Use and Acceptance of a Geo-located Arboretum Database as a Student Learning Tool

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Abstract

The grounds of Purdue University are registered as an arboretum with the aim to enhance the educational, research, and outreach missions of the University. The Horticulture and Landscape Architecture (HLA) program uses the campus arboretum with plants across nearly 800 different taxa as a living laboratory for plant identification courses. Purdue HLA has created a multi-layered geo-database to provide the majority of content for a sophomore level course on plant identification, with students using their own digital devices (smart-phones and personal computers) to access the arboretum database. This paper will investigate student acceptance and use of this web-based learning platform as a means of disseminating course content in informal learning environments.

1 Introduction

The goal of the Purdue University Arboretum is to be a resource for learning for many different fields of study at Purdue. The campus landscape currently serves as an important living laboratory and classroom for numerous courses taught in the life science fields such as horticulture, botany, forestry, plant pathology, and entomology. Our campus landscape is also important for engineering and the liberal arts, in areas such as drawing, sculpture, landscape architecture, and hydrology. Besides teachers and students in formal classes, it is common to see researchers on the campus exploring topics as diverse as plant taxonomy and physiology, plant-insect and plant-pathogen interactions, microclimatology, urban ecology, and issues in environmental sustainability, among others.

A number of arboreta and park systems have incorporated location based educational components into their programming (ART 2007; HWANG et al. 2012; OSAWA et al. 2007; REISER & BRUCE 2008; YANG 2012) with attempts to extend learning opportunities beyond formal classroom or guided tour formats. These alternative learning options are becoming more attractive to modern students, especially when presented through use of mobile devices such as cell phones, tablets, and hand held computers. This technology allows the classroom to be mobile, to move into real world contexts that can change depending on time, seasonality, or proximity to other objects and areas, and to present material in unique ways unavailable in a fixed location environment. Mobile learning (m-learning) can be defined as being able to learn at any time, in any place, at any pace, with the help of mobile technology (HWANG et al. 2012; PENG et al. 2009; SHARPLES et al. 2005; YANG 2012). M-learning systems have been shown to be effective as the "spontaneous, informal, contextual, portable, ubiquitous, pervasive, and personal features of the mobile learning, students were

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provided with more access and greater exposure to abundant authentic learning contexts" which can help "students bridge the gap between formal and informal learning experiences" (YANG 2012, pg. 148). Previous study results "indicated that students demonstrated positive attitudes toward m-learning. Students considered that m-learning offered more chances to acquire more information and supported collaborative and ubiquitous learning" (YANG 2012, pg. 152). The "always connected" nature of digital devices creates opportunities for students to find additional information outside of materials provided in a course if they were so inclined, providing a depth of content not possible under traditional course methods.

The move from traditional to self-guided and self-initiated learning methods can mean that control over the course shifts from the teachers to the students (SHARPLES et al. 2005) though this is not necessarily something to avoid. The shift in responsibility (though not without guidance) from faculty to student can foster life-long learning habits that require "…learners to be active and responsible for their learning. Learners need to apply self-regulatory strategies to their learning: they must articulate the goals that they intend to achieve, the decisions that they make, the strategies that they use, and the answers that they find" (PENG et al. 2005, pg. 179). This style of learning can connect students with content learning motivation when they became engaged in the authentic learning tasks" (YANG 2012, pg. 148). The increases in student motivation to participate, communicate, and actively control their learning justify the transition from traditional to student-initiated learning methods.

2 Methods

Historically at Purdue University, plant identification courses have been taught through a combination of classroom slide based lectures, handouts, and teaching assistant guided "plant walks" that toured students on a pre-defined route. HORT 217, a plant identification course for sophomore students in horticulture and landscape architecture, uses LAVE & WENGER's (1990) "Situated Learning" methodology where learning takes place in a context and setting functionally similar to where the knowledge or skills taught will be applied.

While this methodology is likely the norm for classes of this type, it typically does not allow for self-guided study and the educational worth of the course can be influenced by poor weather, human error, poor quality teaching assistants, or an individual student's ability to take notes and absorb the material in the field on a given day. In order to attempt to address some of these issues, the Purdue Arboretum, based in the Department of Horticulture and Landscape Architecture (HLA), created a multi-layered geo-database to serve student learning goals while providing an accessible resource to the public.

This study followed students in HORT 217 at Purdue University, consisting of 25 students with an adjunct faculty member handling the 50 minute lecture, and two (2) teaching assistants leading the plant quiz walks.

