ECTC 2015
Official Conference Proceedings
ISSN: 2188-1138

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The European Conference on Technology in the Classroom 2015, Brighton, United Kingdom

Official Conference Proceedings

ISSN: 2188 - 1138

The International Academic Forum (IAFOR)
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Experiences in Using Open Source Software for Teaching Electronic Engineering CAD

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract

Embedded systems and simulation distinguish modern professional electronic engineering from that learnt at school. First year undergraduates typically have little appreciation of engineering software capabilities and file handling beyond elementary word processing. This year we expedited blended teaching through the experiential based learning process via open source engineering software. Students engaged with the entire electronic engineering product creation process from inception, performance simulation, printed circuit board design, manufacture and assembly, to cabinet design and complete finished product.

Currently students learn software skills using a mixture of electronic and mechanical engineering software packages. Although these have professional capability they are not available off-campus and are sometimes surprisingly poor in simulating real world devices. In this paper we report use of LTspice, FreePCB and OpenSCAD for the learning and teaching of analogue electronics simulation and manufacture. Comparison of the software options, the type of tasks undertaken, examples of student assignments and outputs, and learning achieved are presented. Examples of assignment based learning, integration between the open source packages and difficulties encountered are discussed. Evaluation of student attitudes and responses to this method of learning and teaching are also discussed, and the educational advantages of using this approach compared to the use of commercial packages is highlighted.

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Introduction

Most educational establishments use software for simulating or designing engineering. Most commercial packages come with an academic licence which restricts access to on-site computers. Even if off-site access is permitted is usually via a time-limited licence which means that students no longer have access to their work once this expires. The cost of non-academic licences is usually prohibitive for students and indeed many commercial companies are switching to open source alternative due to high licence costs [1, 2]. For these reasons we decided to consider switching to open source software in the teaching of electronic engineering CAD. Although there were inevitably some technical challenges in doing this we found several unexpected educational advantages.

Choice of Software Considered

Although there is a wide variety of open source tools available (mostly running on Linux) we wanted to keep the student computer interface as close as possible to that of their existing experience which meant using tools that would run under Microsoft Windows. We also wanted to keep the existing course objectives of taking students through the electronic product design and production cycle – from circuit design and simulation, PCB design and manufacture, and finally cabinet design, production and product installation – that was previously implemented using commercial packages. Thus we made the following software usage changes:

MultiSim (National Instruments) → LTspice (Linear Technology) *
Ultiboard (National Instruments) → FreePCB (GNU General Public Licence)
Solidworks (Dassault Systèmes) → OpenSCAD (GNU General Public Licence)

* strictly LTspice is freeware rather than open source software [3] however the practical implications from the educational user perspective are the same.

Students were also encouraged to think about using Open Office however the financial costs involved in purchasing Microsoft Office are not nearly so prohibitive as for less generic software. It is important to direct students to correct download site otherwise malware has a tendency to be bundled with the required software.

Software Experiences

1) Analogue Electronics Simulation Experiences with LTspice

LTspice [4] was chosen for a number of reasons (i) it is free for the end user, (ii) it supports schematic capture, (iii) there is copious online support via Yahoo! Groups [5], (iv) device manufacturers provide models that can be downloaded and incorporated into designs and simulations, (v) it is relatively easy to set up new components and devices, (vi) input and output files are simple text files that can easily be edited in any text editor, (vii) there is no limit to the complexity of circuits that can be simulated, subject to available processing power, (viii) it gives reliable simulation results that agree with experiment.

In order to use this type of software correctly students need a good understanding of basic computer file handling, such as directories and file extensions. Our computers are set up so that students can only write to the external USB drive or to their allocated server space. Students needed to understand how to create the necessary path structures. Similar issues occurred when trying to specify the directory of a stored model to be included in a simulation that was not in the main program library. Files can either be located in the same directory as the schematic (in which case no

path needs to be specified) or in another perhaps more convenient directory (which must be specified). One issue that occurred with Windows 7 was its habit of concealing filename extensions unless set to display them. Consequently students added an additional false extension and wondered why the files did not behave as expected. Our university uses a virtual learning environment called "Student Central" [6] which is a convenient method for distributing simulation files to students. Unfortunately this has an irritating habit of adding a numerical digit to the filename which does not appear on the Student Central interface. In LTspice the undo and redo operations do not follow the normal Microsoft control-z and control-y keystrokes; instead the function keys are used. Similarly the conventional cut and paste shortcuts do not work. Strangely control-r does work for rotation. It is also necessary to be careful about assigning zero to component values because a singularity can be generated. Once these fundamentals and peculiarities had been understood the program worked extremely well. A rather nice feature is the appearance of voltage and current probes under mouse control once the simulation is running which are then placed on nodes or wires as required.

LTspice is not quite completely accessible via a graphical user interface. Whilst in schematic capture mode the drawing of circuit diagrams and the assignment of component values is undertaken through the GUI. However the inclusion of non-standard models and calling the appropriate analysis, as well as accessing more powerful operations, requires the writing of one or more *spice directives*. These are text commands entered anywhere on the schematic and must follow the prescribed syntax. Students soon realised that these commands, if at first rather tricky to master, gave LTspice a functionality far beyond their expectations.

Students were required to undertake simulation of basic DC circuits containing voltage and current generators, and a network of resistors. An interesting case was inclusion of a potentiometer which does not exist in the standard library; students were required to download the necessary files to include in their simulation. LT spice is quite capable of dealing with pulsed rather than repetitive signals and students were encouraged to explore this. Sinusoidal AC circuit theory was taught by the flip method [8, 9] with students undertaking simulation of reactive capacitor and inductive circuits before the theory was taught in lectures or real experimentation performed. Such is the convenience of freeware that they could return to the simulation whenever required to reflect on new material presented. Students undertook both frequency and transient analyses by writing the appropriate spice directive. This work inevitably led to filters and finally to the inclusion of non-linear device models and sub-circuits for diodes, transistors and operational amplifiers.

Fig. 1 shows a typical LTspice schematic with a corresponding voltage output plotted as a function of resistor value as seen on the screen (window layout, colours etc can be tailored according to personal taste). This was obtained with a "print screen" request however LTspice has a rather nice "copy bitmap to clipboard" function that is very useful for creating reports. This circuit formed the basis of an assignment fairly early in the course in which students had to enter the correct spice directive to achieve the desired computation. Thus students were, without them realising it, learning about syntax, functions and arguments, loops and limits, i.e. some of the elementary constructs of computer programming. Of course this example is easily amenable to

mathematical analysis by application of circuit laws and indeed some of the better students were able to validate their simulation results by doing precisely that.

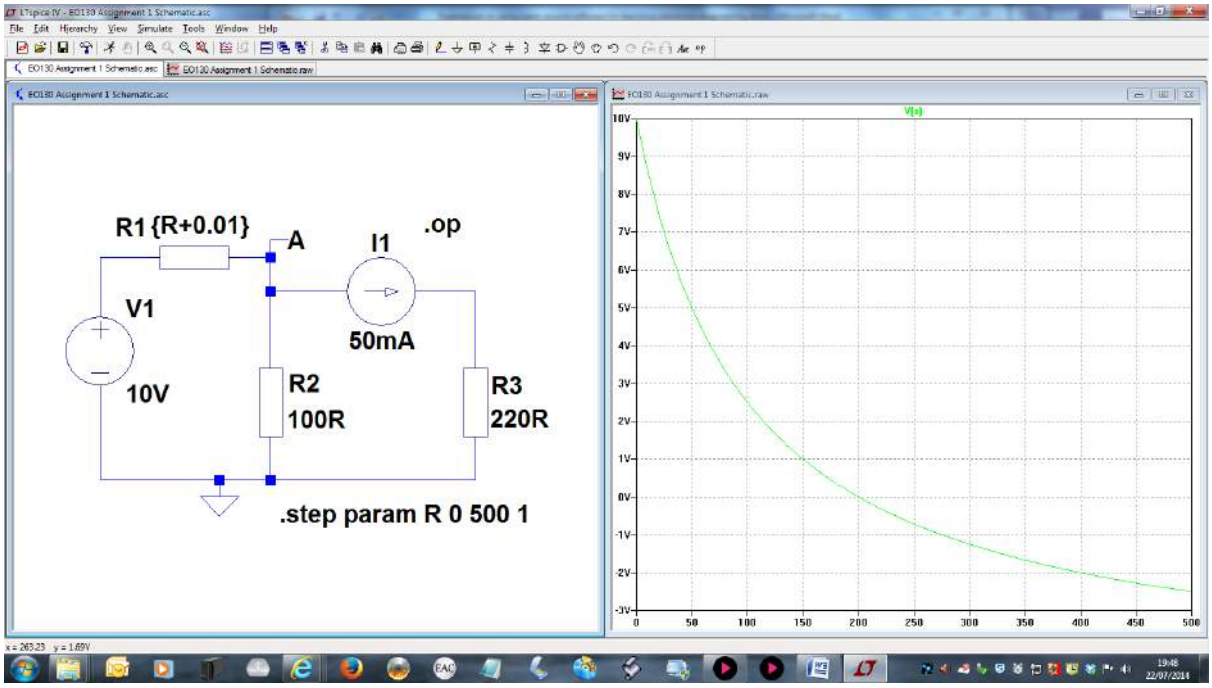

Fig. 1. Typical screen from LTspice showing schematic capture and analysis windows

Although LTspice can simulate digital circuits it requires an arcane "digital signal viewer" to trace outputs. More significantly its built in digital library is rather sparsely populated with devices and external standard spice libraries are not compatible. Future work might explore software such as Logisim [6].

2) PCB Design and Manufacture Experiences with FreePCB

Although open source, FreePCB [10] is as capable and as easy to use as many of its commercial counter parts. It was chosen because (i) it is free for the end user, (ii) it is operated by an intuitive GUI, (iii) it has a comprehensive footprint library including surface mount components, (iv) virtually all board parameters – pad, hole, track sizes etc. – can be adjusted, (v) it has an in-built footprint editor, (vi) online support is available, (vii) input and output files are text files, (viii) multi-layer boards are supported, (ix) gerber files are supported for CAM.

Students were required to lay out a PCB design for a small audio amplifier circuit based around the 741 op amp and two output transistors. The board was of a pre-determined size to fit into the cabinet designed in the next phase of the course. It was necessary to design and save several footprints as these were not in the library. Students had to pay attention to pitch, pad and hole size. The placing and routing resolutions should be set the same. The same issues with directories and paths occurred. Students had some difficulties with polarised components however their greatest challenges were understanding nets and avoiding track clashes requiring links. Issues such as setting insufficient grid resolution or changing resolution and not being able to snap to the correct coordinates were also apparent. Note that the

Microsoft copy and paste shortcuts are observed for this program. It is necessary to remember net numbers or consult the netlist, which can be confusing. Students were advised to increase the pad size and track width from the default to suit our routing machine. FreePCB makes extensive use of function keys (fortunately it indicates their function) which is very useful because whilst one had can operate the mouse the other is free to press keys.

Fig. 2 shows a screenshot of FreePCB with a partially completed board for this phase of the course. Note the mounting holes in readiness for the cabinet design.

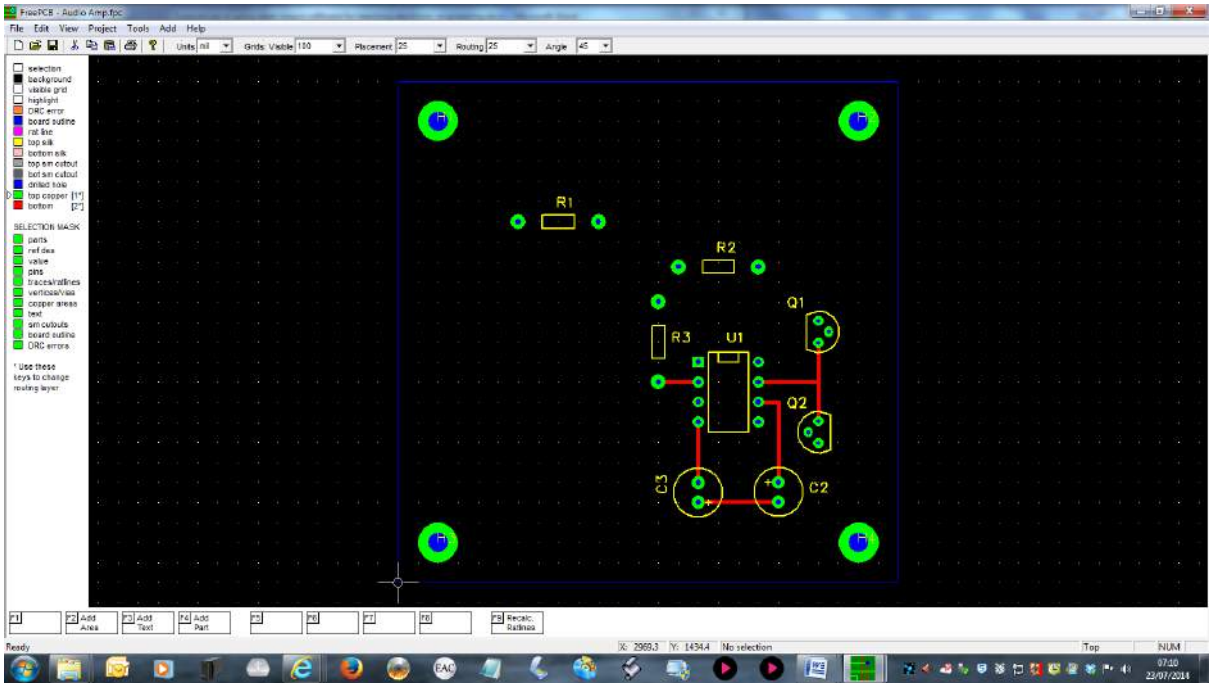

Fig. 2. Typical screen from FreePCB showing placement and routing in progress

Some students discovered that if they had set the number of layers to 1 they could only route tracks on the top side of the board. Some students proceeded to complete the layout without realising this. Fortunately it is a relatively easy matter to export their project as a text file, edit it offline with e.g. Notepad and then reimport it. The layers could then easily be changed. Finally students were asked to manufacture their PCB by outputting gerber CAM files to be submitted to our PCB router (which is a dry milling machine). They could then solder the parts in place and get their circuit to work.

Students were strongly advised to check the gerber CAM files before fabricating to ensure that everything was in order. We used gerbv [11] (released under the gEDA licence) for this task. This program (not to be confused with “gerbview”) is free, open source and intuitive to use. It allows each gerber file to be loaded individually for checking. Multiple files can be loaded simultaneously to produce an overall view.

An interesting assignment was asking the students to find out how to export the netlist from LTspice, edit it to contain footprint information, and then import it into FreePCB so that the parts were already connected with nets which could be “rubber banded” by moving components. This is the essence of modern circuit design; there is little point

in having a good simulation only to introduce further human generated errors by requiring the layout connections to be done manually. That it is possible to do this with open source tools is quite remarkable.

Students found this quite challenging. Those who researched it found an excellent resource online [12]. The issues included ensuring the correct format of netlist between the two programs (there are several standards for netlist formats) but by far the biggest difficulty encountered was pin assignment. With unpolarised components this is of little importance, but it is essential to have consistency of pin assignment between LTspice and FreePCB for electrolytic capacitors, transistors, integrated circuits etc. Unfortunately the default positions are inconsistent! The best way to deal with this is by a pin swapping routine written into the device model so that they can be parsed between the two programs. This ensures that LTspice uses the correct physical pin allocations and not arbitrary ones. As this is rather subtle only the better students managed to comprehend this. Most students merely imported the netlist as-is and then physically reassigned nets to pins within the PCB package. Although this showed an understanding that pin assignment was important it rather defeated the object of automating the process as it introduced an extra stage of potential human error.

3) Cabinet Design and Manufacture Experiences with OpenSCAD

The inclusion of a mechanical element in the course is slightly beyond the scope of the learning of most electronic engineering students, although product design students are quite adept at this. It was felt that the former group should experience the complete electronic engineering design process, from schematic, analysis, performance simulation, PCB manufacture and finally enclosure design. It was clear that students had never before thought about how controls, indicators and transducers should be mounted, how to apply power to a completed product and the implications for connectors. They had not thought about which part of the enclosure should be internally accessible, e.g. for battery access, how PCBs should be mounted or indeed what shape and colour should be selected. Students were therefore asked to think about the final customer user and what demographic their product would be aimed at. Most students had never done this before. As well as a software design exercise students were asked to 3D rapid prototype their result and then assemble their electronics inside it. Students who had hobby experience with electronics produced interesting and innovative products whereas those new to it tended to stick with cuboid structures.

