built into 26% of

mobile phones [10] and this ratio has been steadily increasing. As LBS on mobile devices provide services such as navigation, field services and "find my nearest", it obviously can be used for context aware or adaptive learning. Some ideas being explored are: Mobile Google Map service can be used for outdoor geography learning; learners can be sent "pinpoint" context aware learning materials; and on the learner side, using mobile LBS, they can always find their nearest community members. For example, a group of like-minded Japanese learners could use the mobile site <http://activo.jp>, an SNS site integrated with GPS.

Mobile 2.0 LMS/ CMS for learning

LMS (Learning Management System) or CMS (Course Management System) are complex software or platforms designed for planning and managing learning activities online or offline. Popular LMSs for educational use are Moodle, a free open source teaching and learning management platform, and Blackboard (WebCT), a widely used commercial LMS. In the era of Web 2.0, many of these LMSs have integrated Web 2.0 technologies.

It is natural to expect that the above types of LMS work on mobile handsets so that teachers can manage teaching and students can conduct learning remotely. Unfortunately, due to the fact that both the hardware and software on mobile handsets have inherent limitations in running a multi-functional LMS, it is difficult to transfer all types of LMS to mobile handsets. Hardware limitations include small screens, low bandwidths, low resolution of images, and the difficulty of typing on small handsets. Software limitations include the rejection of cookies and the problem that mobile handsets do not support as many applications as PCs. Moreover, mobile online learning security such as access control can only work reliably through integrating an operating system, which many current mobile phones do not have [14].

Poodle, a mini-LMS course-management system developed by Houser and Thornton, is designed to read quizzes in Moodle's own GIFT format, and randomly distribute questions and responses to learners of English, with each of these displayed in its own tiny webpage. The authors also built a Wiki and forum server, which enables students to collaboratively learn about American culture. Poodle was highly rated by learners, who cited its ability to be used anywhere and anytime as one of its main advantages of it [15]. With the exception of its online quiz function, Wikis and forums, other Moodle functions were not mentioned in Houser and Thornton's paper. Further, Researchers at Sapporo Gakuin University, Japan, have successfully converted PC Moodle to mobile phones, allowing feedback and quiz modules to be viewed on mobile phones, but not the other functions of Moodle.

Nevertheless, both Poodle and Moodle for Mobiles maintain their status as groundbreaking mobile LMS developments. With the increasing enhancement in mobile hardware and software, powerful and comprehensive LMSs are bound to emerge in the near future.

3 Mobile 2.0 – A Transformation of mLearning

The potential of Mobile 2.0 for learning was presented in the previous sections. In fact, not only has Mobile 2.0 changed learning for the better, but it has also fundamentally altered the means of everything from conducting business to education. From shopping to making ticket reservations, and from finding accurate directions to

learning, mobile devices have not only made our lives easier, but they also present us with opportunities we once may never have imagined. Throughout history, educational technology has greatly increased the way in which we learn: technology like movies, which has brought the world into the classroom since 1920, was considered to be a progressive teaching approach in the 1920s and the 1930s. Moreover, radio was regarded as "the assistant teacher" in 1930s. The 1950s witnessed a teaching transformation when TV was first used in the classroom [16], and the 1990s witnessed the World Wide Web being introduced into educational settings. Nowadays, Mobile 2.0 has changed both the way we live our lives and the learning styles we use.

There has been a plethora of research that envisions e-learning as an educational paradigm shift from classroom learning to distance learning [17]. From 1996 onwards classroom teachers started to incorporate the Internet into their regular classroom teaching. In the past decade, mobile devices have presented educators and learners alike with new opportunities for learning. They bestow upon us innovative means with which to conduct research, gain access to course administration and management, provide learners with support and guidance, and offer us the up-to-the-minute knowledge we require to compete and succeed in today's increasingly wired world. Ally, Schafer, Cheung, McGreal, and Tin assert that mLearning is distinctive because it facilitates the manner in which learning is delivered to people at the right time and in the right place. In the near future, "mLearning will become a normal part of lifelong education and self-directed learning" [18]. Accordingly, we believe the emergence of Mobile 2.0 will bring about a revolution in mLearning. Mobile 2.0 frees people's learning from a fixed place to any location while still maintaining a rich and interactive learning content. In Mobile 2.0 world, traditional SMS has been replaced with Mobile IM, MMS (Multimedia Messaging Service) has been replaced with mobile media sharing, WAP (Wireless Application Protocol) sites replaced with Mobile Web and Mobile search, Push-to Talk (PTT) with mobile VoIP, WAP Push with Mobile RSS reader, and LBS has been replaced with Mobile Google maps. Obviously Mobile 2.0 has made wired e-learning and wireless mLearning seamless. It makes the extension of in-house learning to outdoor learning much more of a reality.