2.1 BG-Map & BG-Base

The Purdue Arboretum chose to use BG-Map (www.bg-map.com), a botanical garden mapping GIS system, and its associated BG-Base management database software (www. bg-base.com), as the backbone for cataloguing the campus plant library and as a facilities management tool for various offices across campus.

The Purdue Arboretum looked to the offices of the campus planner, landscape architect, and building and grounds maintenance for their various unlinked GIS databases (predominantly housed in Esri Arc-based systems) as the mapping provider for hardscape, structures, and plant locations and species. Using BG-Map as its backbone, the system is able to track plant locations generated by the campus planning department and integrate it into the database of educational material created by the faculty and IT staff behind Purdue's plant identification course. A faculty led team of students and staff then refined and expanded the plant database over the course of a year to simplify the data set, reducing the data from individual plants in large masses to grouped single identifiers for plant beds (trees remained as individual elements). The metadata within the plant list was expanded with the educational plant information and imagery and merged with the georeferenced database, allowing for the creation of a location based mobile learning platform. This platform aims to benefit students with alternative learning methods while providing consistent and comprehensive information from year to year.

Plants around campus have integrated signs that list plant family, genus, and species along with a scannable QR code that links directly to that plant's page in the arboretum learning database. Each plants page includes information on flowering type and time, soil and growing conditions, general history, and seasonal imagery of the plant whenever possible. From each individual plant page, viewers can link to plants similar in genus, flowering type or season, or to pre-planned plant tours, all overlaid on a zoomable campus map.

Fig. 1:
An example of a P University Campus Arboretum QR sign

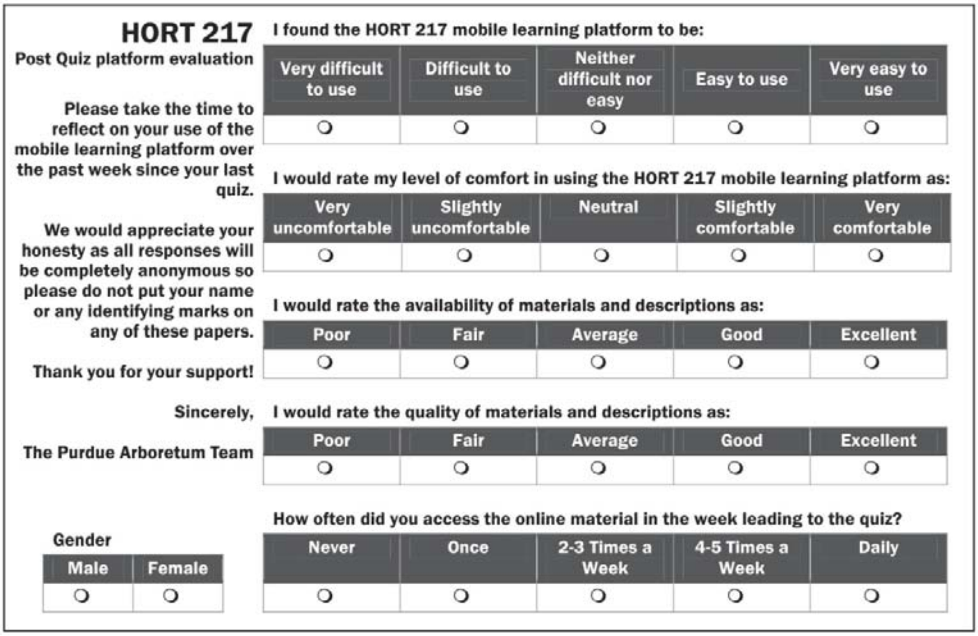
QR codes were chosen instead of RFID tags due to the broadcast distance limitations and costs of passive or active tags and instead of GPS location initiated data due to obstructions blocking satellite signals and the general inaccuracy of cell phone GPS antennas. This choice was further justified as most modern cell phones have built in cameras capable of capturing the QR data. The signs posted at example plant materials were sized and placed to maximize QR scanning accuracy and speed from both a standing or seated position to allow for ADA accessibility. The use of QR codes may aid in the educational mission of the arboretum as they "may be functional 'hooks' to making mobilism more relevant to student learning and engagement in higher education" (GRADEL & EDISON 2012, pg. 46).

With both a desktop and mobile phone optimized web portal to the database, both students and the general public can log in and search through the system using either scientific or common names, plant and flowering characteristics or times, or by scanning the QR codes on campus arboretum signage. The BG system includes a student course module that allowed instructors to present certain plants during specific weeks while students could take practice quizzes as often as they wished as a studying tool.