Usually physical components are designed with a 3D graphical design package such as SolidWorks or Autocad. This is perfectly compatible with product design or mechanical engineering students but is a little out of place for electronic engineering students. Although there are equivalent open source alternatives we decided to try OpenSCAD [13] because we thought it might help reinforce ideas in mathematics and geometry. OpenSCAD is a script based renderer based on constructive solid geometry. Users must describe the article to be rendered by reference to a coordinate system and by using vector based operations such as translate and rotate. Boolean operations can form more complex structures from simple shapes. The renderer allows 3D rotation and zooming for full a perspective view. The script can be saved, reloaded and even edited offline as a simple text file. OpenSCAD will product

standard .stl files recognised by most rapid prototyping 3D printers. A typical screen shot is shown in fig. 3.

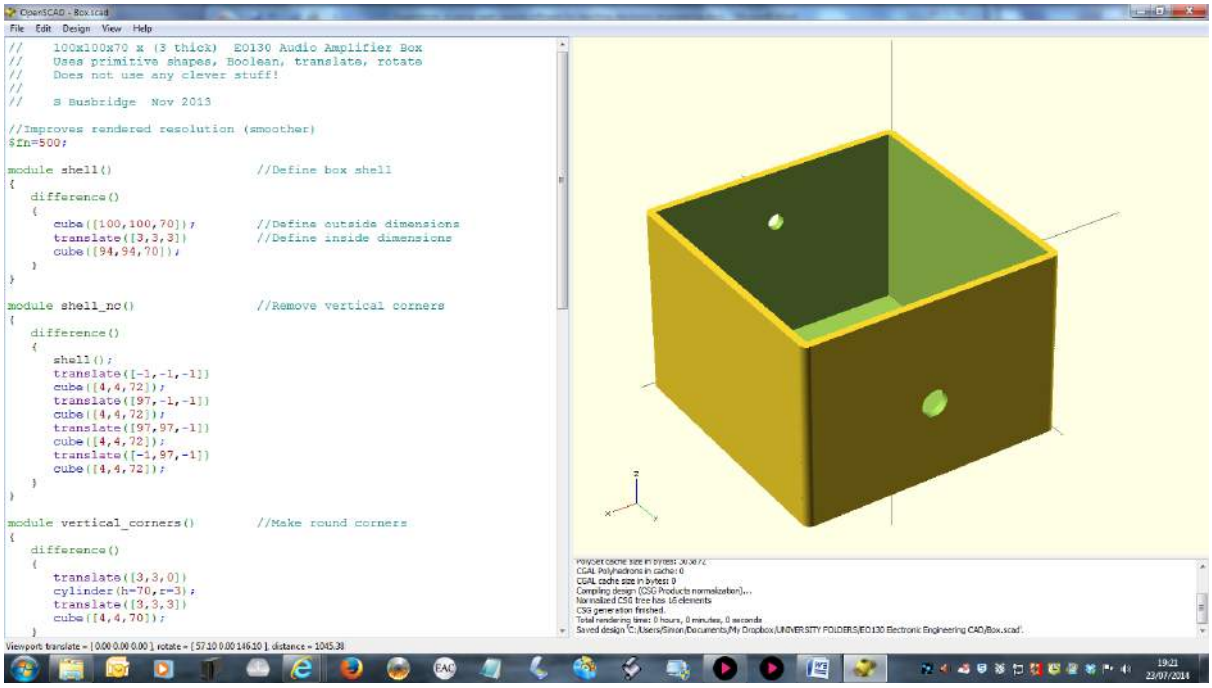

Fig. 3. Typical screen from OpenSCAD showing script and render windows

The script is essentially a mathematical description of the object to be rendered. The approach taken was to manipulate primitive shapes line by line, although the program is capable of much more complex structures such as loops and minkowski operations. As this was the first time that most students had encountered the need to describe objects and operations in code the simpler approach was used. In spite of this many students found 3D constructive vector geometry concepts challenging. The amount of detailed support provided for this phase of the course was deliberately reduced so that the flip method of teaching was more apparent. Clues how to build specific objects by using showing carefully selected operations forced students to use the online manual and support. Most students rose to this challenge very well, although a few disliked it and wanted to be told step by step. There were additional constraints to consider for 3D rapid prototyping, such as minimum wall thickness. Furthermore students had to carefully consider the overall size and mounting options for their electronics, as well as the external appearance.

Fig. 4 shows examples of students work [14]. The example on the left was the best of the group, showing a non-cuboid container with all electronics correctly mounted and fully operational. The middle example is ambitious but was poorly finished and the electronics mounting poorly executed. However the script written was impressive. The example on the right shows a case where there student had not properly considered the dimensions. The object was supposed to have a circular cross-section but it turned out to be elliptical.

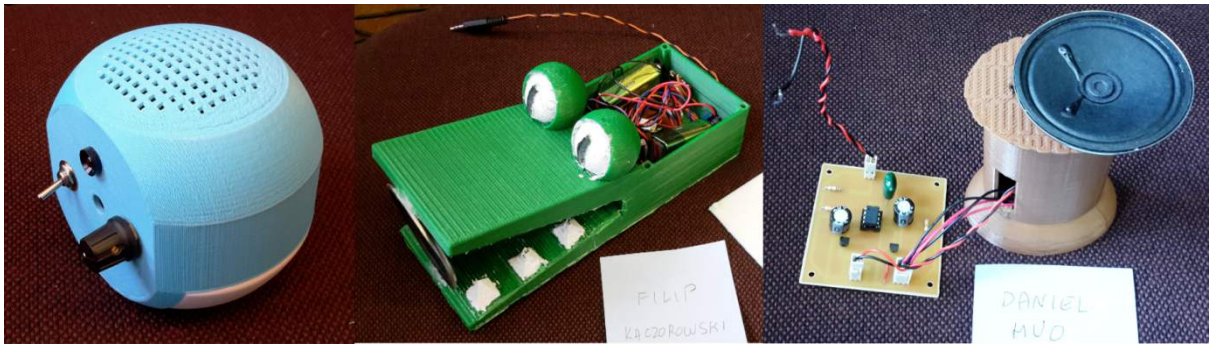

Fig. 4. A selection of student projects created by FreePCB and OpenSCAD open source software

Options for the future include use of a freeware vector-based 2D drawing package such as DraftSight (Dassault Systèmes) to more easily create and then import more complex shapes into OpenSCAD (which can be done as .dfx files)

Student Responses

Student responses were anonymously solicited by means of a questionnaire designed and accessed via SurveyMonkey [15]. Feedback was achieved from 8 students which represents approximately one third of the class cohort. Students were asked to rank their views on a scale from 1 (unfavourable or difficult) to 9 (favourable or easy).

Fig. 5 shows the response to asking if students found it useful to have access to the software offsite on their own computers. 88% of the student who replied stated that they downloaded and install all three packages. The results clearly show a benefit of allowing students access to course resources at their convenience. We did not notice a commensurate reduction in attendance; instruction, guidance, worked examples and tutorial support were provided conventionally in class.

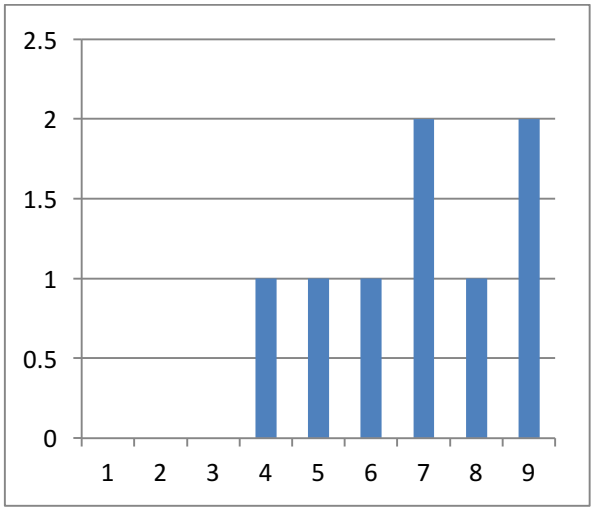

Fig. 5. Distribution of student responses stating they found access to software offsite helpful (9) or not (1)

We asked whether the students found LTspice difficult or easy to simulate analogue electronic circuits. The results are shown in fig. 6. Students adapted to using this software very well and were able to simulate a range of reasonably complex circuits. They told us that whilst the schematic capture worked very well, they found using the

spice directive and analysing the results more challenging. The former requires text to be inserted according to the correct syntax which requires more thought than a drag and drop operation, even though its functionality is quite advanced.

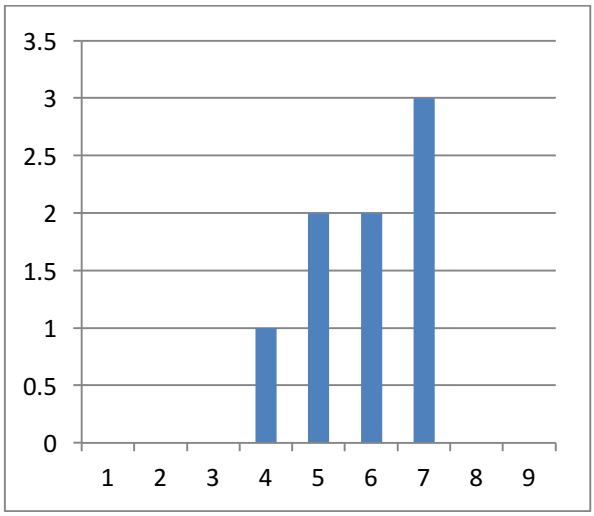

Fig. 6. Distribution of students who found simulating analogue circuits with LTspice difficult (1) or easy (9)

Students were asked if using LTspice improved their understanding of analogue electronics. The results are shown in fig. 7. Apart from a couple of mediocre replies the result is overwhelmingly positive. Of course this could have been achieved with *any* analogue electronics simulation package, but the point is that it was also achieved with an open source (freeware) package means that going open source does not detract from the educational objectives of the course.

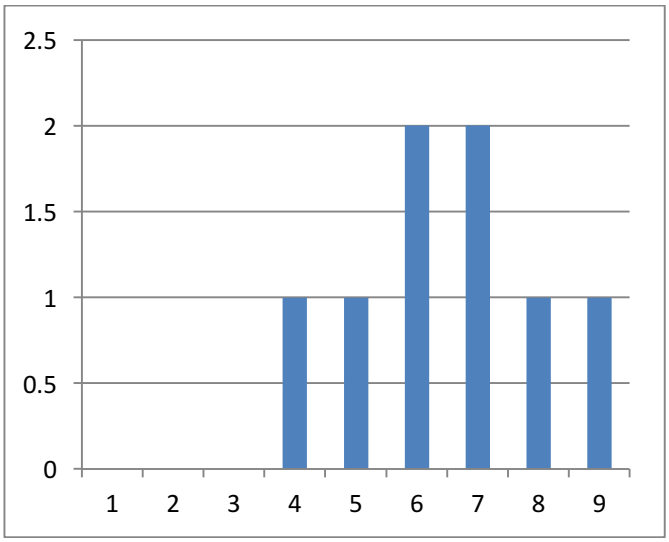

Fig. 7. Distribution of students who said using LT spice improved their understanding of electronics (9 is more)

Moving on to FreePCB, we asked the students how difficult or easy they found designing a board for their circuit and getting it manufactured. The results are shown in fig. 8. It is clear that students coped using this software very well (it is known that amateur electronics enthusiasts use it for hobby applications). This is unlike the results given in fig. 9 which show that students found the integration between LTspice

and FreePCB much more difficult. Students particularly found the assignment of pin numbers to polarised components difficult to get right as this, and the assignment of footprints, required manually editing the netlist.

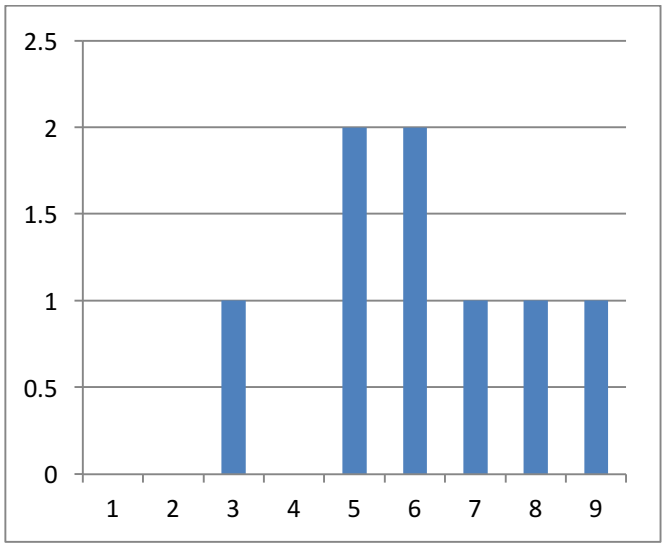

Fig. 8. Distribution of students who found designing PCBs with FreePCB difficult (1) or easy (9)

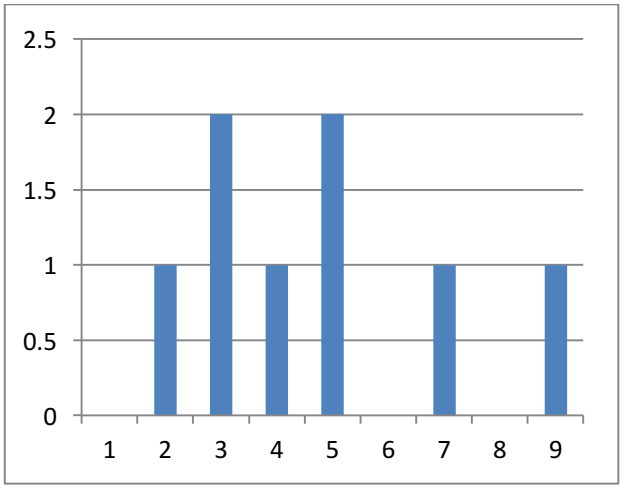

Fig. 9. Distribution of students who found the integration of LTspice with FreePCB difficult (1) or easy (9)

Whilst there are easy to use graphical interfaces to both LTspice and FreePCB, the same is not true of OpenSCAD. This software produces a rotatable 3D image rendered from a script which must be entered as text in the correct syntax in the accompanying box. This is rather more difficult, as it requires an extra level of understanding to convert from the desired physical object to its constructive solid geometric mathematical description. This is quite different to Solidworks, or indeed Google Sketchup, and the extra level of complexity is reflected in the feedback results.

We asked students if including an element of mechanical, or geometrical, design and its production contributed to their understanding of the entire electronic product design process. The results are shown in fig. 10.

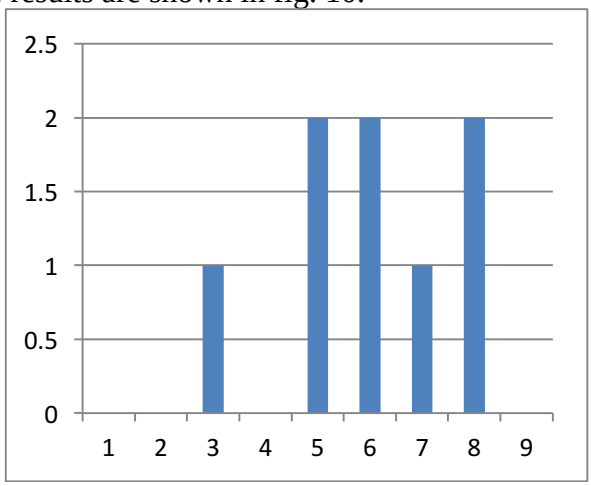

Fig. 10. Distribution of electronics students who found mechanical enclosure design worthwhile (9 is more)

It is clear there are mixed views on this, which is perhaps not surprising as most electronics students do not get to design cabinets (although interestingly hobby enthusiasts do). Despite these views all but one student managed to finish the assignment and produce a 3D printed result with only one disaster designed too small for the application.

