Better Learning Through Augmented Reality: AR and the Classroom

Abstract

This paper reports on the development of an augmented reality (AR) game that immerses students virtually and in their physical environment to view PSU in different ways. Players learn historical information, interact with contributions from previous players, and use language to describe what they see, discovering new and rediscovering old hotspots. By producing knowledge through activity and learning through action, students are engaged in and shape their own education in real scenarios instead of through book work alone. Player experience and dynamics are recorded and assessed with a view toward creating more powerful learning environments.

A Brave New Augmented World

"The voyage of discovery is not in seeking new landscapes but in having new eyes" (Marcel Proust, as cited in Schell, 2008, p. xxv). Augmented reality games take place in real-world environments whose elements have been expanded using computer technology to create new experiences in otherwise familiar domains. AR games therefore have the potential to transform the classroom into a new and exciting academic frontier where the students become active participants. By producing knowledge through activity and learning through action, students are engaged in and shape their own education through real scenarios instead of through traditional educational models focusing on receptive learning and memorization. With mobile technology, learners are introduced to new concepts by way of place-based augmented reality games. The benefits of utilizing available mobile technology can supplement formal educational settings by facilitating open learning opportunities.

As of December 31st, 2011, the world Internet-using population exceeded 2.2 billion (Miniwatts Marketing Group, 2012), almost one third of the global population. Since the first wave of large scale public access to the Internet about 20 years ago, this number has rapidly expanded and will continue to do so, especially with the inception of mobile devices like smartphones and tablets. By the end of 2012, the number of mobile devices will exceed the human population on Earth, and is projected to grow to 1.4 devices per capita by 2016 (Cisco Visual Networking Index, 2012). Mobile applications and tablets "have become pervasive in everyday life, at least in the developed world, and students at universities and colleges have ever-increasing expectations of being able to learn on these devices whenever and wherever they may be" (Johnson, Adams & Cummins, 2012). A majority of students already have the necessary hardware and are waiting for educational institutions to implement them in meaningful ways.

Integrating Mobile Technology into Education

While there is little widespread adoption of mobile technologies for educational purposes, mobile devices are highly popular outside of the classroom. The ubiquity of mobile devices presents an opportunity to implement this technology in education. Even with the emerging market of self-education and learning-as-entertainment gaming, the mobile media industry has provided relatively few learning based applications. Those which have developed focus on memorization from static content, such as dictionary or flash card applications (Squire, 2009).

The need to memorize and quickly recall fact is no longer absolutely necessary as learners have the new-found ability to rapidly look up information on portable devices. Integrating mobile devices into the learning process, whether it is inside or out of the traditional academic setting, is key to advancing modern pedagogy (Squire et al, 2007). The dream of a computer for every learner is most likely to happen by way of handheld mobile technology, therefore showing the need to fully integrate these devices. Education lags behind most fields in terms of adopting mobile devices. Mobile phones have profoundly evolved from simple calling devices into fully functional handheld computers capable of incredibly complex functions (Squire, 2009). By utilizing the full capabilities of mobile technology educators will easily complement traditional classroom environments and real-world circumstance.

One major benefit of introducing the wide use of mobile technology to educational practices is the ability to personalize the learning process. A personal, handheld computer allows the student to choose when, where, and how they consume and produce information. With the connection of their mobile device they are no longer confined to learning in the barriers of the classroom but are now able to take their schoolwork out into any environment where mobile data access is available. Through this high level of connectivity, consumption, construction, and communication of information in physical places, mobile devices break down the barriers between public and private space, allowing users to personalize surroundings simply by being connected (Squire, 2009). Using this technology, learning shifts from a formal academic setting to a more applicable environment where place, circumstance, and the surroundings directly contribute to the acquisition of knowledge.

New Media and Language

With this massive growth of available digital information and communication technology comes a host of associated changes in everyday communicative practices. Unquestionably, information and communication technologies have had a substantial impact on educational practices and institutions. With technological advances evolving so quickly, academia constantly struggles to keep pace. Forms of evaluation, new modes of scholarship, and digital media literacy present significant issues with standard education (Johnson, Adams & Cummins, 2012). With some form of computer-mediated communication in the lives of a third of the world's population, the language we use has become in part shaped by emerging contexts; texting, blogging, social media, gaming, and so many more technologically dependent activities bring with them their own specific forms of literacy and identity formation (Thorne, Black & Sykes, 2009). As Thorne and Black argue in their 2007 article on language and literacy development in computer-mediated contexts, "qualitative shifts in communicative contexts, purposes, and genres of language use associated with new media necessitate a responsive and proactive vision of educational practice, particularly in the areas of first and additional language instruction" (p. 134). Language instruction in formal educational settings should use technology to augment instructional techniques and to provide learners with real-world skills applicable to engagement in new media contexts (Thorne, Black & Sykes, 2009). Formal educational settings rely on traditional forms of communication, mostly face-to-face communication with set time limits; few other fields have limited themselves this strictly by eliminating the use of technology.