2.2 Survey Instruments

The first lab and quiz day served as a guided tour and use tutorial of the mobile learning platform where not only the system was introduced but guidance towards self-directed study and "learning how to learn" was presented. These tutorials were presented through the first few weeks of the course to assure that students were aware of the full extent of the class module. Data was gathered after each weekly quiz and responses were completely anonymous other than a gender identification question.

The first survey's intent (see Fig. 2) was to build a weekly snapshot of student acceptance and use of the mobile learning platform. These surveys were given in the field regardless of weather and collected by the teaching assistants leading the plant identification quiz walk. Responses from these surveys were quantified along a five (5) point Likert scale.



HORT 217

Post Quiz platform evaluation

Please take the time to reflect on your use of the mobile learning platform over the past week since your last quiz.

We would appreciate your honesty as all responses will be completely anonymous so please do not put your name or any identifying marks on any of these papers.

Thank you for your support!

Sincerely,

The Purdue Arboretum Team

I found the HORT 217 mobile learning platform to be:

Very difficult to use	Difficult to use	Neither difficult nor easy	Easy to use	Very easy to use
❍	❍	❍	❍	❍

I would rate my level of comfort in using the HORT 217 mobile learning platform as:

Very uncomfortable	Slightly uncomfortable	Neutral	Slightly comfortable	Very comfortable
❍	❍	❍	❍	❍

I would rate the availability of materials and descriptions as:

Poor	Fair	Average	Good	Excellent
❍	❍	❍	❍	❍

I would rate the quality of materials and descriptions as:

Poor	Fair	Average	Good	Excellent
❍	❍	❍	❍	❍

Gender

Male	Female
❍	❍

How often did you access the online material in the week leading to the quiz?

Never	Once	2-3 Times a Week	4-5 Times a Week	Daily
❍	❍	❍	❍	❍

Fig. 2: The weekly post-quiz survey

The second survey, which was given at the end of the semester, served to provide an opportunity for students to reflect on their semester long interactions and opinions of the web based platform and its content. This survey also gathered technical data to determine how students were accessing, interacting with, and accepting the mobile learning platform along with some open ended questions for qualitative results.

3 Data and Results

Using Cohen's d (COHEN 1988), a medium effect size was found between the first and last week's quiz surveys across the entire class (d = -.70), the majority of this difference was found in male students responses compared to females (d = -1.06 and -.34 respectively). On average, male respondents began the course less comfortable with the mobile learning platform (mean = 3.31) and found it more difficult to use (mean = 3.38), they also had the largest change in these categories (male mean Δ = .84 and .10 and female mean Δ = .32 and .20 respectively). By the end of the course a small difference in effect sizes between male and female perception of use (Cohen's d = .41) and comfort using the learning platform (Cohen's d = .45) were found.

Student responses to the arboretum mobile learning platform were generally positive as demonstrated in Figure 3. On average, students accessed the arboretum database 4-5 times per week across the entire 12 week study period. The mobile learning platform allowed students to study material at their own pace, with the average student taking 1-2 hours to complete the weekly plant walks which is the same time it historically took with the leading TA's time shared amongst up to 20 students in a section. The content provided within the online database not only covered the basic material typically presented in the course, but added descriptions, photos, and use characteristics not previously presented in the field.