We asked if the use of OpenSCAD improved their understanding of 3D vector geometry. The results are shown in fig. 11. The results are generally positive, although it is clear that some of the weaker students struggled with some of these concepts.

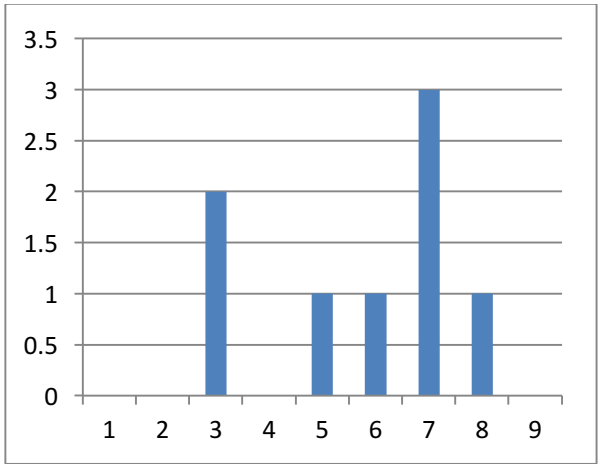

Fig. 11. Distribution of students who said using OpenSCAD improved their understanding of 3D vector geometry (9 is more)

Lastly we asked, on a scale of 1 (no) to 5 (yes) whether students enjoyed using these packages. The results are shown in fig. 12. It is clear that students really liked designing and making the PCB. They also liked doing analogue electronics simulations with LTspice, but they liked using OpenSCAD the least. Anecdotal feedback suggests that this is the script nature of the software selected and the

associated challenge of using it, rather than the mechanical/product design nature of that part of the course.

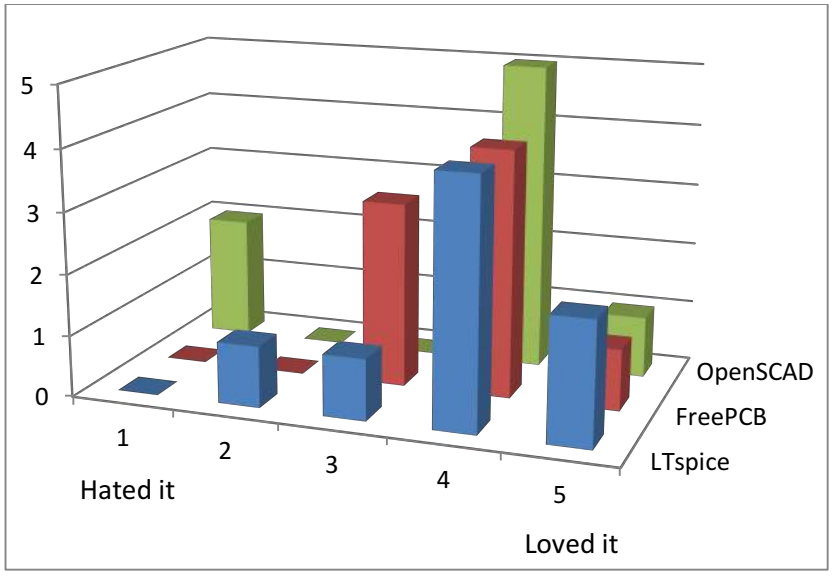

Fig. 12. We asked the student whether or not they enjoyed using each of the three packages

Table shows the average responses for each of the questions.

Was it helpful to have access to the software offsite?	6.9
Did you find LTspice easy or difficult to simulate analogue electronic circuits?	5.9
Did you find using LTspice improved your understanding of analogue electronics?	6.5
Did you find using FreePCB easy or difficult to design and manufacture a PCB?	6.1
Did you find the integration between LTspice and FreePCB easy or difficult?	4.8
Was the inclusion of a mechanical element helpful to understand the complete product design cycle?	6.0
Did you find using OpenSCAD improved your understanding of 3D vector geometry?	5.8
How enjoyable did you find using LTspice? (1 – 5)	3.9
How enjoyable did you find using FreePCB? (1 – 5)	3.8
How enjoyable did you find using OpenSCAD? (1 – 5)	3.4

Table 1. Average question responses (1 – 9 except the last three questions, higher represents more agreement)

Analysis with Bloom's Taxonomy

Bloom's taxonomy [16,17] provides a method of gaining insight into the mechanism and structure of the learning process. During the early stages of teaching students to use open source packages a certain amount of *knowledge* had to be conveyed. This included basic operational information, how to locate, install and run software, facilities required (e.g. use of a USB memory stick for local storage) and basic software operational procedures. It was clear that even at this stage students required a *comprehension* of file name extensions, how these are handled in Microsoft

Windows, hidden file extensions, paths and directory structures (e.g. to specify the location of a file to be saved). In many cases students had not encountered the role of the operating system, even though they were adept in using computer and information technology as consumers. These concepts were valid for all the open source packages used however by the time students progressed from LTspice to FreePCB and then to OpenSCAD it was clear that they were *applying* the file handling knowledge learnt during the earlier weeks as this did not have to be re-taught.
Both the integration of netlists between LTspice and FreePCB, and the use of three dimensional vector geometry in OpenSCAD required students to *analyse* objectives in terms of the syntax required. For example, specifying shapes, their translation and rotation required development from the comprehension and application of a task to its analysis in terms of the underlying geometric operations. Similarly students had to think beyond merely generating netlist information learnt in class to an analysis of that information and its structure (e.g. pin assignments, component footprints, etc.). Once students had undertaken this analysis they were required to *synthesise* a solution to ensure that their chosen schematic netlist and associated information would import directly into FreePCB and that the geometric shapes manipulated in OpenSCAD would 3D print to a viable solution.
Evaluation of achievement was undertaken by academic members of staff during the assignment marking process, although it was clear that some students had already thought about this phase of the learning process as they were asked to critically review their work. In some cases the evaluation was trivial (e.g. too small for the intended task) but others required more insight (for example how to change batteries in a portable electrical product, intended target market etc.). It was felt that student evaluation (as opposed to staff evaluation) could be better enhanced by the use of blogging techniques.

Conclusions

We have shown that it is possible to perform effective teaching and learning of electronic engineering CAD using open source software. Apart from being considerably cheaper for the host institution, students appreciated unrestricted access to their work at a time and place of their choosing. This provides ideal opportunities to use the flip technique. Without doubt the use of open source tools is not as user-friendly as their commercial counterparts. Students must have, or acquire, an elementary understanding of computer file handling.
This work has given an indication of what could be done in electronic engineering. There are many more opportunities, both within electronics and in general, some of which could be explored in future work.

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Trends and Patterns in Social Media Usage Among Pre-Service Teachers

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
Social media allow users to connect each other and share multimedia information instantaneously that transcend across geographical lines, cultural boundaries and differential time zones. Recent Pew study suggests that 73 percent of teens in the US use social media and the number is growing. Among social media sites, Facebook, in particular has been expanding its network and reported that the number of monthly active users in the first quarters of 2015 topped 1.44 billons. Facebook has been clearly recognized as a dominant social media site.
A study was conducted at one of the teacher training institutions in the Gulf region to find out the trends and patterns in social media usage among pre-service teachers. A survey questionnaire was used to collect information regarding the use of Facebook as a social media. This paper reports preliminary findings from the study that focuses on pre-service teachers' perception about Facebook and how the media has been used in their daily activities. The paper suggests some innovative ways that educators can harness the social media and use as an instructional technology tool. Implications from the study are also discussed in the paper.

Keywords: Social media, Facebook, teacher education, collaboration, instructional technology

Introduction

Facebook has been emerged as one of the convenient ways to establish contact with friends, to make new friends and develop relationship. Many studies have been conducted in the past to investigate the roles and affordances of social media, positive and negative impact on human interactions, bonding and bridging among communities from the social communication perspectives. There were also some attempts to use social media as an educational tool in schools, colleges and higher learning institutions. Some studies examined the use of social media as collaborative tool to enhance teaching and learning and its impact on education (Khine, in press).

Review of the literature

A meta-analysis of Facebook research conducted by Nadkarni and Hofmann (2012) aimed to answer a direct question: Why do people use Facebook? They examined 42 evidence-based studies on Facebook and search for the psychological factors contributing to Facebook use. Their investigation focused on finding notable trends in general Facebook use, the demographics of its users, and the personality characteristics associated with its users. The respondent of these studies were undergraduate and graduate students. They noted that "Facebook use was motivated by two primary psychological needs: the "need to belong" and the "need for self-presentation." They posited that the need to belong was intrinsically driven and focused on gaining affection and social acceptance from others, while the need for self-presentation consisted of online behaviours involved in the continuous process of impression management".

In another meta-analysis, Song et al (2014) explores the relationship between Facebook use and loneliness. The study involved examination of 18 research that covers 8798 samples to measure Facebook use and loneliness. The study asks whether using Facebook increase or decrease loneliness and what causes what, i.e. does Facebook make its users lonely (or less lonely), or do lonely people (or less lonely people) use Facebook?. The researchers found that there was a significant overall average effect in the positive relationship between Facebook use and loneliness. Social support and shyness contribute to the loneliness and that causes the Facebook use.

In Cheung's et al (2011) study, the researchers attempts to explain why students use Facebook. They employed social influence theory, the use and gratifications paradigm, and social presence theory to explain the phenomenon. The results show that social presence has the strongest impact on Facebook use. They also found that social factors are more important in determining intentional social action.

Sagioglou et al (2014) presented three studies to explore the hypothesis that Facebook activity negatively affects people's emotional state. A first study shows that the longer people are active on Facebook, the more negative is their mood. The second study indicates causal evidence for this effect by showing that Facebook activity leads to a deterioration of mood. They found that the effect is mediated by a feeling of not having done anything meaningful. Although there are negative outcomes for the users, so many people continue to use Facebook regularly. This prompted to ask a

question, why people still use it. The answer lies in the third study that "suggests that this may be because people commit an affective forecasting error in that they expect to feel better after using Facebook, whereas, in fact, they feel worse (p.361)". From these studies much has been revealed the phenomenon, effects and consequence of Facebook use in public and among students.

Methods

Subjects

The sample of his study involved pre-service teacher training students in one of the teacher training college in the Gulf. The sample consists of 438 students, predominantly female. Out of the total students, 356 were female (81.3%) and 82 were male (18.7%). Among the sample, majority of the students were within the age range of 17-18 (44.1%) and 37.4% falls into the age range of 19-20. 15.5% of the participants are in the age range of 21-22 years.

Participants were briefed by their respective class teachers and consents were obtained to participate in the study. They were also told that there is no right or wrong answers in the survey and participation in the study it will not affect their studies and grades. It was clearly indicated to the students that all what the researchers wanted was their opinion.

Instrument

A 24 -items bilingual survey was developed for this study. The survey comprises of 4 descriptive items on patterns of use that determine the number of years participants used (FB1), whether they used Facebook before joining the college (FB2), frequency of Facebook use (FB3) and duration of Facebook use (FB4). The remaining 23 items are the participants' perception about Facebook. The participants choose their answers from five-point Likert scale ranging from strongly agree (SA) to strongly disagree (SD). If they are not sure about the answer they can also choose neither agree nor disagree (N). Examples of items are "I am proud to tell people I am on Facebook" and "I use Facebook to find new friends". It took approximately 20 minutes to answer all the questions in the survey.

Analysis and Results

Reliability

Analyses were conducted to determine the reliability and consistency of each items. The overall Cronbach alpha value of 24-items (FB5 to FB28) was found to be 0.953. The reliability analysis for each item ranged from 0.949 to 0.955. All the Cronbach alpha values exceeded the recommended value of .70 (Nunnally, 1978), indicating adequate internal consistency.

Descriptive Statistics

The first question addresses how long the students had their Facebook account. 44.7% of the students revealed that they had account for more than three years. Most of

them had accounts from 1-3 years and only 13% indicated that they had account less than a year ago.
The second question asked for whether the students participated in the Facebook groups before joining the college. It was found that half of the students were already in Facebook groups and remaining half joined the groups after they join the college.

When asked about the frequency of logging on to the Facebook, 26.5% indicated that they log on to the Facebook several times a day and 29% of them answered that they log on once a month. This data shows that one third of the students in this sample are not really active users.

The students were also asked how long they stay on Facebook once they log on to the platform. 56.4% indicated that they stayed on for approximately 30 minutes. 24.2% indicated that they stay on for an hour and 12.6% stayed on for one to three hours. It seems that majority of the students stayed on for a half an hour.

Some descriptive statistics of the survey items are shown in Table 1. The mean score ranged from 1.58 to 3.30 and all the items of the Facebook scale had a mean score above the midpoint of 3.00. This indicates that the participants exhibited a strong response for the Facebook questionnaire. All the standard deviations (SD) were above 1.00, indicating a large spread of item scores around the mean.

The highest mean score is linked to the item “Facebook is a good way to network with others” and the lowest mean score is related to the item “I use Facebook to buy and sell stuff”. Majority of the respondents (61.2%) perceived that Facebook is not part of their daily activity. Approximately of half of them indicated that they are proud to tell people that they are on Facebook, but the remaining half did not agree. Only 20% of the students feel that they are part of the Facebook community, but half of them think they are not. Again only 22% think that they will be sad if the Facebook shut down, and 61% of them think that it will be affect them.

In terms of usage, majority of them (62.3%) revealed that they use Facebook to look at friend’s photo album always, often and some occasions. When asked whether they Facebook help them feel closer to their friends, the answers were mixed. 40% of them agree or strongly agree that it makes them closer, but another 40% disagree or strongly disagree the fact while remaining 20% are not sure. Majority of the students (55.7%) indicated that Facebook allows them to find new friends. In terms of mode of communication, 70.6% and 76.5% of students did not use Facebook alternative to email and phone calls. It was also found that overwhelmingly (83.5%) of the students did not use privacy settings to select what part of their profile share with other users.

Table 1: Descriptive statistics of the items in the survey

Number	Item	Mean	SD	Skewness	Kurtosis
FB5	Facebook is part of my everyday activity	2.39	1.370	0.575	-1.004
FB6	I am proud to tell people I am on Facebook	2.62	1.252	0.261	-0.987
FB7	I dedicate a part of my daily schedule to Facebook	2.00	1.135	1.005	0.157

FB8	I feel I am out of touch when I haven't log on to Facebook for a while	2.21	1.370	0.800	-0.686
FB9	I feel I am part of the Facebook community	2.61	1.375	0.235	-1.234
FB10	I would be sad if Facebook shut down	2.26	1.413	0.710	-0.877
FB11	I get ideas about what everyone else is watching, reading or listening to from Facebook	2.97	1.366	-0.140	-1.252
FB12	Facebook is a good way for me to network with others	3.30	1.306	-0.474	-0.912
FB13	Facebook helps me feel closer to my friends	2.97	1.372	-0.056	-1.234
FB14	Facebook allows me to find new friends	3.33	1.376	-0.526	-0.961
FB15	I use Facebook to keep in touch with family members	2.14	1.317	0.839	-0.561
FB16	I use Facebook to keep in touch with friends	2.75	1.375	0.152	-1.254
FB17	I use Facebook to look at the profile of someone I think attractive	2.65	1.442	0.249	-1.312
FB18	I use Facebook to post photos in my album	2.21	1.279	0.658	-0.780
FB19	I use Facebook to look at friends' photo album	2.96	1.352	-0.053	-1.188
FB20	I use Facebook to leave wall comment	2.76	1.384	0.141	-1.269
FB21	I use Facebook when I don't want to study	2.55	1.395	0.413	-1.089
FB22	I use Facebook to keep in contact with old friends	2.82	1.407	0.040	-1.318
FB23	I use Facebook instead of phone	1.76	1.147	1.393	0.915
FB24	I use Facebook instead of email	2.01	1.287	1.048	-0.121
FB25	I use Facebook to pass the time	2.71	1.304	0.137	-1.103
FB26	I use Facebook to find new friends	2.49	1.393	0.425	-1.159
FB27	I use Facebook to buy and sell stuff	1.58	1.083	1.903	2.614
FB28	I use privacy settings to select what part of my profile share with others	2.98	1.599	0.093	-1.557

N = 438

Discussion and Conclusion

The purpose of the study is to determine the trends and patterns of Facebook usage among pre-service trainee teachers in a teacher training college in a Gulf country.

