Pictures and words: Data collection proposal to investigate the affordances of current experiential learning environments

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Structured Abstract

BACKGROUND
Experiential learning, traditionally conducted in on-campus laboratory venues, is the cornerstone of science and engineering education. The online delivery of engineering coursework endeavours to mimic this with remote and simulated laboratory experimentation. This paper describes the data collection process that was implemented to obtain data for the investigation of the affordances within existing face-to-face experiential learning environments.

PURPOSE

The data collection process is free of participant bias and facilitates the collection of "repeatable" analysis by researcher(s) and/or any other expert(s) and/or interested parties.

DESIGN/METHOD
Following appropriate ethics approval, project team members at Swinburne University of Technology, Curtin University and Queensland University of Technology were asked to identify laboratory classes for inclusion in the data collection process. A number of fixed and wearable video cameras were used to record the participant activities during experimentation with both real and simulated equipment in a number of face-to-face venues. The collected data was de-identified and was analysed for identifiable student-student, student-demonstrator and student-equipment interactions.

RESULTS
An innovative tool, Studiocode (http://www.studiocodegroup.com), was used to identify *kikan-shido* and over-the-shoulder-learning/teaching events which occurred during the observed experiential learning. These findings can be used to identify venue affordances. Details of the results obtained from this process, as well as their interpretation to obtain affordances, will be disseminated at a Master Class which will be held at this conference (AAEE2014 Conference Wellington, New Zealand).

DISCUSSION
The use of video equipment ensured "repeatability" of both data collection and subsequent analyses. after an initial "break in" period, some participants became totally unaware of the presence of the video glasses and/or the fixed video camera and behaved as they would have otherwise.

CONCLUSIONS
Venue affordances were reliably identified from the data that was collected. However, the video glasses used did not allow for real-time streaming of the recordings, resulting in some unusable clips. The use of *Google Glasses*, to collect data on student activities will be investigated in 2015.

KEYWORDS
Affordances; data collection, experiential learning, kikan-shido, over-the-shoulder-learning/teaching.

Introduction

The recent growth of the digital economy and the rapid development of internet communication technologies have promised improved online education and training (Bell, Bush, Nicholson, O'Brien, & Tran, 2002). Furthermore, extra pressures exist on education providers to be globally competitive in their tertiary education offerings by improving the quality of their internet-based delivery with the incorporation of new technologies. The subsequent offerings are particularly targeted to support students in remote communities and disabled students anywhere (Lang, 2012). These steps are seen by many as attempts to preserve the institutions' income levels by evolving "their businesses in new and exciting ways" (Davies, 2012). Technology-driven innovations in education must be founded on evidence-based curriculum design.

Attempts to address the engineering skills shortage in Australia by increasing graduate numbers (Back et al., 2012), while dealing with budgeting pressures with academic staff cutbacks, have challenged the higher education institutions to migrate their courses to online platforms. This includes courses that involve experiential learning in laboratory venues (Nickerson, Corter, Esche, & Chassapis, 2007). In order to ensure that graduates are exposed to 'real-world' situations and attain the necessary professional skill-sets, as mandated by course accreditation bodies such as Engineers Australia (http://www.engineersaustralia.org.au), face-to-face laboratory learning with real equipment has been an integral component of traditional engineering education (Lowe, Murray, Li, & Lindsay, 2008; Sarukkalige, Lindsay, & Anwar, 2010). To satisfy accreditation requirements, the common practice has been to offer off-campus students equivalent remote and/or simulated laboratory experiments in lieu of the ones delivered on campus in face-to-face venues (Nedic, Nafalski, Ozdemir, & Machotka, 2011). The current implementations of both remote and simulated laboratories tend to be specified with a focus on technical characteristics, instead of pedagogical requirements. The described data collection procedure attempts to redress this situation by investigating the affordances for quality teaching and learning in different experiential educational environments.

In 2013, the successful submission for an Australian Government Office of Learning and Teaching (OLT) Seed Project funded the development and verification of a research framework that aimed to identify student activities in existing experiential learning environments - such as face-to-face and remote engineering laboratories, where students have access to real and/or simulated equipment. The data collection tools and the subsequent analysis facilitated the identification of the affordances of experiential learning venues.