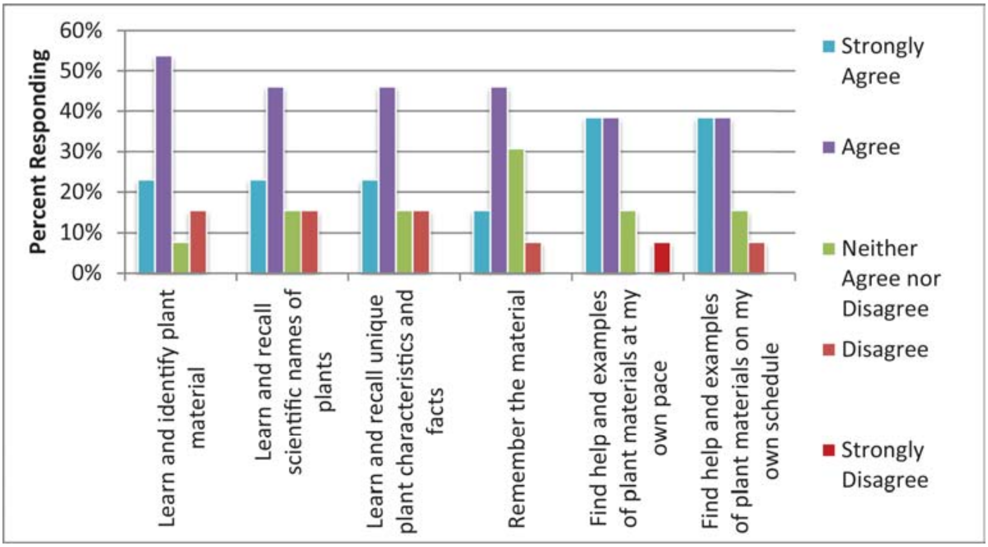


Fig. 3: Student perception of the mobile learning platform

This dynamism of supplementary data and hands-on live plant experience both engaged students in outdoor learning (77% positive response) and provided students with the resources they needed to succeed in the course (85% positive response).

Similar to results in other studies (ART 2007; YANG 2012) the majority of users commented that they were motivated to learn using the mobile platform and that learning could take place any time without the constraints of scheduled classroom hours and access (85% enjoyed the self-sufficient nature of the system). Students commented that: “I could do the plant walks whenever I wanted to, and didn't have to bring all the plant information with me because it was all in my phone.” and “I liked being able to work individually and on my own time. The independence was one of my favorite parts of the M-Learning platform. I liked being able to physically interact with the plants, but the convenience of the platform [allowed me] to view pictures and details.”

With regard to equipment, 77% of students used their own personal phones to access the online plant database in the field, and of those, only one student was uncomfortable using their personal device to access course data. Of those who responded to the end of semester survey, 85% of students predominantly used digital devices to view course material.

It should be noted that the mobile learning system did not seem to foster group work or communication among classmates with 62% of respondents finding that the system worked better as a solitary tool. Students commented that they wished the self-quizzes had a noncumulative option to aid in learning newly presented material, and that the audio would be more helpful if it was broken into smaller files (separate files for common and scientific name, identification characteristics, etc.), and for the inclusion of more photographic images that ranged across seasons.

4 Discussion

Based upon survey responses, the Purdue Arboretum was successful in creating a mobile learning platform that achieved favorable responses in both usability and acceptance. Students believed that the materials provided were robust and complete (85% positive), that there was sufficient technical help provided, and that they would recommend using the m-learning platform in other courses (77% positive respectively). There was some initial need to aid students in “learning how to learn” in an independent learning environment, as the methodology was new to students at the sophomore level. The nature of the m-learning platform depends on student-initiated efforts, but the faculty and staff managing the course was able to provide guidance that will be of benefit to students in more advanced courses. Based on survey responses this learning curve seemed to take place after five (5) weeks of use, with acceptance and ease of use ratings showing a small effect size increase between the fifth and sixth weeks of class (Cohen's d = -.46).

Over 20% of students expressed an interest in having the option to quiz on new weekly material along with the larger cumulative plant list. While the graded quizzes were cumulative throughout the course, the self-guided quizzes available through the online course module did not allow students to quiz themselves on only new plants from the current week.

As students are often in the field when accessing course materials, the audio files could be reformatted so that the most vital information (the plant names and identification characteristics) was presented first to reinforce the importance of this information in the context of the course. The Purdue Arboretum will continue to track further iterations of HORT 217 and aims to include data concerning how much time each student spent at each plant on their self-guided plant walks, which parts of the system they accessed while in the field, and which specific specimens were visited (as there are multiple examples of each taxa across campus). This data would aid both the arboretum and the course by seeing which plant specimens provide a better example for students to recall the material during quizzes, in correlating time spent on plant walks with quiz scores, or which content is either most popular or most effective towards student success.

5 Conclusion and Outlook

Based on these findings, sophomores enrolled in HORT217 at Purdue University felt comfortable and confident in using the mobile learning platform, believing that it helped them identify, recall, and understand the material while providing access to plant examples at their own pace and schedule. The self-initiated active learning fostered by the Purdue Arboretum mobile learning platform allowed students to learn in their own ways using multiple learning methodologies: in the field interaction with plant materials, plant data available both digitally and as printed notes, recorded auditory commentary, photographic images, and practice quizzes. Under this course methodology, students are able to focus on absorbing and understanding material while in class instead of scrambling to copy notes.

The materials provided through the m-learning platform allow a student to repeat and revisit content as needed. The ubiquitous nature of smartphones and other digital devices with modern students represents an opportunity to shift course methodologies towards a language and interface familiar to modern students. Along with the large amount of supplementary material available on the internet, learning systems like the Purdue Arboretum mobile learning platform can foster a new depth of learning in early university courses and opportunities for specialization tailored to individual student's interests.

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