This paper presents preliminary findings from the study. The usage of social media among teens are rapidly changing. Recent Pew Research (2015) revealed that internet use is a near 'constant' for some teens and mobile devices are ubiquitous among them. The data collected in the US shows that 80% of the teens use internet almost constantly or several times a day.

There are many social networking software that are introduced in recent years, some for international users and some for local audience. Connecting to social media is not limited to Facebook only, and teens use mobile apps such as Snapchat and Whatsapp to contact each other. In addition other social media sites such as Instagram, Tumblr, Vine, Twitter and online pinboards (like Pinterest and Polyvore) are also popular to share multimedia messages. In some of the Gulf states, d1g (diwanji) platform attracts millions of users in the region and it allows to share videos, photos, audio, forum and Q&A facility, in addition to Facebook and Twitter which can use Arabic language. Strong and Hareb (2012) reported the social media use among Arabic women in the UAE. The study involved 167 female Emiratis and explore the usage of Twitter among them. The results showed that majority of them (94%) prefer Twitter to Facebook. Due to the nature of the rapidly changing phenomenon, it is prudent to consider that the results from this survey is valid at the time of data collection.

For the young generation today technology is integral part of their lives. The use of social media such as Facebook by students is expected to continue and increase annually as they embrace digital life style. More research and innovative approaches are needed to determine the effects of social media and explore the use of Facebook for education purpose leveraging the affordance of the medium.

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Effects of Multimedia Instruction on Retention and Achievement of Basic Machining Skills in Mechanical Craft Practice

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
The emergence of ICT has changed the global status of education. Multimedia instruction which offers alternative to traditional paradigm of learning has made learning more meaningful, accessible and interactive within and outside the classroom. However, Nigeria has not fully embraced the use of multimedia instruction in teaching and learning. Therefore, the study aimed at investigating the effects of multimedia instruction on retention and achievement of basic machining skills in mechanical engineering craft practice. The study was conducted in four selected Technical colleges in Adamawa and Taraba states Nigeria. The population was 252 students in National Technical Certificate (NTC) 2. A sample of 156 were drawn from the population using Yaro Yamane's formula. The design of the study was experimental. The sample drawn were divided into control and experimental groups. Experimental group were taught with multimedia instruction while control group were taught with demonstration method. Instructional video files, and lesson plan, teacher's made test for pretest and posttest, were the instrument developed, validated by three experts and used for data collection. Two research questions and two hypotheses were raised. Mean and standard deviation were used to answer the research questions. t-test statistics was used to test the hypotheses at 0.05 level of significance. The research findings indicated that there is a significance difference between the mean performances of students in the experimental group than those students in the control group. The students in the experimental group performed better in mechanical craft practice and in retention test than those in the control group. Hence multimedia instructions have more effect on learning achievement and retention of skills in craft practice. The study recommended that multimedia instructional tool is an effective tool for enhancing teaching and learning of practical skills in mechanical craft.
Keywords: Multimedia, Instruction and Demonstration.

Introduction

Technical and Vocational Education and Training (TVET) programmes are faced with the challenges of finding innovative ways to accommodate the growing interest in the programmes (Aloraini, 2012). Technical Colleges are not exceptional in this regard. Conventional teaching methods which is the traditional face to face method of teaching that includes: lecture method, demonstration method, field trip etc. have been predominantly used in TVET schools and colleges. Difficulties associated with traditional teaching methods had contributed to poor levels of academic achievement related to improper teaching and learning strategies employed for teaching technical courses in technical schools and colleges (Nwanekezi & Kalu, 2012; Oshinaike and Adekunmisi, 2012 & Robert, 2011). Udofia, Ekpo, Nsa, and Akpan (2012) noted that inadequate instructional techniques do not enhance students' acquisition of skills and development of self-concept as well as interest. It may rather make it difficult for the students to develop the right habit for job performance.

The average school age child spends much time watching television; playing video games and exploring other electronic media devices, including the cell phones (Nwanekezi & Kalu, 2012). These exploration and manipulations according to Nwanekezi and Kalu is a great development in education which have further stimulated interest and created enabling environments for learning to take place both inside and outside the classrooms. Conversely, Idris and Rajuddin (2012a) opined that problem based, context based, and fieldwork teaching methods were significant predictors of technical skills among students. The views of the foregoing authors have undermined the fact that the emergence of Information and Communication Technology (ICT) have created a knowledge based society that have changed the global economy and the status of education (Atsumbe, Ngutor & Enoch, 2012). Moreover, it is essentials for learners to have access to education anytime and anywhere. Hence it is unrealistic to ask students to be in a designated place every time to engage in learning (Atsumbe, et al). Multimedia instruction can deliver instruction anytime and anywhere; and can make instructions available and accessible to learners on multimedia compact discs (CD) and on multimedia files which can be played or viewed on their multimedia mobile devices. This can further facilitates learning outside the school and classroom settings.

The purported strengths of ICT, multimedia technology has made multimedia instruction possible in audio files, video or both files (Gertner, 2011). Multimedia instruction is a vital instrument for transforming traditional paradigm of learning (Mahajan, 2012). Its offers a promising alternative in delivering the intended learning content that may not be available in the traditional face to face instruction (Donkor, 2011). Multimedia instruction has become a powerful medium for explanation of concepts, theories and abstract things which make learning more meaningful (Gupta & Sehgal, 2012). It links the images, audio and visual together to provide a multisensory experience for the learner (El-Sayed & El-Sayed, 2013). Gertner (2011) considered multimedia application to consists of at least three of these seven components: text, data, audio, graphics, photographic images, and animation as well as moving pictures. He further noted that multimedia based lectures provide a unique opportunity to present, teach, and internalize information. Judicious use of multimedia resources can substantially increase the quantity and quality of time spent on task; it offers an excellent avenue for focusing the students' attention on specific details on

the subject to be taught (Robert, 2011). Multimedia allows students to view actual objects and realistic scenes, see sequences in motion, and to listen to narration (Nazir, Rizvi & Pujeri, 2012).

Retention was defined by Kundu and Tutoo (2002) as a preservative factor of the mind. The mind acquires the materials of knowledge through sensation and perception. These acquired materials is preserved in the form of images for knowledge to develop and whenever a stimulating situation occurs, retained images are revived or reproduced to make memorization possible (Kurumeh & Obida, 2011). Multimedia instruction can convey information in a stimulating situation that aids the brain to preserved information in the form of images which can be easily retained and remembered. Nwanekezi and Kalu (2012) observed that students taught with multimedia instruction have high retention score than their counterpart who were taught with traditional teaching methods. This is so because multimedia has certain features that increase the receptive and memory ability of the learner. These features is focused on the ability of the learner to learn with multiple senses, thus increases student achievement and ensure learning permanency, and improvement of mental process skills that promote deeper learning which increases the rate of retention (Li, 2011; Oguz-Unver & Yurumezoglu, 2013)

Academic achievement is about how successful the learner can master the materials of the learning object (Tanah, 2009). It is the extent to which a student, teacher or institution has achieved their educational goals. Academic achievement is commonly measured by examinations or continuous assessment. The main focus of academic achievement is centered on the holistic approach in attaining the objectives of the object of study. This implies that the learner should academically achieve cognitive, psychomotor and affective educational domains. This will further prepare the learner to acquire practical skill, basic and scientific knowledge and attitude required as craftsmen and technicians at sub-professional level (Olaitan, 1996). Once this is achieved, the learner will be able to live well and contribute greatly to his or her society.

Hence, technical college graduates are supposed to have three options at the end of the three years program. These options according to the National Policy on Education (FRN, 2004) is to either secure employment in the industries, pursue further education in advance craft in a higher technical institutions or set up their own business and become self-employed. Unfortunately, despite all effort by the government to ensure quality educational delivery at the technical colleges failed (Peter, Abiodun & Jonathan, 2010). There have been persistent reports of high failure rate among graduates of the Technical colleges. The high failure of students in recent years according to NABTEB (2011) chief examiners' report is partly due to teaching methods employed by instructors to teach the students. In most technical colleges, teaching methods used in teaching are mostly lecture and the demonstration methods. Continued use of these traditional teaching methods reduces the ability of students to grasp relevant concepts than when exposed to appropriate teaching techniques. The Federal Ministry of Education (2012) in her reports on TVET institutions revealed that students are always put-off or not been interested in vocational education because of the non-motivating and unchallenging methods and approach used by their teachers. Therefore, a viable instructional methods that will stimulates and motivates as well as enhancing teaching and learning should be employed. Instructional

approaches that will ensure quality educational delivery and retention of what is learned need to be explored (Oshinaike & Adekunmisi, 2012). It is on this view the researcher want to investigate the effects of multimedia instruction on the retention and achievement of basic machining in mechanical craft theory in technical colleges.

In this modern age of advanced technology, the success of any educational enterprise could be measured not only in terms of how much instruction is given by teachers, but also in terms of technologies and / or media employed to ensure effective delivery and development of learners (Robert, 2011). Conventional instructional methods cannot picture clearly abstracts, difficult concepts and illustrations to the learner. In fact, the traditional technique of instruction has contributed to a lot of frustration among learners especially, the slow learners who always surrender themselves to excessive rote learning and memorization (Odo, Adenle & Okwori, 2012). It is a very difficult task for teachers to take care of each and every student in a classroom comprised of many students with individual needs. It is impossible for teachers to teach every individual according to their pace of learning and level of understanding in as limited time period. Sharma (2013) pointed out some of the things traditional method cannot achieve. He noted that teacher using traditional method cannot be able to:

i. Provide teaching material according to the need of each student
ii. Teach every student according to his/her own pace of learning.
iii. Provide teaching material for as much time as the student review.
iv. Guide the students keeping in view their individual differences.

Advancement in computer and software technology, has brought outstanding development into educational sector. Consequently multimedia instruction can be designed to take care of all the learning conditions (Gantt, 1998). Hence, there is need for technical colleges in Adamawa and Taraba states to take advantage of this technology and make use of dynamic multimedia technology to illustrate abstract concepts in teaching cognitive and manipulative skills.

Purpose of the Study

The purpose of the study was to find out the effect of multimedia instruction on the retention and achievement of basic machining skills in mechanical craft engineering practice. Specifically, sought to find out:

1. The performance of students in cognitive skills achievement test when taught with multimedia instruction.
2. The performance of students in psychomotor achievement test when taught with demonstration instruction.
3. The retention of learning content by the students when taught with multimedia instruction.
4. The level of retention of learning object by the students when taught with demonstration instruction.

Research Questions

Two research question were poised to guide the study as thus:

1. What is the mean performance of students in psychomotor achievement test when taught with multimedia and demonstration instruction?
2. What is the retention of the content of learning by the students when taught with multimedia and traditional instruction?

Hypotheses

Two null hypotheses were tested at 0.05 level of significance. These hypotheses includes:

Ho_1: There is no significant difference between the means performance of students taught with multimedia and demonstration instruction in psychomotor achievement test.

Ho_2: There is no significant difference between the retention of students taught with multimedia instruction and those taught with demonstration instruction.

Methodology

Experimental pre-test and post-test design was used for this research work. Six lessons of multimedia instruction was designed and produced by the researcher, based on 2011 NABTEB syllabus. Lesson topics includes: Workshop Safety Rules and Practice, Centre Lathe and its accessories, Cutting Fluids and Tooling Materials, Tool Shapes and their uses, Safety Measures when Working on Centre lathe as well as Basic Operations on Centre lathe. The last lesson gave instruction on basic machining processes on the centre lathe and the production of engineering component (See appendix 1). This machining processes basically include: straight and step turning, drilling, boring and counter boring, as well as grooving and taper turning.

The population of 256 students was considered for the study. This population constituted the total registered numbers of year two students in National Technical Certificate (NTC) programme in mechanical engineering craft in the four selected technical colleges in Adamawa and Taraba States.

The sample of 156 students was drawn using Yaro Yamane's formula.

$n = \frac{N}{1 + N(e)^2}$ n = the sample size, N = the finite population, e = level of significance (or limit of tolerable error), 1 = unity (a constant). $n = \frac{256}{1 + 256(0.05)^2}$ = 156.

Random sampling with replacement was adopted during sample selection. The researcher asked the students to draw scraps of papers from the box. On each paper, letter A or B was written on it. Once the letter is identified, the student is asked to replace the paper back into the box. This procedure was repeated until the sample were drawn. The researcher prefers this technique because it gives individual equal chances to be selected and eliminates biases in the selection (Uzoagulu, 2011).

The instrument for data collection was the 2011 to 2013 National Business and Technical Examination Board (NABTEB) mechanical craft practice objective and practical questions with assessment profile of 40% theory and 60% practical skills, making a total of 100% gain in theoretical knowledge and practical skills. Forty objective questions was selected and used for pre-test, post-test and retention test. Practical test was used for the post test and retention test. Each objective questions carried 1 marks making a total of 40 marks. While 60 marks were awarded for the practical test, making a total of 100%. Students' retention and achievement test was recorded and categorized into four point grade as thus: Distinction: 70 to 100%, Credit: 50 to 69%, Pass: 40 to 49%, Fail: 0 to 39%.

The test instrument was face and content validated by three experts in the Department of Technology Education, Modibbo Adama University of Technology Yola. The test instrument were not subjected to any reliability test. This is because the test questions were selected from the past NABTEB questions which was a standard instrument that had already undergone reliability test.

The researcher taught both groups by himself and administered the test instrument. The control group was taught using demonstration method of instruction. While experimental group was taught using multimedia method of instruction. At the end of the treatment, students were tested on what they were taught and what the retained. The objective of the test instrument was to measure cognitive and psychomotor skills of the educational domains. The scores generated were used for data analysis in the study.

Method of Data Analysis

Mean and standard deviation were used to answer research questions 1 and 2 while t-test analysis was used for testing null hypotheses 1 and 2 at 0.05 level of significance.

Results

Research Question 1

What is the mean performance of students in psychomotor achievement test when taught with multimedia and demonstration instruction?

Table 1. Mean and Standard deviation of pre-test and post-test scores of experimental and control group in psychomotor achievement test.
N= 156

Group		Pretest		Posttest		Gain in practical Test
	N	$\bar{x}_1$	δ	$\bar{x}_2$	δ	$\bar{x}_2$-$\bar{x}_1$
Experimental	80	41.26	4.15	72.15	7.29	30.89
Control	76	41.49	4.18	56.92	7.39	15.43

The data presented in Table 1 indicated that the experimental group had a mean performance of 41.26 and a standard deviation of 4.15 in the pre-test and a mean performance of 72.15 and standard deviation of 7.29 in the post-test. The result indicated that the mean differences between the post-test and pre-test ($\bar{x}_2 - \bar{x}_1$) was 30.89 in the experimental group. The control group had a mean performance of 41.49 with a standard deviation of 4.18 in the pre-test. While in the post-test, the mean performance was 56.92 and a standard deviation of 7.39. The post-test ($\bar{x}_2 - \bar{x}_1$) gain was 15.43. This implies that the experimental group performed better than the control group in practical test.

Research Question 2

What is the retention of the content of learning by the students when taught with multimedia and traditional instruction?

Table 2. Mean and Standard deviation of post-test and retention test of experimental and control group.
N=156

Group		Posttest		Retention test		Difference in posttest-pretest
	N	$\bar{x}_2$	δ	$\bar{x}_3$	δ	$\bar{x}_2$-$\bar{x}_3$
Experimental	80	72.15	7.29	67.15	4.15	5
Control	76	56.92	7.39	40.97	7.39	15.95

The data presented in Table 2 indicated that the experimental group had a mean performance of 72.15 and a standard deviation of 7.29 in the post-test and a mean performance of 67.15 and standard deviation of 8.73 in the retention test. This make a loss in retention in the experimental group to be 5. The control group had a mean performance of 56.92 and a standard deviation of 7.39 in the post-test and a mean performance of 40.97 and standard deviation of 8.42 in the retention test, loss in the retention was 15.95. This implies that the experimental group had more retention ability than the control group.

Ho_1: There is no significant difference between the mean performance of students taught with multimedia and demonstration instruction in psychomotor skills achievement test.

Table 3. t-test analysis of means scores of the posttest of students taught with multimedia and those taught with the traditional instruction in practical test.