Mobile 2.0 uniquely provides learners with a movable, sociable, community-based synchronous or asynchronous learning environment. Face-to-face learning is usually restricted to classrooms, and e-learning on wired networks is confined to PC desks. On the other hand, mLearning without Mobile 2.0 tends to be too individual, isolated and fragmented. Multi-featured Mobile 2.0 learning environments cannot be duplicated in any other contexts.

The limitations of mLearning [19] are likely to be overcome by the development of new technologies in the coming years. When mobile networks gain the capacity to reach broadband speeds, and when the inherent typing problems associated with mobile devices are eventually solved, the rich interaction and ease of content management that Mobile 2.0 promises will be fully functioning on mobile handsets. Mobile handsets will eventually integrate many more functions that the learner can use for learning. For example, the Apple iPhone is a mobile phone integrated with many of the functions of the iPOD, PDAs, digital cameras, GPS and TV. The iPod uses the Web as a back end and the PC as a local cache. In this sense, the Mobile 2.0 service is "driven by the Web and configured at the PC." With this concept in mind,

we will begin to see a complete transformation into truly practical handsets that will also facilitate a transformation in learning.

4 Mobile 3.0 for Future Learning

Although very few people are as yet talking about Mobile 3.0, some indeed have started to research Web 3.0, which is a term that is sometimes referred to as the Semantic Web. In the coming Web 3.0 era, browsers will have the abilities to discover and organize massive amounts of disordered knowledge generated on Internet. The Web 3.0 world is a place where machines can read web pages much as human beings read them. Current keyword search on the Internet is not intuitive and does not reflect the underlying Intent of the query. Being semantic in nature, Web 3.0 will allow semantic sentence input and be able to linguistically interpret it, including any misspelling, then return with accurate results. When Web 3.0 is expanded to mobile devices, that is, Mobile 3.0, this kind of "artificially intelligent interpretation" will dramatically improve learning efficacy using Mobile search, as misspellings happen more often when users input words via built-in speech recognition software or touch pad into mobile devices while on the move than when using a fixed-base PC.

Another potentiality of Mobile 3.0 for learning is to realize 3D virtual classroom on mobile devices. Mobile Second Life is already being tested for business purposes on mobile phones. This would involve the Web transforming into a series of 3D spaces, taking the concept realized by Second Life further. This could open up new ways to connect and collaborate using 3D shared spaces in learning activities. As the virtual 3D world on PC starts to be widely used in education, we believe that mobile virtual 3D classrooms can be realized on mobile devices in the near future.

While some people feel that Mobile 2.0 carriers such as the Apple iPhone, Google Earth and GPS phones that integrate user-generated-content are in fact Mobile 3.0, most consider that these are but the first feeble steps in that direction. One thing that is certain, however, is that Mobile 3.0 for learning is a field that is wide open for exploration and exploitation.

5 Conclusion

This research focused on how to use Mobile 2.0 concepts and technology to benefit learning and teaching. The paper discussed how emailing, blogging, SNS, online games, mobile searching, and the integration of SMS and IM can be used on mobile devices, especially mobile phones, for learning. This community-based and user-led mobile educational style is undoubtedly leading to a transformation not only into mLearning itself, but also the whole e-learning world. This transformation is one that will positively affect the way in which we teach and learn. Arising from this discussion is the projected transformation from Mobile 2.0 to Mobile 3.0 that will eventually take place with a Semantic Web element possessing artificial intelligence being built-in to mobile devices. This can ultimately result in a virtual classroom that can be viewed on mobile phones and PDAs that will feature 3.5G and 4G technology expected to appear in 2009-2010 in Japan and some other countries.

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