The term "*affordance*" is used to describe how an object, or an environment, impacts on the actions of its user and is attributed to Gibson (1977). Norman (1990) argued that while affordances facilitate use, constraints impede potential uses. Hence, "*affordances*" must be context specific.

Purpose

Such collection data will enable the identification of the affordances of experiential learning venues and subsequent comparative benchmarking of existing and proposed face-to-face and online environment affordances for the same experiments performed by students in either venue. Unlike other data collection methodologies the data is free from participant bias and the nature of the collection facilitates for verification by any researcher at any time.

Method

The underlying methodology for the OLT Seed Project is based on the assumption that if: *affordances impact on activity then activity patterns reflect on a venue's affordances, hence on learning outcomes*.

The objective for the data collection is to facilitate the identification of "*kikan-shido*" - a Japanese term meaning '*between desks instruction*' (Clarke, 2006) - occurrences which are summarised in Table 1. While these events were originally identified for secondary school experiential learning in mathematics classes, they were also found to exist in university level engineering laboratory sessions (Banky, 2007, 2010).

As shown in Figure 1 the data collection and subsequent analysis utilised a three-layered interpretive model for media-rich research into social interaction, attributed to Wortham and Derry (2006), in order to ensure a traceable path from the analysed data, through any intervening depiction(s), back to the recorded data. One of the benefits of this technique is an implied link between the various data forms and the raw data. Additionally, video recordings of the sessions resulted in permanent records that permitted a researcher and/or any other expert(s) and/or interested parties to repeatedly review the affordances depicted in the video recordings, facilitating coding or recoding anytime (Fraenkel & Wallen, 2006).

Table 1: *Kikan-shido* activity groupings (O'Keefe, Xu, & Clarke, 2006, p. 76)

<table>
<tr><td rowspan="4">Kikan-Shido
Between desks instruction in which the teacher walks around the classroom, predominantly monitoring or guiding student activity and may or may not speak or otherwise interact with the students.</td><td></td><td>Monitoring Student Activity
The process by which the teacher observes the progress of on-task activities and homework, ascertains student understanding, or selects student work, with intent to keep track of student progress, question student comprehension and record student achievement.</td></tr>
<tr><td></td><td>Guiding Student Activity
The process by which the teacher gives information, elicits student response in order to promote reflection, or facilitates engagement in classroom activity, with intent to actively scaffold the development of student participation and comprehension of subject matter.</td></tr>
<tr><td></td><td>Organisational
The process by which the teacher distributes and collects materials, or organises the physical setting in the classroom, with intent to support interactions among students and facilitate student engagement in learning activities.</td></tr>
<tr><td></td><td>Social Talk
The teacher engages with student(s) in conversations not related to the subject matter or current on-task activity.</td></tr>
</table>

Data Collection

Following appropriate ethics approval, project team members at Swinburne University of Technology, Curtin University and Queensland University of Technology were asked to identify laboratory classes for inclusion in the data collection process. One fixed and a number of wearable video cameras were used to record the interactions during experimentation with both real and simulated equipment in a number of face-to-face venues. Various attempts were made to investigate the optimal recording equipment to enable the recording of events while having the least amount of impact on the behaviour of the participants. Both desktop cameras and helmet-mounted cameras were considered, and discarded since each potentially caused reduction of recorded data due to the fixed position of such cameras. Video recording glasses, in theory, offered similar views to those that a subject observes and the unobtrusive nature of these glasses allowed for lower awareness of potential surveillance.