Group	$\bar{x}$	δ	N	Df	Standard Error	t-cal	t-table	Decision
Experimental	72.15	7.29	80	154	1.18	12.91	1.98	Significant
Control	56.92	7.39	76					

The analysis of data in table 3 showed that t-cal (12.91) is greater than t-table (1.98). Hence the null hypothesis is rejected.

Ho_2: There is no significant difference between the retention of the content of study by students taught with multimedia and those taught with traditional instruction.

Table 4. t-test analysis of the retention of the content of study by the students taught with multimedia and those taught with demonstration instruction.

Group	$\bar{x}$	δ	N	Df	Standard Error	t-cal	t-table	Decision
Experimental	67.15	4.15	80	154	1.08	10.91	1.976	Significant
Control	40.79	7.39	76					

The analysis of data in table 4 showed that t-cal (12.91) is greater than t-table (1.98). Therefore the null hypothesis is rejected.

Findings

On the basis of the data collected and analyzed for this study, the following findings were made:

i. Students taught with multimedia instruction performed higher in the post-test than those taught with Demonstration instruction, as the result of the effectiveness of the method used
ii. There was significant difference in the retention abilities in cognitive and psychomotor skills of students taught with multimedia.
iii. Multimedia instruction is effective on teaching cognitive skills, psychomotor skills and it consolidates retention of learning content than demonstration instruction.

Discussion of Findings

The results showed that the experimental group had higher mean performance than the control group in the post-test in practical test. This finding indicates that multimedia instructional has a positive effect on students' academic achievement in basic machining processes. This finding is in consonant with the works of Nazir, Rizvi, and Pujeri (2012), which found out that learning with multimedia instruction increased interest in the learner and enhances learning. This means that multimedia instructional approach is more effective than the demonstration method when it comes to developing students in handling complex tasks such as the production of engineering components. It flexibility in instructing and having more access repeated

lessons make the students to learn and retain more content. Similarly, analysis on the retention of the content of study shown that there is significant difference in the retention of content of study. The experimental group retained more content compared to the control group. This result was in accordance to the work of Nwanekezi and Kalu (2012) who found out that students taught with multimedia instruction tended to be superior to their counterparts with regard to retention in Basic Science Concepts studied. This inferred that multimedia instruction significantly improves active participants in learners and making learning more meaningful. It also connect the existing and new knowledge to consolidate learning experience.

Recommendations

Base on the results of these findings the following recommendations are made.

1. TVET teachers should adopt the components of multimedia instruction. This will enable them to cater for diverse learning styles of students in their classrooms as this, will improve academic achievement and development of practical skills.
2. Government should provide more funds and grants to equip laboratories, studios and workshops that will facilitate production and multimedia instruction.
3. TVET teachers should be given on-the-job training opportunities such as short-term courses, seminars and workshop to enable the teachers to update their knowledge; this will help them to constantly keep abreast with the ever-changing scientific knowledge and various modern methods of teaching trade subjects.

Conclusion

Having found out that instructions with multimedia proved to be effective especially in teaching difficult and abstract concepts. It is ideal to use it in teaching courses that may not permit safe environment to the teacher and learner. It can be used where mastery of procedures is needful, and in distance learning where teacher-student personal contact is not possible. Instructing with multimedia bring the object of learning the real situation in a virtual world. Thus stimulates, motivates and enhances learning. It creates mental image in the mind of the learner, thus creating faster remembering and enhances retention of learning content. It is therefore important to adopt the use of multimedia instruction in the quest for education for all. Base on the results of the findings of this study, the following recommendations were made.

1. TVET teachers should adopt the components of multimedia instruction. This will enable them to cater for diverse learning styles of students in their classrooms as this, will improve academic achievement and development of practical skills.

2. Government should provide more funds and grants to equip laboratories, studios and workshops that will facilitate production and multimedia instruction.

3. TVET teachers should be given on-the-job training opportunities such as short-term courses, seminars and workshop to enable the teachers to update their knowledge; this will help them to constantly keep abreast with the ever-changing scientific knowledge and various modern methods of teaching trade subjects.

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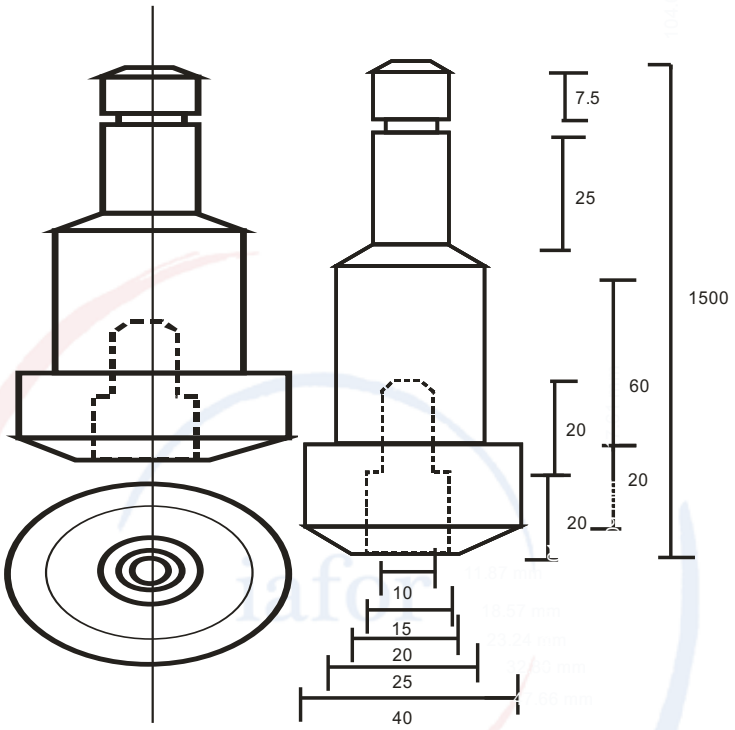
Appendixes

Appendix 1

Mechanical Engineering Component (Stud)
Instruction: All Dimension in Millimeters



List of Tables

Table 1. Sample distributions into control and experimental groups

Schools	Experimental group	Control group	Total
GSTC Yola	20	19	39
GSTC Numan	20	19	39
GSTC Jalingo	20	19	39
GSTC Balli	20	19	39
Grand Total	80	76	156

Hybrid Teaching Approach: A Strategy for Enhancing the Mastery of Knowledge and Practical Skills in Students of Vocational and Technical Education

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
This study was aimed at investigating an effective strategy that will enhance mastery of knowledge and practical skills in teaching and learning. The study was carried out at Modibbo Adama University of Technology Yola, Adamawa State Nigeria. The sample population was drawn from three hundred level undergraduate students of Technology Education (TE) and Vocational education (VE) in the school of science and technology Education. One hundred students were purposively drawn; 70 from TE and 30 from VE. Twenty five were female and 75 male. The design adopted for the study was pretest post-test experimental non-equivalent control group. Hybrid and traditional lesson plans, Students' achievement and performance test were the research instruments developed, validated by three experts and used for data collection. Three research questions were poised and three hypotheses were formulated. Mean and standard deviation were used to analyse data to answer the research questions. The t-test analysis was used to test the hypotheses at 0. 05 level of significance. The research findings indicated that significant different exist in the performance between the students in control and experimental groups, students in experimental group performed better than those of the control group. Furthermore, results also indicated that there is no significant difference in the opinions of male and female students on the effect of hybrid method of teaching in enhancing teaching and learning. Hence, the study recommended that hybrid teaching method should be adopted as a teaching strategy in enhancing teaching and learning.

Keyword: Hybrid Teaching, Traditional Teaching. Approach (Method)

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Introduction

Technical and Vocational Education Training (TVET) is used as a comprehensive term to refer to those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life. It is the type of education that prepares individuals to acquire knowledge and skills for gainful employment in different occupational disciplines. TVET equips its recipient to become an employee or employer of labour. Idris and Rajuddin (2012) suggested that teaching method in TVET gives more emphasis on the inspiration and flexibility, adaptability and future needs of businesses.

Teaching effectively demands that the teacher possess some basic ability to organize, co-ordinate and utilize personal qualities. He / she should also be objective and competent in lesson preparation, presentation and evaluation (Onweh & Akpan, 2014). Teachers can also motivate the learners, make students active participants in learning, use appropriate strategies and facilities to enhance effectiveness in instructions.

Instructional strategies according to Onweh and Akpan (2014) are decisions about organizing people, materials and ideas to facilitate learning. Hence instructional strategies can be seen as both the teaching method and the materials employed in the process of teaching. It is the method a teacher may take to achieve learning objectives. A key requirement for the future is the need to prepare students to participate in the information society, where knowledge and skills is the most crucial factor in the social and economic development of a country (Dimitrios, Labros, Nikolaos, Maria & Athanasios, 2013). However there is need to come up with a strategic pedagogy where mastery of knowledge and skills can be enhanced and enable the learners to compete favourably in the global market. Certain strategies and techniques have come into existence with accompanying frameworks to make the best out of every student through innovative, efficient and effective instruction. The emerging method of teaching “Hybrid Teaching” which combine the traditional and the interactive multimedia based learning has offer the benefits of both in-person and online instruction. Hybrid method allow for flexibility and choice in pedagogical strategies that work best in face-to-face and online environments. Traditional method allows for more spontaneity and immediate feedback, while online allows for more reflection, critical thinking, recollection, and conceptualization (Skibba & Ndon, 2012).

Scholars have defined hybrid method of teaching in many ways. Kalekar and Patil (2014) defined hybrid learning method as a blended learning that combines the engaging benefits of traditional instructor-led training with the advantages brought by a variety of technologies to create an optimum program. It underscores the fact that many “ingredients” can comprise a blended learning model, including instructor-delivered content, e-learning, webinars, conference calls, live or online sessions with instructors, and other media and events. Furthermore, this is an instructional practice that combines teaching methods, instruction and online learning (Nunamaker, 2014). Westover and Westover (2014) defined hybrid as classes in which instruction takes place in a traditional classroom setting augmented by computer-based or online activities which can replace classroom seat time”
Hybrid teaching method is sometimes referred to as blended learning. It is a mixture of the traditional and the on-line learning that facilitates instructions occurring both in the classroom and on-line (Vernadakis, Antoniou, Zetou, Giannousi, & Kioumourtzoglou, 2012). It is the combination of traditional teacher-led classroom instruction and independent student learning

outside the classroom using online materials (Taylor, 2013). Hybrid teaching method includes traditional, multimedia and web based teaching approaches where the teacher is at liberty to use varieties of teaching methods in instructing the learner (Johnson, 2013). Thus, teacher has the flexibility to incorporate the two teaching and learning approaches and use any method he or she deems useful to increase and enhance the students' learning processes. In this case, the same multimedia courseware content can also be packaged and delivered over satellite and broadband technologies for distance learning. Here, the student learns the materials at his or her own time and interacts with the teacher via video-conferencing in real time (Neo & Neo, 2002).

In this paper however, the hybrid teaching approach is considered as a combination of traditional method of teaching, Multimedia Technology and web based learning where teaching and instructions occur on-line, in and outside the classroom**.**

Statement of the Problem

Modern age of advanced technology and Information and Communication Technology (ICT) has tremendously transformed the educational sector. The success of any educational enterprise could be measured in terms of how much instruction is given by teacher and technologies employed to guarantee maximum skills and cognitive development of learners (Reddi & Mishra, 2005). Underfunding of schools and institutions has led to lack of technical manpower and inadequate facilities for teaching practical courses. Another challenge posed by the use of ICT to enhance teaching and learning in the developing countries and Nigeria in particular are: incompetent ICT teachers; limited and low internet connectivity and lack of steady electricity. Sectarian crises which lead to the closure of schools because of the attacks on students and the schools has brought a serious challenge on the development of education in North East, Nigeria.

It is paramount to embrace teaching strategies that will be effective amidst afore-mentioned educational challenges in Nigeria so as to equip learners with the higher order thinking skills for easy adaptability and more flexibility in both virtual and physical environment. This can enhance instruction and learning within and outside the school and classroom settings (Oshinaike & Adekunmisi, 2012). Perhaps, one of the best reasons for developing hybrid teaching method is that it provides a viable option for students who seek the flexibility of distance courses but also wish to have some personal contact with faculty and other students in classroom settings. Hybrid teaching method goes beyond barriers of time, location and culture and has created many better opportunities for learning. The foregoing reasons make up the advantages of multimedia. It is on this note, that this study investigated the strategy for enhancing the mastery of knowledge and practical skills in students of vocational and technical education through hybrid teaching method.

Purpose of the Study

Specifically, the study sought to determine:

1. The impact of hybrid method of teaching on the students' academic achievement test.
2. The effect of hybrid method of teaching on gender.

Research Questions

The following research questions were asked to guide the study:

1. What is the mean performance of students taught with hybrid teaching methods and those taught with the traditional methods in students' achievement test?
2. What is the mean performance of students taught with hybrid teaching methods and those taught with the traditional methods in students' performance test?
3. What is the mean performance of male and female students exposed to the hybrid teaching method?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

Ho_1: There is no significant difference between the mean performance of students taught with hybrid teaching method and those taught with the traditional teaching method in students' achievement test.

Ho_2: There is no significant difference between the performance of students taught with hybrid teaching method and those taught with the traditional teaching method in students' performance test.

Ho_3: There is no significant difference between the performance of male and female students exposed to the hybrid teaching method.

Methodology

The pretest, post-test quasi experimental non-equivalent control group of experimental design was used. Two intact classes were assigned into experimental and control groups. Vocational Education (VE) and Technology Education (TE) students were assigned into control and experimental groups respectively. The population of the study consisted of 100 students of 2012/2013 academic session. The population was used as the sample. The sample comprises of 70 students from VE and 30 students from TE.

The instruments used for the study were hybrid lesson plan, conventional lesson plan, and materials used for designing simple hydraulic components. Multimedia CDs, video projector and tablet computers with internet access were also used. Instruments for data collection were fifty items test questions. Twenty five for achievement and 25 for performance test respectively which were designed by the researchers. The test instruments were used for both the pretest and posttest. The hybrid lesson plans, the conventional lesson plans and students achievement and performance tests were faced and content validated by three test and measurement experts in the Department of Vocational and Technology Education MAUTECH in Yola, and Federal of University Kashire, Gombe state, Nigeria. The validations focused on adequacy of content, suitability of the test items, compare each

instrument of data collection against hybrid instructional method, logical sequence and suitability of the technical term used. Their comments and suggestions were used to restructure the final instrument.

To ensure high reliability of the instruments the students' achievement test and performance test were trial tested by administering it on 20 students in 500 - level which were randomly selected in the Department of Vocational and Technology Education Abubakar Tafawa Balewa University of Technology Bauchi Nigeria. The test - retest reliability technique was adopted. The Pearson product moment correlation coefficient of the students achievement test was 0.90 and students, performance test was 0.07. This was considered suitable enough for the study. The research involved two main stages: Administration of pre-test and post-test that contained the same questions but arranged in different order. Each item of the pretest and the posttest carried two (2) marks making the total marks to be 100 percent. The study was conducted in a period of six weeks during which two topics were covered: hydraulic systems and production of hydraulic components. The pre-test was administered in the first week of the research exercise to all the students before both the experiment and control groups were subjected to the treatments. All the practical lessons were held in the Mechanical Engineering hydraulic lab of the University, with the materials provided by the university. After the administration of the pre-test, students in the experimental group were taught using the hybrid instructional method. While the control group were thought with the use of the traditional teaching method.

Experimental and control groups were taught by the researchers. The teaching process lasted for 5-weeks. Post-test was administered to all the students in the 6th weeks of the exercise. The data were collected and analyzed using mean, standard deviation and t-test.

Results

Research Question 1

What is the mean performance of students taught with hybrid teaching method and those taught with the traditional teaching method in students' achievement test?

Table 1. Mean and standard deviation of pre-test and post-test performance of experimental and control group in students' achievement test.