Games, Augmented Reality, and Proactivity

By 'gamifying' academic materials, students become active participants or role-players,

shedding their own personal identities to adopt alternate personae in order to advance. Role playing games mimic many of our real life situations, often producing unintentional learning results. Educational games created for mobile devices generate interest and engagement for learning outside the classroom (Squire et al, 2007). Augmented reality, a fusion of virtual and physical space, demonstrates potential learning qualities relevant to many numbers of academic subjects, areas, and educational settings. Augmented reality "looks to use mobile technology to help produce learning that is personally customized, socially constructed, and which extends beyond the classroom" (Holden & Sykes, 2011). A game created to be malleable by the player provides an environment unhindered by the structure of the classroom. The learning pattern is not one of just transmitted knowledge, but an undefined trajectory of learning where a player can develop and absorb academic content, real world skills, values and identities. A number of augmented reality games have emerged from academia, immersing players into different fields of study. University of Wisconsin's game *Dow Day* sends its players through a history lesson by transporting them to 1967 to investigate the Dow Day riots, utilizing virtual interviews with protesters and real footage from newsreels. University of New Mexico throws its Spanish students into the murder mystery *Mentira* in the middle of Spanish speaking Albuquerque. In order to solve the mystery and clear their names, players must apply what they have learned in their Spanish courses to real life by immersing themselves in Albuquerque's historically Hispanic culture, using only Spanish to communicate (both virtually and with native speakers). These two examples highlight the potential to expand coursework outside the classroom, providing the opportunity for students to learn through their own choices and decisions. By presenting the player with a variety of decisions throughout the game, different narratives branch out, presenting the player with different endings, which promote debate and contemplation. (Holden & Sykes, 2011). Through decisions that translate to real consequences, players become proactive participants instead of educational bystanders.

Why Portland State University?

As Oregon's largest university with more than 29,000 students, Portland State University (PSU) also has the highest number of international students in the region and represents over 100 different countries in its population (Portland State University, 2012). The diverse student body at PSU and robust department of World Languages and Literatures create a unique opportunity for language learning at an institution becoming known for its progressive educational practices. PSU therefore is an ideal candidate for exploring innovative technologies for purposes of foreign language learning, one of the newest and most compelling of which is the use of augmented reality or place-based approaches for coupling real-world physical locations with Wi-Fi delivered data and/or game narratives and mechanics. With Wi-Fi readily available to all students and faculty and with a centralized location in downtown Portland, PSU already has the necessary tools in place to create a successful augmented reality experience.

Game Development

ChronoOps: Survive the FuturePast

In this section, we discuss the different elements of our game *ChronoOps: Survive the FuturePast,* the platform ARIS, the immersive narrative, different elements of gameplay, the locations visited, and applications to classroom environments.

ARIS: A powerhouse platform in a small package.

Games and applications are limited by two key components: the hardware and the software. Apple's iPhone, with a 40% market share amongst college students (Dean, 2011), not only has enough users, but also has the necessary hardware to create an immersive experience. The free and open-source application ARIS (Augmented Reality for Interactive Storytelling) utilizes the iPhone's GPS functionality, built-in microphone, internal speaker, memos and camera (either still image or video). Employing these varying forms of media does not require years of programming experience, but rather a basic understanding of using computers. ARIS games are built server-side (http://www.arisgames.org/alphaeditor) using drag-and-drop items and basic logic, allowing anyone to build a game or an experience.

Narrative.

In early brainstorming sessions, we struggled with finding a narrative hook. How can we entice people to play this ambitious multilingual game centered around sustainability? We determined that without a strong narrative nobody would have any reason to play. In *ChronoOps*, the player takes on the role of an agent sent back through time to find a piece of green technology to save the future, while at the same time avoiding an unknown enemy force. The game begins with a garbled message from an unknown person, "I found a way out! Don't believe them, they are the ones behind it!" Players are then greeted by a non-player character (NPC) named "Aries", who gives a brief tutorial on how to use the ARIS interface. Aries, an artificial intelligence sent back through time to assist in the player's mission, uses circumlocution to describe regular items and places. One example of this is Aries's description of a solar array panel, "I sense an anomalous heat signature from what resembles a quarter dome complex south of here." Players are then shown a picture of the solar array panel and are told to approach it for further analysis. The game ends on a cliffhanger, with Aries disabled and the player face to face with the enemy.