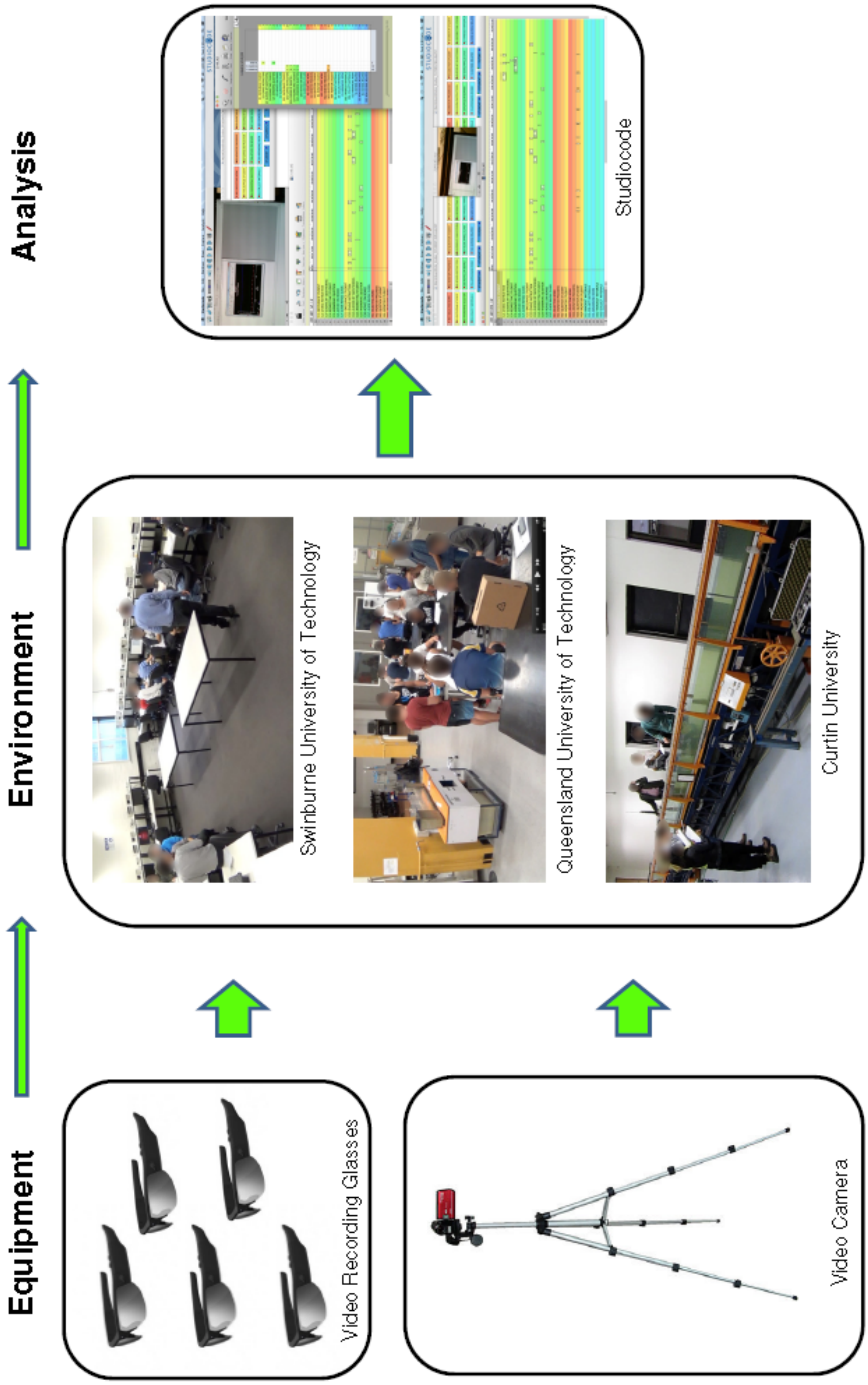

Figure 1: A schematic showing methodology used to identify affordances.

Recordings, using student video glasses and a stationary camera, were used to collect the data in three practical laboratory settings provided by Swinburne University of Technology (SUT), Queensland University of Technology (QUT) and Curtin University (Curtin). The experiments were designed for students in small groups working together and students in larger groups guided by their demonstrator(s).

At SUT the students, in groups of two, were asked to design and test, then construct a specified transistor-based amplifier circuit firstly using simulated and later real components. In their written reports they were asked to compare and discuss the performance of each realisation.

At QUT the students, in groups of ten, performed two experiments on fluid behaviour in two water tanks. They were guided in the operation and use of the respective flow equipment and under supervision had to complete certain experiments and record instrument readings, and then perform calculations in order to consolidate their understanding of the relevant theorems.