N_1= 30, N_2= 70

Group		Pretest		Posttest		Gain in achievement Test
	N	$\bar{x}_1$	δ	$\bar{x}_2$	δ	$\bar{x}_2$-$\bar{x}_1$
Experimental	30	58.50	9.8	71.78	8.73	13.28
Control	70	54.76	10.52	62.22	8.45	7.46

The data presented in Table 1 indicated that the experimental group had a mean of 58.50 and a standard deviation of 9.80 in the pre-test and a mean score of 71.78 and standard deviation of 8.73 in the post-test. Post-test gain ($\bar{x}_2$-$\bar{x}_1$) in favour of experimental group is 13.28. The control group had a mean score of 54.76, standard deviation of 10.52 in the pre-test. A mean of 62.40, standard deviation of 9.66 in the post-test. Post-test gain ($\bar{x}_2$-$\bar{x}_1$) was 7.46.

Research Question 2

What is the performance of students taught with hybrid teaching method and those taught with the traditional teaching method in students' performance test?

Table 2. Mean and Standard deviation of pre-test and post-test performance of experimental and control group in students' performance test.

N_1= 30, N_2=70

Group		Pretest		Posttest		Gain in performance Test
	N	$\bar{x}_1$	δ	$\bar{x}_2$	δ	$\bar{x}_2$-$\bar{x}_1$
Experimental	30	42.54	12.50	72.04	8.73	29.50
Control	70	42.70	12.32	61.66.	8.45	18.96

The data presented in Table 2 indicated that the experimental group had a mean of 42.54 and a standard deviation of 12.50 in the pretest and a mean score of 72.04 and standard deviation of 8.29 in the post-test making post-test ($\bar{x}_2$-$\bar{x}_1$) gain in favour of experimental group to be 29.50. The control group had a mean of 42.70 and a standard deviation of 12.32 in the pretest and a mean of 61.66 and standard deviation of 8.63 in the post-test, making post-test ($\bar{x}_2$-$\bar{x}_1$) gain of 18.96.

Research Question 3

What is the mean performance of the male and female students exposed to hybrid teaching method?

Table 3. Mean and Standard deviation of pre-test and post-test performance of male and female students experimental and control group in students' performance test.

N_1= 22, N_2= 8

Group		Pretest		Posttest		Gain achievement Test
	N	$\bar{x}_1$	δ	$\bar{x}_2$	δ	$\bar{x}_2$-$\bar{x}_1$
Male	22	54.79	10.40	70.14	8.44	15.35
Female	8	54.50	11.12	70.71	11.24	16.21

The data presented in Table 3 indicated that male students had a mean of 54.79 and standard deviation of 10.40 in the pre-test. Mean score of 70.14 and standard deviation of 8.44 in the post-test. Post-test ($\bar{x}_2$-$\bar{x}_1$) gain by male students was 15.35. while the female students had a mean score of 54.50 and a standard deviation of 11.12 in the pre-test and a mean of 70.71 and a standard deviation of 11.24. The gain in the post-test ($\bar{x}_2$-$\bar{x}_1$) of female students was 26.21. The difference in the scores of male and female students in performance test was 0.86.

Ho_1: There is no significant difference between the mean performance of students taught with hybrid teaching method and those taught with the traditional teaching method in students' achievement test.

Table 4. t-test analysis of mean performance of students taught with hybrid method and those taught with the traditional teaching method in students' achievement test.

Group	$\bar{x}$	δ	N	Df	Standard Error	t-cal	t-table	Decision
Experimental	7.78	8.73	50	98	7.76	2.21	1.660	Significant
Control	62.22	8.45	50					

The data presented in Table 4 shows that the t-cal (2.21) computed is greater than the critical value of t-table (1.660) at 0.05 level of significance. Therefore, the null hypothesis was rejected.

Ho_2: There is no significant difference between the mean performance of students taught with hybrid teaching method and those taught with the traditional teaching method in students' performance test.

Table 5. t-test analysis of mean performance of students taught with hybrid teaching styles and those taught with the conventional teaching method in students' performance test.

Group	$\bar{x}$	δ	N	Df	Standard Error	t-cal	t-table	Decision
Experimental	72.04	8.29	50	98	7.8	1.82	1.600	Significant
Control	61.66	8.63	50					

The data presented in Table 5 shows that the t-cal (1.82) computed is greater than the critical value of t-table (1.660) at 0. 05 level of significance. Hence, the null hypothesis was rejected.

Ho_3: There is no significant difference between the mean performance of male and female students exposed to the hybrid teaching method.

Table 6. t-test analysis of mean performance of male and female students exposed to the hybrid teaching method.

Group	$\bar{X}$	Standard Deviation	N	Df	Standard Error	t-cal	t-table	Decision
Male	70.14	10.40	228	28	10.99	0.87	1.701	Not significant
Female	70.71	11.12						

The analysis on table 6 revealed that there is no significant difference between the mean performances of male and female students exposed to the hybrid teaching method. Since t-cal is less than t-table, the null hypothesis was accepted.

Findings

On the basis of the data collected and analysed for this study, the following findings were made.

i. Students taught with hybrid teaching method performed higher in the post-test than those taught with traditional teaching method in achievement test.
ii. Students taught with hybrid teaching method performed higher in the post-test than those taught with traditional teaching method in the performance test.
iii. There was no significant difference in the mean performance of male and female students taught with the hybrid method in the performance test.

Discussion of Findings

The analyses and results of this study showed that the experimental group in table 1 had higher mean performance than the control group in the post-test. This finding indicates that the hybrid teaching method has a positive effect on students' academic achievement in basic hydraulic system. This implies that key components of hybrid teaching method when used collectively are more effective than the traditional teaching method in enhancing student academic achievement. This finding is in line with the works of Uzun and Senturk (2010) who found out that the adoption of hybrid instructional method and it components greatly increases student academic achievement. The key components found in hybrid instructional method when used collectively are more effective than traditional teaching method in enhancing student academic achievement in basic hydraulic system. This means that hybrid teaching method is more effective than the traditional method when it comes to developing students in handling complex tasks such as the principle of hydraulic system, production of simple hydraulic engineering components etc.

In table 2, there is more gain in performance test in the experimental group than in the control group. Hence hybrid teaching method is proved to be more effective. This is so because hybrid teaching method is flexible in learning which significantly improves active participants in learning and make meaningful connections between: Prior knowledge and skills, new knowledge and skills, and the processes involved in learning. It also creates quality learning time for the learner to connect and apply learning experiences in real practical situations. Meydanlioglu, and Arikan (2014) concurred with the above statement when they discovered that hybrid instructional method is good and may even have the advantage in terms of improving student achievement and potentially expanding the amount of time (and quality time) students spend during learning. Hence it significantly improves active participants in their learning and makes meaningful connections between: Prior knowledge and skills, new knowledge and skills, and the processes involved in learning.

It is also in agreement with the report released by Harvard University July 28, 2014 on the pilot studies on blended learning experiments shared some similarities with this study. Students appreciated the used of high quality of the Hybrid materials and majority are found to be interesting and engaging. The report also shown that Students valued the increased flexibility and ability to learn at their own pace, but still wanted meaningful in-person interactions with faculty and among themselves. The importance of sections, small group discussions outside of the regular class, was underscored as students said they found them vital, enabling feedback, time for questions and answers, meaningful collaborations, and a deeper sense of intellectual community. The finding also agreed with the work of Peter, Abiodun, and Jonathan, (2010) students learn and master skills better when they are allowed to participate actively in and outside the class by interacting freely with teacher and their peers, work in groups and taking instruction with diverse instructional technology as well as performing practical projects.

In table 3 and 6, the analysis shows that hybrid teaching method is not gender sensitive. The method is gender friendly. Hence, there is no significant differences between the performance of male and female students taught with hybrid teaching method. This is needful especially in Nigeria where girl child education needs to be improved. This finding was consonants with the work of John, Barchok and Ng'eno (2014) that hybrid enhances students' motivation to learn as well as bridge the gender gap that exists between boys and girls in the learning of sciences.

The implications of this study is that instructions which combine components of hybrid teaching method produce an optimal learning outcomes. Individual components of hybrid teaching method have one weakness to the other. Combining or mixing these components, eliminate all the weaknesses. Thus, teaching and learning with this method motivates, stimulates and enhances the mastery of skills and knowledge of the content of study. The method takes care of cognitive, psychomotor and attitudinal behavior of the learners across gender. Consequently, combining teacher-led instruction (traditional instruction), multimedia instruction and web based learning lead to higher academic achievement in basic hydraulic system than the traditional method.

Conclusion

All the activities and innovations in hybrid instructional method were geared towards the teaching and mastery of cognitive and practical skills that will correspondingly meet the demands of the 21st century labour market. Having found out that the hybrid instructional method has positive effect on students' academic performances, there is need to use hybrid teaching method in conventional teaching setting and distance learning system. It can also be used in a hostile environment where closure of schools, Internally Displace People (IDPs) and restriction of movement hinders teaching and learning. Policies makers, curriculum planners and teachers need to adopt this method by incorporating the components of hybrid in order to make teaching and learning process effective.

Recommendations

In regard to the results of these findings and conclusions reached in the study, the following recommendations are untaken.

1. TVET teachers should always adopt the components of hybrid teaching method in teaching and learning. This will enable them to cater for diverse learning styles of students in their classrooms as this, will improve academic achievement and development of practical skills.
2. TVET Students should always be permitted to participate actively in class by interacting freely with the teacher and their fellow students as this will improve their academic ability and performance in their trade subject.
3. Government should provide more funds and grants to equip laboratories and workshops and ICT facilities that will facilitate hybrid teaching method.
4. TVET teachers should be given on-the-job training opportunities such as short-term courses, seminars and workshop to enable the teachers to update their knowledge; this will help them to constantly keep abreast with the ever-changing scientific knowledge and various modern methods of teaching trade subjects.

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ICT-Integrated Formative Assessments: A Literature Review for K-12

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
Assessment is an important part of teaching and learning as it informs about teachers and learners about the progress of learning. Summative assessments have been dominant for many years and have been used mainly for categorizing or certification. Using assessments to inform teachers about their teaching and learners about their learning have gained much attention in recent years as more focus has been placed on student-centric classrooms. Black and William (2009) proposed 5 key aspects of formative assessment (FA) to guide classroom teachers in their practice of making utilizing assessments. This paper aims to review studies done with respect to technology-integrated FA in the K-12 classrooms based on the 5 key aspects. It is found that most K-12 studies lacked the consideration of clarifying and sharing learning intentions and criteria for success (aspect 1); and activating students as instructional resources for one another (aspect 4), which are important enablers for technology-based formative assessments. Areas of related topics or studies that could be explored will be discussed as well.

Keywords: Formative assessment, technology integration, ICT-integration, assessment for learning, computer-based learning

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Introduction

Assessments have been an integral component of teaching and learning for decades. But for most part of time, assessments are mainly carried out to judge whether a learner has learnt the intended content knowledge and/ or able to apply the skills acquired, at the end of learning. These are summative in nature and the results are usually meant for ranking, streaming, certifying. Not much attention has been paid to the formative nature of assessments till late 20th century, whereby Black and William (1998) discussed the importance of *formative assessments* in the classroom as opposed to *summative assessments*. Formative assessments are meant to be implemented in the classroom by teachers to gather students' learning process, progress and outcomes. These in turn inform the teachers about the gaps that need to be filled before learners reach the final learning objectives. Wise teachers would pick these up and design lessons to close these gaps. Students could use feedback from the formative assessments to know which point of the learning they are at and in turn, plan their learning to achieve the learning goals.

The implementation and impact of formative assessments have been of great interests to policy-makers and academics. Much discussion has been carried out to emphasize how formative assessments are an essential feature of the 21st century learning environment (Redecker & Johannessen, 2013). Feedback from formative assessments, either from teachers, peers or self are known to help learners progress in their learning (Landauer, Lochbaum & Dooley, 2009; Espasa & Meneses, 2010).

In 2009, Black and William re-stated their definition of formative assessment and developed the theory of formative assessment, based on their earlier works which were more practice-based than theoretical-based, so as to provide a common basis for the already diversified formative assessment practices (p. 7). Their latest definition is: "Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited" (p. 9). They had also proposed the five key aspects of formative assessment to guide teachers in their practice (please refer to Table 1).

Five Key Aspects of Formative Assessment (Black & William, 2009)

	Where the learner is going	Where the learner is right now	How to get there
Teacher	1) Clarifying and sharing learning intentions and criteria for success	2) Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding	3) Providing feedback that moves learners forward
Peer	Understanding and sharing learning intentions and criteria for success	4) Activating students as instructional resources for one another	
Learner	Understanding learning intentions and criteria for success	5) Activating students as the owners of their own learning	

Table 1

With a clearer definition, vivid aspects and strategies as guidelines, it is easier to understand the fine-grained aspects of formative assessment and ponder further on how to actualise it in classroom practice, so as to help teachers gather information about where their learners are right now and how to make use of rubric, feedback, peers and self as resources to move closer to the learning objectives.

Another feature of the current and future learning environment, not be ignored, is the incorporation of information and communication technologies (ICT) in teaching, learning and assessing activities. ICT has become indispensable in modern life, both for learning and for work. Students and working adults alike are closely inter-connected via the internet, mobile smartphones, tablets etc. In a comparative analysis of international frameworks for 21st century competences, Voogt and Roblin (2012) found that the common needed skills stated across various frameworks, like *Partnership for 21st century skills (P21), EnGauge, Assessment and Teaching of 21st Century Skills (ATCS)* etc., are communication, collaboration, ICT-related competences and social and/ or cultural awareness, and "ICT is at the core of each of the frameworks" (p. 308). Regardless of teachers' attitudes on ICT in teaching, learning and/or assessing, the development and influence of ICT cannot be ignored.

Besides the need to integrate ICT into teaching and learning, how ICT can be exploited to carry out formative assessments, which are essential to help in gathering evidences about students' learning progress and outcomes, should be explored. Advancements in ICT have been more than fast enough to support formative assessments in the classrooms. Looking at the developments of future technologies, Redecker and Johannessen (2013) highlighted the possibilities of "embedded assessment", whereby Learning Analytics (a data mining capability) will be employed to collect data on students' online learning process and in turn provide information to teachers on the feedback and instructions that can be given to the students on how they can close learning gaps (p. 85). Such assessments are formative in nature and if used strategically by teachers based on sound pedagogies, it would be beneficial to educators, students and stakeholders alike. However, learning analytics is still in its infancy and had hardly been utilised in practical settings yet.

Though research on learning analytics is still limited, there are many previous and current researches that looked into how ICT could be used to support formative assessment. Espasa and Meneses (2009) concluded that the presence of feedback in online distance education is related with improved levels of performance and higher levels of student satisfaction. Welsh (2012) in her study found that self- and peer-based formative assessment was effective in developing students' self-regulation and the use of an e-portfolio system aided in the process. Timmers, Van der Broek and Van der Berg (2013) looked into the student feedback behaviour. This was an interesting aspect worth exploring as most would likely to focus on teachers giving feedback instead of the recipients of feedback. The team had defined success expectancy and task-value beliefs as the motivation behind seeking feedback.

But current literature mainly focuses on higher education and rarely on K-12 education and a review of the literature reveals that current available research does not reveal much about how K-12 teachers may organize formative technology-enabled activities in a social network setting such that they can utilize the affordances of ICT to gather evidences of learning; and provide and/or elicit feedback (from students

themselves or their peers), and how they use these information to further students' learning or close learning gaps. As such, the level of assessment literacy amongst K-12 teachers is also an issue which is of interest. This paper aims to review the literature on K-12 technology-enabled formative assessment and secondary related resources, so as to explore further issues that would matter for ICT-integrated formative assessments to be carried out successfully for teaching and learning, such as the assessment literacy and social network awareness of teachers.

Methodology

Searching the literature

The search of literature was done using an authoritative electronic database, *Web of Science.* The key terms and phrases used for the search were “ICT” AND “formative assessment”; “technology” AND “formative assessment”; and “computer” AND “formative assessment”; “ICT” AND “assessment for learning”; “technology” AND “assessment for learning”; “computer” AND “assessment for learning”. The search criteria were further narrowed to peer-reviewed journal articles on educational research only. Papers from conference proceedings were not considered. The search yielded 76 articles.

Reviewing the literature

The articles were scanned and organised according to the year of publication (2015 - backwards) and how much they were relevant to the interest of study. All abstracts of the 76 articles were perused and the selection process was first based on whether the articles were written based on empirical studies. Then the studies based on K-12 were picked and the rest on higher education, literature review position papers and development of tools were classified as secondary sources. Subsequently, only empirical studies on K-12 which had themes that coincided with one or more of the five key aspects (as mentioned in Table 1) that are core to formative assessment and had it applied in an ICT-integrated teaching and learning environments were chosen. A total of 21 studies suited the selection criteria (please refer to Table 2).