Gameplay.

ChronoOps is primarily played using Google Maps. Players explore PSU through different perspectives, discovering new and rediscovering old areas of campus. The NPC Aries and different virtual plaques appear on the map as players complete tasks or approach specific locations. The iPhone plays a sound and vibrates as new items become available. As they play, they create their own unique content, thereby ensuring a different overall experience every time. Players have three forms of content at their disposal: photo/video, text, and audio. Through the photo/video function, players not only capture images, but also choose whether or not to share them. By sharing them, the images show future players the same physical space through another's eyes. Players also have the ability to "like" images taken, which allows for a more social experience. The text feature (similar to notepad or memos) allows for more pedagogical tasks that test L2 comprehension; these notes can also be shared with players. Lastly, the audio feature provides players with the ability to record. Everything recorded, written, or captured gets uploaded to the ARIS server and anyone with the correct credentials can view all uploaded content (regardless of whether players choose to "share" in-game). Content is uploaded anonymously; however, players can create unique names for uploaded content thus providing a way around anonymity if they choose to do so. By simply logging into the ARIS editor, professors could quickly view and assess all user created content.

Locations.

For a place-based game, location is everything. *ChronoOps* guides players through a route rich with sustainable projects and unique vantage points. The game begins under the breezeway

between Smith Memorial Student Union and Neuberger Hall, a central area of campus. Players must then walk from Neuberger Hall to Parking Structure 1 via the second story skybridge. After walking up to the rooftop of Parking Structure 1 and examining each corner, players receive the prompt to approach the solar array panel on SW 6th & Jackson. Through more clues and scripts, players walk along a predetermined path showcasing many of PSU's projects such as the Research Greenhouse, the community garden, bike garages, the copper beech tree in front of the Millar library, and Electric Avenue. Players are constantly prompted to take pictures of their surroundings. Through juxtaposing scenes of modern technology with long-forgotten projects (a desolate putting green, or old landscaping now overgrown), *ChronoOps* delivers a visceral and lasting experience.

Discussion

Applications In The Classroom

Moving forward with *ChronoOps* and the ARIS platform, we will include a number of new features within the game to help measure the level of success language learners have. We have drafted a stripped down English narrative with simple tenses and basic vocabulary to make the game accessible with first and second year English learners. By translating this simplified narrative into other languages, we will give players an option at the beginning of the game to select their comprehension level or difficulty in multiple languages. Through coordination with different language departments at PSU, we could develop lists of vocabulary terms to coincide with first and second year curricula, in addition to short seminars showcasing gameplay and navigating through the user interface of ARIS. Players could write in a number of different styles, and in addition could record themselves speaking in their second languages. Due to the fact that all user-created content remains server-side, professors could easily access and assess their students participation by simply logging in to the ARIS editor. Ultimately, *ChronoOps* has the potential to serve as an excellent supplement to a number of classrooms using a variety of media in real physical spaces.

Conclusion

Let the City Serve Knowledge

Universities across the world have started researching different ways to gamify learning through augmented reality. With mobile technology quickly advancing, the sheer number of units in the hands of potential learners increasing, and with a culturally and linguistically diverse population, Portland State University has the right makeup for testing augmented reality games in a variety of contexts and fields. Through AR, players witness what once was, what could have been, and what will be. In language development, students learn past, conditional, and future tenses. Using AR for language development, students see their curricula in real physical space in addition to inside their textbooks. *ChronoOps* takes this idea even further through the development of user created content. User created content transforms the student into a player and a contributor to the game itself. This level of involvement not only serves as a great way to assess progress, but also changes the overall game experience each time. This content, which is accessed only by the creators of the game, allows for study and improvement to current game mechanics. By analyzing the limited statistical gameplay data collected by the ARIS server, editors can quickly make modifications to improve gameplay, learning and enjoyment. Through surveys, interviews, discussion, and participant observation, further research should be conducted on the benefits of *ChronoOps* and other implementations

of augmented reality games to broaden and bolster the academic landscape at PSU. As technology moves forward, so do potential educational tools. The future of education is here, and it is mobile.

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