At Curtain the students, in groups of no more than ten, were asked to communally experiment on a rig then discuss with their demonstrator various flow and turbulence phenomena recreated in the water tank. Values such as flow velocities and amounts of water were obtained from instruments by one student. The students were rotated in taking measurements and all of them participated in the subsequent discussions.

The experiential learning recorded covered the spectrum from student-centred learning (SUT) to demonstrator-centred learning (Curtin) with a blended version somewhere in-between (QUT).

Data Analysis

The recordings were analysed with *Studiocode*® (a video analysis software) that is available from the Studiocode Business Group (http://www.studiocodegroup.com/). As applied by Clarke (Clarke, 2001) the software utility facilitated the annotation of the recorded material. Code was written to map two subsets of activities as they occurred in each video recording. Each subset of activities was based on the *kikan-shido* principles, which were grouped as shown in Table 1. The first subset consisted of the original "demonstrator-student" *kikan-shido* activities which were proposed by Clarke et al. (O'Keefe et al., 2006, p. 77) and a complementary "student-student" *kikan-shido* set of activities was proposed by the authors. The "student-student" kikan-shido activities were refined further to distinguish whether an observation was first hand (student with video glasses performing activity) or second hand (student(s) being observed/questioned by student(s) wearing video glasses).

The partner institutions provided both the participants and the various data collection venues.

Results

During the data collection phase, over 50 hours of video recordings were collected from three different laboratory venues. One fixed video camera, capturing the venue activities, as well as video glasses, worn by the participants provided effective recordings for analysis. The recordings from each class in each venue were synchronised to provide a "wider" view of the proceedings.

From the collected data it was evident that, while some *kikan-shido* event were the same across all observed sessions, others differed primarily because of the type of experiment (electronic amplifier design at SUT, or fluid flow at QUT and Curtin), size of study groups (groups of two at SUT or groups of six to ten at QUT and Curtin) and the teaching strategy practiced by the demonstrator (student-centred at SUT or demonstrator-led at QUT and Curtin).

It appeared that the participants quickly ignored the presence of the cameras. The comfort factor of the video glasses did have an effect on the duration for which they were worn before a participant took them off and placed them on the work bench.

Details of the results obtained from the above-described data collection process, as well as their interpretation to obtain affordances, will be disseminated at a Master Class which will be held at this conference (AAEE2014 Conference Wellington, New Zealand).

Discussion

The use of video equipment ensured “repeatability” of both data collection and subsequent analyses – a highly desirable feature for verification of the analysis by researcher(s) and/or any other expert(s) and/or interested parties. Furthermore, the data collected in this way was free from participant bias that must be present with: student/staff experience surveys (Bodner, Wade, Watson, & Kamberov, 2013; Corter, Esche, Chassapis, Ma, & Nickerson, 2011; Lang, 2012), focus groups (Jarmon, Traphagan, Mayrath, & Trivedi, 2009), and selected participants’ reflective journals (Jarmon et al., 2009; Lang, 2012). Using the features of *Studiocode®* to investigate laboratory learning/teaching quality will need further investigation with a very much larger sample population.

Learning styles, student personality and experiment design did affect the amount of, and the time taken by each *kikan-shido* event. Such analysis may be useful if the research aim is “quality of the activity” and not just the affordances of the venue. On the other hand a simple binary notation of an occurring event indicates venue affordance, while the converse (not occurring) is not a clear indicator of a deficiency in venue affordance. Non-occurrence may also indicate that the performed experiment may not require it or both.

Furthermore, anecdotal feedback established that after an initial “break in” period, some participants became totally unaware of the presence of the video glasses and/or the fixed video camera and behaved as they would have otherwise.

Conclusions

Data collection using video recordings and subsequent analysis for the occurrences of *kikan-shido* events will reflect experiential learning venue affordances free of participant bias. For a binary summary of occurrences, the use of *Studiocode®* is not necessary. However, if quality of the activities is the aim, using *Studiocode®* is highly recommended.

The video glasses used for data collection did not allow for real-time streaming of the recordings, resulting in some unusable clips. The use of *Google Glasses*, to collect data on student activities will be investigated in 2015.

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