Table 2 listed the studies based on chronological order. As can be seen from Table 1, there were only 21 empirical studies done on K-12 ICT-integrated formative assessment for the past 11 years. Despite the recognition that formative assessment is an important part of teaching and learning, and that ICT can provide potential affordances in actualising the 5 key aspects of formative assessment, there were not as many studies done in the levels from K-12 as desired. It could be that K-12 teachers are not in the capacity to design and create tools or systems that would be able to carry out formative assessments effectively. What are easily accessible to them and researchers are video recordings and classroom response systems (CRS, or “clickers”).

Tan and Towndrow (2008), Weir and Conner (2009), and O’Loughlin, Chroinin and O’Grady (2013) had utilized video recordings to achieve formative assessment in the areas of improving science practical sessions and physical education for the latter two and found that students’ skills in these areas had improved after they were shown the videos recorded on their performance comparing with the rubric as set by their teachers.

The use of clickers was also more readily available to the teachers. There are 2 articles on classroom response systems for K-12. One is by Lee, Feldman and Beatty (2011) which focused on studying how secondary level teachers perceive the use of clickers after going through training based on CRS. The other article by Beatty and Gerace (2009) is on the use of clickers is not included in Table 2 as it described strategies on how teachers used clickers in the classroom, and is not an empirical study. They wrote on how they assist high school teachers in mastering the CRS-based pedagogical approach with 4 theoretically-based principles, of which one is formative assessment. Though the use of clickers is a quick way to gather students' understanding and learning, however its use is limited to multiple choice (MCQ) and true/false questions, which are not open-ended enough to elicit students' deeper understanding and/ or application of concepts and skills learnt. Moreover, it is probable that some students may get the answers right by chance or guessing. It is more like a paper and pen MCQ done with technology without much authenticity and opportunities for students' collaboration considered in the design of the assessment. It can be said that the CRS is not an ideal tool that can support the 5 key aspects of formative assessment, especially in the area of "activating students as instructional resources for one another", as clickers do not provide the affordance of in-depth user interaction.

Other related empirical studies done for K-12 were mainly focused on the learning systems and their formative assessment features which aided in improving students' learning outcomes in a certain subject (usually Math). To incorporate the key aspects of formative assessment into learning systems that are designed for K-12 students can be complex and time-consuming. Besides the creation of the systems, research teams (usually researchers in tertiary institutions) must ensure tests on the system are conducted; teachers need to go through professional development on formative assessment and to be trained on the systems etc. before empirical studies can be conducted. The CRS project done by Lee, Feldman and Beatty (2011) took 6 years, and Palmer and Devitt (2014) also mentioned in the conclusion of their study of an online formative assessment programme for medical students that "online medium is a valuable and appreciated resource, capable of providing timely formative feedback and stimulating student-centred learning. However, the production of quality content is a time-consuming exercise..." (p. 9). It is no wonder empirical studies on ICT-integrated formative assessment for K-12 is few and rare for the past 10 years.

Focusing on the studies in Table 2 and how far they had incorporated the 5 key aspects of formative assessment, we can see that all studies would have integrated aspects 2 and 5 ("*engineering discussions and tasks that elicit evidence of student learning*" and "*activating students as the owners of own learning" respectively*).

Aspect 2 is apparent in all studies as the online and/ or ICT-integrated assessment activities were designed to assess and gather information about students' learning and thus providing teachers with the data needed on where their learners are at on the learning trajectory. If such data is used and analysed correctly, it should facilitate teachers' future planning and design of subsequent lessons and activities to close learning gaps. To illustrate with examples, Nedungadi and Raman (2012) had developed a cloud-based adaptive learning system for Math learning. The assessment activities designed were meant to ascertain skills that individual students had mastered. The system would then diagnose students' instructional needs, monitor improvements

and produce reports for teachers' perusal and further actions (p. 662). Another example, Koedinger and McLaughlin (2010) also did their study based on a Math tutoring system which assess and tutor learners concurrently. While learners were completing the online Math assessment, the system would gather and record the difficulties they face and provide feedback to teachers. In both cases, evidence on student learning had been elicited via the systems.

The online ICT learning activities of the all studies listed in Table 2 provided feedback to students. The intention is to "*activate students as owners of their own learning*" (aspect 5). Upon receiving feedback on the completed tasks, students would know where their learning position is and subsequently plan their next steps for moving towards learning success. However, not all feedback will have such effect on learners (aspect 3).

The quality of feedback given is of concern here. A score given at the end of an online task is not as helpful as a detailed comment on how to improve writing or solve a Math problem. Butler (1988) conducted a study on the impact on student achievement and attitude due to the effects of different feedback received by low and high ability students. An analysis of 132 students at the top and bottom of each class showed that those who received only scores as feedback made no improvement in their achievement. High ability (HA) students' attitude was positive, while the attitude of low ability (LA) students was negative. As for those who received only comments as feedback had a 30% gain in achievement. The attitude of both HA and LA students was positive. Such a comparison shows that giving comments as feedback helps learners more than giving scores. There were other groups in this study which received both scores and comments as feedback. Students in these groups had the same results as those who received scores only, i.e. they had 0% gain and HA students possessed positive attitude while LA students' attitude was negative. Providing both scores and comments together is as bad as giving only scores as feedback to students. It could be that when students receive both scores and comments together, they would focus on the scores instead of perusing the formative comments written by their teachers. The implication here is teachers could help LA students level up by providing them with comments instead of scores. If scores is to be given, then the effort on writing the comments can be saved as it does not have much impact on students' gains and LA students' attitudes would remain negative.

Back to Table 2, most of the studies did incorporate the provision of feedback to learners, but it is doubtful whether the feedback provided did "move learners forward". Besides the quality of feedback, how learners accept and respond to feedback are key considerations which have not been investigated in K-12 yet.

Two other aspects of formative assessment which should be looked into by K-12 teachers, researchers and system engineers, are aspects 1 and 4. Aspect 1 is to "*clarify learning intentions and criteria for success*" and aspect 4 is to "*activate students as instructional resources for one another*". Of the 21 studies, only 3 explicitly mentioned the learning objectives and criteria for success to its learners by the usage of rubrics (on paper). What could be done here is to include this information into the ICT-integrated learning systems whereby teachers and all learners are clear about what it takes to attain the best performance. These can be presented in the form of rubrics (must be aligned to the learning goals), which is easier for K-12 learners to

understand and operate. And rubrics serve as a common basis for everyone to provide feedback, comments and suggestions for one another (aspect 4). The lack of aspect 4 amongst the 21 studies could be due to this as well. A few studies indicated that it was part of the formative assessment process for students to discuss, comment on one another's work. Most other studies would just provide feedback to the individual student and send a report to his/ her teacher and it ends there. It would be most beneficial if the technology designed for formative assessments could tap on the ideas of social interaction to afford students to question, comment and provide feedback to their peers so as to "*activate them to be instructional resources for one another"*.

Overview of the studies

Authors	Study Design	5 Key Aspects of Formative Assessment					Purpose/ Central Focus
		1	2	3	4	5	
Topping and Fisher (2003)	Experimental		X	X		X	To explore the impact of an individualised computerised assessment of student reading comprehension with feedback given to both teacher and student.
McGuire (2006)	Action research	X	X	X	X	X	To discuss how mobile phones and internet can be used to support formative assessment.
Chen and Chen (2008)	Experimental		X			X	To examine how a mobile formative assessment tool can collect and measure online learning behaviour and learning performance of Maths.
Tan and Towndrow (2008)	Case Study	X	X	X		X	To examine how the use of digital video technology can enhance student-teacher interactions in science practical formative assessment.
Weir and Connor (2009)	Qualitative		X	X		X	To investigate the use of digital video in the teaching, learning and assessment of physical education.
Koedinger and McLaughlin (2010)	Quasi-experimental		X	X		X	To examine whether a tutoring system can improve students' Maths summative scores.
Roschelle, Rafanan, Estrella, Nussbaum and Claro (2010)	Designed-based research		X	X	X	X	To examine how a software support both collaborative learning and formative assessment by providing rapid feedback at group level.
Trumpower and Sarwar (2010)	Quasi-Experimental		X	X		X	To examine the effectiveness of structural feedback provided by Pathfinder networks to improve students' structural knowledge in Physics.
Lee, Feldman and Beatty (2011)	Evaluation		X	X		X	To find out the factors that influence secondary science and math teachers' initial implementation of a pedagogy developed for teaching with CRS (clickers).
Sainsbury and Benton (2011)	Experimental		X	X			To examine the potential of the immediacy of feedback from e-assessment in helping teachers plan the next steps in teaching and learning.
Hickey, Taasoob-shirazi and Cross (2012)	Designed-based research		X	X	X	X	To explore embedding of formative assessment more directly into the curriculum.
Hickey and Zuiker (2012)	Designed-based research		X	X	X	X	To align learning across inquiry-oriented activities, feedback on formative embedded assessment and summative assessment.
McLaren (2012)	Action Research		X	X	X	X	To explore the integration of innovative methods of capturing evidence of creative performance with providing formative feedback to learners.
Nedungadi and Raman (2012)	Quasi-Experimental		X	X		X	To examine the performance, scores and perceptions of students who used a cloud-based adaptive learning system that runs on mobile devices - PDA
Bokhove and Drijvers (2012)	Design-based research		X	X		X	To investigate the effects of a digital intervention in the learning of algebraic expertise.
Crossouard (2012)	Case study		X	X		X	To explore a teacher's use of digital photography to provide 'feedback' to pupils.
O'Loughlin,	Orientational	X	X	X		X	To examine how the use of digital videos in

Chroinin and O'Grady (2013)	qualitative inquiry				primary physical education lessons impact students' motivation, feedback, self-assessment and learning.
Okita (2013)	Experimental	X		X	To examine how the application of computer tools can help students assess and self-correct their learning
Shieh and Chang (2013)	Quasi-Experimental	X	X	X	To examine the challenges teachers face when developing interactive response system (IRS) questions. And how a PD intervention helps a teacher design better IRS questions.
Chu (2014)	Quasi-Experimental	X	X	X	To investigate the possible negative effects of mobile learning by analysing the students' cognitive load and learning achievement based on a formative assessment learning strategy.
Rodrigues and Oliveira (2014)	Quasi-Experimental	X	X	X	To describe a system composed by several modules whose main goal is to work as a formative assessment tool for students and to help teachers creating and assessing exams as well monitoring students' progress.

5 Key Aspects of Formative Assessment (Black and William, 2009)
1) Clarifies and shares learning intentions and criteria for success
2) Engineers effective classroom discussions and other learning tasks that elicit evidence of student learning
3) Provides feedback that moves learners forward
4) Activates students as instructional resources for one another
5) Activates students as the owners of their own learning

Table 2

Secondary Sources of Literature

There are another 55 articles which do not belong to the K-12 empirical studies of ICT-integrated formative assessment. Some of them are position papers, some of them are literature reviews or descriptions on development of systems and tools (non-empirical), and majority of them are studies done for higher education (HE). A breakdown is listed in Table 3.

Number of articles on ICT-integrated formative assessment from 2015 and backwards

Papers on ICT-integrated formative assessment from 2015 and back	Number
Position Papers	7
Literature Review (Higher Education)	2
Development of systems/ tools (non-empirical)	3
Focus of the empirical studies in Higher Education	
• **Clickers**	7
• **Videos**	3
• **Development of systems/ tools**	9
• **Provision of Feedback**	
○ **In general**	4
○ **Scores and grades**	8
○ **Elaborated feedback**	5
○ **Peer feedback/ assessment**	7
○ **Students' motivation on feedback**	3
Pedagogy	2
Total	55

Table 3

Amongst the seven position papers, one was published more than 8 years ago, and it was authored by Gipps in year 2005 to review the role of ICT-based assessment in HE. The other four are more recent, published in year 2013. Webb (2013) proposed a framework to understand online learning, how to incorporate elements of formative assessment and build a culture that supports interaction (p. 1). The authors of the other three position papers (Spector, 2013; Redecker & Johannessen, 2013; Webb, Gibson & Forksoh-Baruch, 2013) examined current emerging technologies and proposed future directions on what could be done in terms of technology-enabled teaching and

learning. The common proposals included embedded assessment or stealth assessment; and learning analytics. Embedding assessment would mean to weave assessments for learning purposes into activities or tasks seamlessly or ubiquitously (Spector, 2013, p. 24). Making such assessments "quiet" is helpful as it takes away the emotional stress of taking tests from students. With learning analytics to collect data and information on students' online interactions and performance, teachers who can analyse and interpret the data would truly know how their students have learnt, grasped and able to apply knowledge and skills. With the fast advancement of technology, learning analytics should be ready in two to three years' time. However, it is the non-readiness of our teachers which would be the barrier to this actualisation. The need for teachers to build capacity on assessment literacy has been brought up by various authors.

Referring back to table 2, it is apparent that there are more studies done and articles written on formative assessment for higher education (55 as compared to 21 for K-12). There are also studies on the use of clickers, video technology and to carry out formative assessment but the majority of studies revolved round online "feedback" (29 out of 55).

Feedback

There are a few areas of concern which have been investigated in HE that had been lacking in K-12. Firstly, the types of automated feedback provided by ICT systems, which students tap on to "move forward" towards learning goals, were examined. Whether the feedback provided by the learning system is only a score, right or wrong, immediate or delayed, written and elaborated, does have implications on what learners can use and how they can further their learning. Lipnevich and Smith (2009) had conducted a study on HE students' response and perceptions on the various methods and quality of feedback they received. They also collected students' views of the "ideal" feedback. They found that all students in the study agreed that the most useful type of feedback that helped them propel forward was detailed comments. Grades were deemed as undesirable and impeded improvement. Laudatory comments or praise had the least impact (p. 364).

Van der Kleij, Eggen, Timmers and Veldkamp (2011) did a study on the impact of different types of feedback provided to students of a Commercial Economics course. Students in the sample were divided into 3 groups. The first group received immediate knowledge of correct response (KCR) and elaborated feedback (EF) after completing each question. The second group received the same EF but would only know the correct response after they had completed the all the questions in the assessment. The third group only received feedback on whether they had answered correctly after answering the whole set of test. With such a set up, it was hypothesized that students in group 1 would have performed much better than the other 2 groups. On the contrary, there were no effects of feedback found on learning (p. 269). It could be due to the fact the formative assessment was done just before a summative assessment was conducted, whereby all students would have prepared well beforehand. Students' perception survey reflected that students prefer immediate feedback than delayed feedback. The time log of how long a feedback screen was kept opened indicated that students were more likely to pay attention to immediate feedback. The implication of

this study is the timing of providing feedback and help is an important consideration for ICT-integrated formative assessments.

Next, the acceptance of different types of feedback by the learners and how willing they are in responding to it are brought to attention by Timmers, Van den Broek and Van den Berg (2012). In their study, they investigated the relationships between students' motivational beliefs, effort and feedback behaviour. Feedback can only be impactful when students seek it and process it (p. 25). There is no point in teachers providing detailed and lengthy feedback when students are reluctant and not motivated to spend time on it to improve their performance. The factors affecting students' motivation in seeking feedback include task-value beliefs and success expectancy. The higher the task-value beliefs and success expectancy, the more likely would a student seek feedback. Teachers and designers of learning systems should keep motivational factors in mind (p. 30).

Detailed studies on feedback have been more prevalent in higher education whereas it is apparently lacking in K-12. The empirical results from the studies can be tested and applied in K-12 context eventually.

Rubrics and Teachers' Assessment Literacy

Besides automated feedback, it is worth while looking at how teachers, peers and self can assess and provide feedback to one another in an ICT system, thus actualising the aspects on "activating students as instructional resources for one another" and "activating students as the owners of their own learning" (aspects 4 and 5 of formative assessment). However to actualise this, teachers and learners require a common basis of measurement that can be utilised to assess completed tasks or work-in-progress assignments. A rubric that matches the learning objectives would be necessary to aid in the process. And such a rubric should be incorporated into the ICT-integrated formative assessment system to convenience the feedback process. A well-developed rubric that facilitates peer assessment and feedback is essential but whether teachers have the capacity to come up with good rubrics is questionable. Zhu (2012) studied a sample of 41 scoring rubrics designed by Chinese language teachers from Singapore and found them unsatisfactory and problematic. The identified problems included mismatches of criteria and descriptors; and negative and obscure descriptors. Zhu suggested professional development (PD) in the area of teachers' assessment literacy, so as to maximise the benefits of using formative assessment to bring about improved teaching and learning.

Besides the design of good rubrics, teachers must train students to have the ability to assess their own work and peers' work so as to provide quality and meaningful feedback that moves one another forward. The seven principles of good feedback practice (Nicol & MacFarlane-Dick, 2006) must be considered and conveyed to the students. Though peer interaction, for example seeking peers' feedback (much afforded by the use of technology), is beneficial, it is important for players, especially teachers, to be aware of the workings of social network and how it could be made use of to carry out dialogue that revolves learning, that benefits all in the class. What could be of help here would be the knowledge and application of social interactions in formative assessment.

Social Interactions in Formative Assessment

Interactions amongst learners are deemed as an important and are a natural way of learning (Hiltz, 1994, p. 22). Black and William (2009) also proposed "activating learners to become instructional resources for one another". One of the seven good feedback practices as presented by Nicol and MacFarlane-Dick (2006) also "encourages teacher and peer dialogue around learning" (p. 205). Social interactions amongst peers are strongly encouraged.

With technology providing such ease and convenience for communication, opportunities for online interactions amongst peers for the purpose of learning should be created and enabled. Krejins, Kirschner and Vermeulen (2013) had identified two problems of social interactions not happening even after computer-supported collaborative learning (CSCL) environments had been developed for students to interact with one another. One of the problems is the lack of social interactions within the environments. With so few posts, it is indeed hard to attract more students to get interested to leave messages for others to read. The second problem is that the socio-emotional aspect of social interaction has been neglected or overlooked (p. 230). Authors proposed increasing the sociability, forming a safe social space and emphasizing social presence for CSCL environments. Actually, besides all these, we could incorporate the "peer interaction/ feedback" component of formative assessment into CSCL environments.

To further illustrate, upon understanding the requirements and criteria for success of an online formative assessment task, a student completes his work, checks his performance against the requirements, reviews and/or amends, and then submits his work online. Subsequently, he can invite his teacher and peers to provide feedback and comments based on a teacher-designed rubric (or the criteria for success) that serves as a common basis for discussion for performance. He can also review his peers' submission and give comments that aid in closing the gap to learning success. Clarifications and words of encouragement can be made in the online environment and further comments can be sought if necessary. The dialogue and interactions will be focused and hopefully dynamic and fluid. By analysing the submissions and interactions (with the help of learning analytics), the teacher can also gather evidence on learners' learning outcome and plan for future interventions.

Conclusion

Based on the review above, we can see that there are more research and studies conducted in the HE sector. These studies had been important as they shone much light on areas and topics in ICT-integrated formative assessment which have great implications for teachers and designers of learning systems with formative components. The essential points to note are the types, timing and quality of feedback that would motivate students to sought after and work on further to improve themselves. For formative assessment to work, teachers' assessment literacy must be heightened. With the infusion of ICT, the possibility of formative assessment in CSCL environments, and implementation of learning analytics in data collection of students' online footprints, it is all the more necessary for teachers to develop awareness, knowledge and skills in these areas. Formative assessment and CSCL can

be put together to bring about richer interactions amongst learners but the theories and actual applications need to be further explored and researched upon.

As mentioned earlier, studies on K-12 technology-enabled formative assessment have been lacking. Areas that should be explored include: 1) how K-12 students accept and respond to different types of online feedback; 2) would the provision of an online criteria for success or online rubric facilitate students' feedback, comments and discussions on one another's work; 3) how K-12 teachers may plan for and organize formative technology-enabled activities based on social interaction such that they can utilize the affordances of ICT to gather evidences of learning; and provide and/or elicit feedback (from students themselves or their peers); and 4) how to build K-12 teachers' capacity in assessment literacy.

To maximise the benefits of technology-based formative assessment for teaching and learning, teachers' assessment literacy must be developed. Concurrently, pedagogies for formative assessment to be incorporated into CSCL should be explored.

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Two Decades of ICT Masterplans : A Comparison

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
Since information and communication technologies (ICT) first came into popular use in the early 1990s, educational jurisdictions have been actively endeavouring to make meaningful use of ICT for teaching and learning. Quite often, these efforts were expressed in system-wide plans that aimed to enhance education. This paper will share some observations on the similarities and distinctiveness of the approaches across the four jurisdictions of Beijing, Hong Kong, Singapore and Taiwan. While these jurisdictions have broadly common foci, primarily in infrastructure build-up, curriculum reviews, teacher professional development and school leadership, both the balance of the plans' components as well as their implementation can differ in instructive ways, reflecting differing context. The paper will also summarise some main learning points from the recently concluded third ICT in Education masterplan in Singapore to give further depth to this comparison across the jurisdictions.

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Introduction

When ICT gained popularity in the early 1990s, countries worldwide began to step up the use of technology in their education systems. Many governments created programmes to integrate technology in schools on the belief that technology has the potential to transform education and improve student learning (Hew & Brush, 2007). This resulted in most national ICT policies focusing on the education sector (in Tondeur *et al.*, 2007).

Since the earlier initiatives in the mid- to late-90s, observed trends have shown a direct relationship between the application of ICTs and the changes in the teaching and environments of schools (in Nair & Hindle, 2013). As ICT capabilities advance, and more importantly, as understanding in the use of ICT in education deepens, the focus on ICT use has been extended to increasingly include the development of 21st Century Skills (Gut 2011; Kong *et al.* 2014).

Beijing, Hong Kong, Singapore, and Taiwan – four jurisdictions in Asia that share many parallels in sociocultural and economic terms – are examples that have undertaken extensive efforts in transforming and enhancing education through the use of ICT. This paper will first compare the similarities and distinctiveness of how these four examples have systematically integrated technologies into their teaching and learning practices, by drawing upon an earlier framework used by Kong *et al.* (2014) albeit with some distinctions. In the second segment, several key learning points from the recently concluded third ICT in Education masterplan in Singapore will be provided to give further depth to the comparison across the jurisdictions.

ICT in Education Masterplans: Key Areas

In Kong *et al.*'s (2014) paper, the authors considered five key areas in analysing e-learning policies.

(1) Infrastructure – the hardware, software, and Internet connectivity for e-Learning,
(2) Curriculum integration – the re-interpretation of school curriculum and development of pedagogical practices for e-Learning,
(3) Students learning – students' development of domain knowledge and 21st century skills through e-Learning,
(4) Teacher professional development – teachers' pedagogical competency and training activities of e-Learning, and
(5) Leadership and capacity building – school leadership, research support, and community involvement for e-Learning.

In the current paper, similar key areas will be adopted to aid in comparing and contrasting the approaches used by Beijing, Hong Kong, Singapore and Taiwan in developing ICT in education. This paper will attempt to broaden the understanding of these five dimensions by analysing the conceptual ideas underpinning the education masterplans of these four territories. As an example, while the original definition for infrastructure was specific to the hardware, software, and Internet connectivity for e-Learning, the current paper also considers other augmenting supporting structures which may be non-physical. For example, in Singapore, while Kong *et al.* (2014) noted that ICT infrastructure development focused primarily on access and network,

the current paper also highlights the rationale for putting in place those arrangements (pedagogy-directed).

Brief Overview of ICT in Education in Beijing, Hong Kong, Singapore, and Taiwan

The education sectors in Beijing, Hong Kong, Singapore and Taiwan have been through extensive reforms over the past two decades (Wong, 2007; So & Swatman, 2006).

In mainland China, the government wanted to modernise education through ICT and had been aggressively facilitating ICT applications in education using a series of specific policies and measures (Zhang *et al.*, 2010). According to Huang and Lin (2010), developments of ICT in education took place in four stages:

(1) 1980s – Teaching computer programming
(2) 1990s – Computer Aided instruction
(3) 1998 onwards – ICT infrastructure construction
(4) 2005 onwards – Building competences for ICT in education

In line with this, Beijing promoted the integration of ICT into learning and teaching in K-12 schools (Kong *et al.*, 2014) since the late 1990s. Three "five-year" plans (the 10th, 11th, and 12th five-year Beijing municipal plan of educational reform and development) were put in place to build up e-Learning environments in the city, with large investments poured in since 2001 for such developments.

In the late 1990s, the Hong Kong government wanted to make Hong Kong a leader in the digital age (Fung & Pun, 2001). In one of their key documents "Information Technology for Learning in a New Era: Five-year Strategy 1998/99 to 2002/03", plans for physical and human infrastructure development in Hong Kong's primary and secondary schools in four key areas were presented, including access and connectivity, teacher enablement, curriculum and resource support, and community-wide culture (Fung & Pun, 2001). This was followed by a second strategic plan "Empowering Learning and Teaching with Information Technology" in 2004, with a focus on actual pedagogical shifts, the promotion of life-long learning and e-learning, the use of wireless technology as an extension of the environment, and the roles of both parents and students in the life-long learning environment (in So, 2006). The third stage of development was implemented via the strategy "Right technology at the right time for the right task" (2008 – 2013) focusing on the human factor (Kong *et al.*, 2014). Huang *et al.* (2014) related a fourth ICT strategy "Realizing IT Potential, Unleashing Learning Power" in Hong Kong from 2014. In this fourth stage, there are five recommended actions including (1) enhancing school's IT infrastructure and re-engineering the operation mode, (2) enhancing the quality of e-learning resources, (3) renewing curriculum, transforming pedagogical and assessment practices, (4) building professional leadership, capacity and communities of practice, and (5) involving parents, stakeholders and the community. Large funding have been put into each of these plans.

According to Singapore's Ministry of Education (2008), the underlying philosophy of its strategic plans is that education should continually anticipate the needs of the

future and prepare pupils to meet those needs. In essence, Singapore recognised the need for the country to be ICT-literate; to meet this, schools were identified as the key starting point**.** Three five-year masterplans for ICT in Education were devised, with the first launched in 1997. The latest masterplan recently concluded in 2014.

Taiwan has experienced waves of integration of technology into learning since the 1980s. A full reform was implemented in the late 1990s based on lessons learned from earlier transformations (Usa & Twu, 2002). According to Kong *et al.* (2014), 1997 marked a new chapter in the promotion of e-learning in school, following the announcement of a 10-year programme. There were three stages, namely, (1) the formulation of a national plan of e-learning, with a strategic document on school infrastructure building, (2) development of a national science and technology programme on e-learning research, with a white paper for e-learning, and (3) the formation of a task force on digital literacy and national programmes on mobile learning and school-based e-learning. Some of the key ICT policies are as follows (Kong *et al.*, 2014; Chao, 2010):

- Building Infrastructure of e-learning in schools (1997)
- Master Plan for School e-learning (2001)
- Challenging 2008: National Development Project – Building an e-learning system for all (2002)
- White Paper on ICT in Education (2008)

Early on, the government focussed on the construction of an information-convenient environment. Later, research and development on e-learning (Kong *et al.*, 2014) and the idea of community learning became important goals in the Taiwanese educational technology model (Usa & Twu, 2002).

Observations of Key Developments Across the Five Areas in ICT Masterplans

In discussing the five areas in ICT masterplans, it is useful to first look at it from a systems perspective as it helps provide a scaffolding through which developments in each jurisdiction can be understood. The unfolding of efforts in ICT use can be observed to follow three interacting and overlapping layers, specifically: (1) laying a strong foundation in the early phase(s), (2) building on the foundation to achieve student learning outcomes, and (3) providing structures and resources to ensure long term sustainability, such as continuing to enhance the capacity of teachers.

It is important to emphasise that the development of ICT in education is an iterative process wherein lessons from foundational levels are used to enhance and better address learning/outcomes and sustainability, and a robust feedback loop allows for righting actions and continual improvements that reach back down to foundational changes. This is illustrated in the Figure 1 below.

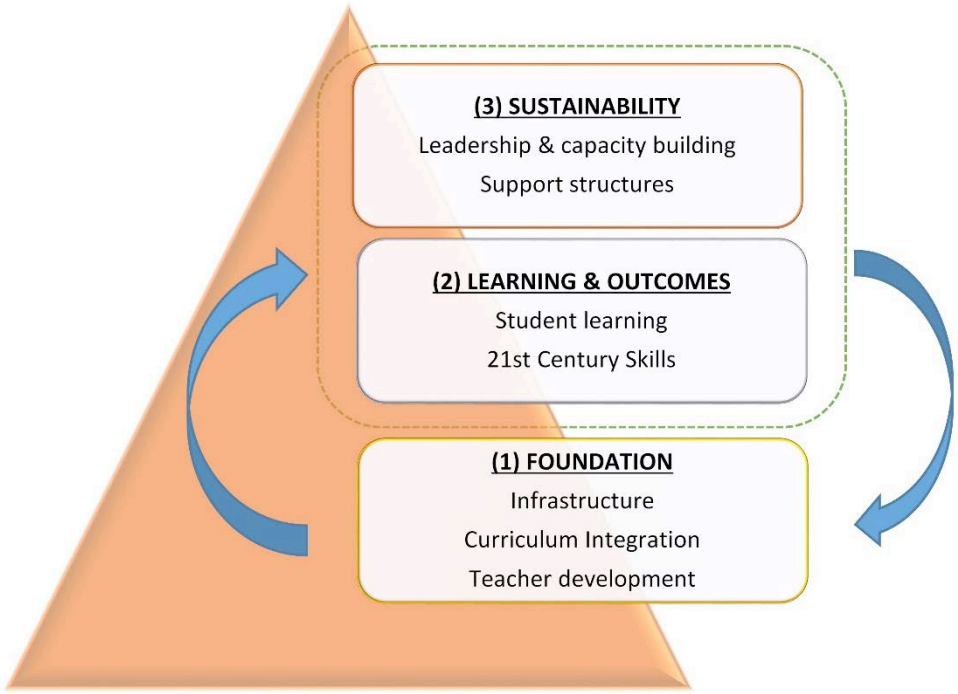

Figure 1. An iterative process in the development of ICT use in education: three interacting and overlapping layers

While the convergence in the approaches taken by the four jurisdictions lie in the overall directions and processes as seen in Figure 1 above, the implementation of the plans and interpretation of what is required within each layer of this model and the five domains of infrastructure, curriculum integration, student learning, teacher development, and leadership are distinct. For instance, the overall balance of the plans' components as well as their actual implementation differ in instructive ways, reflecting differing contexts across the jurisdictions.

Using the model described above (figure 1), the development of each of the five domains will be revisited in the four jurisdictions, supported with observations about particular contextual goals, considerations and constraints.

Layer 1: Building foundations

Table 2a highlights the key developments in infrastructure within each jurisdiction during the implementation of their plans for ICT in education.

Table 2a

Beijing	**Hong Kong**	**Singapore**	**Taiwan**
Basic physical infrastructure development including internet access & network connectivity in urban and rural	Physical infrastructure as key consideration with the installation and strengthening of ICT campus facilities, access	Pedagogy-led ICT infrastructure development in schools, including campus facilities, access, connectivity,	Physical infrastructure installation and upgrades in schools including access, connectivity, and campus facilities

areas, and installation of campus facilities and networked computers Digital resources and platforms for e-learning and teaching Education information management systems and platforms Data management and capital support platform for integration and storage of education data Digital schools E-textbooks	and connectivity, including the use of wireless technology Technical support and IT coordinators in schools Online repository with curriculum-based resources E-textbooks Use of mobile devices	digital resources for teaching and learning, and ICT support Digital resources and platforms to support e-learning in school Partnership between schools and IT industry	Strong public-private partnership Digital access for rural areas Open-source software Learning objects management system with platforms for sharing E-learning based interactive whiteboards classrooms

Each jurisdiction invested substantially on the installation and upgrading of ICT facilities in schools, such as broadband internet access, wired and wireless network connectivity, and computing spaces and devices. Hong Kong and Taiwan in particular geared sharply towards laying the foundation for a mobile environment. In the case of Hong Kong, one major focus in their phase 2 masterplan was on technology improvement (Law *et al.*, 2010), where the use of wireless technology as an extension of wired network was implemented, so that by phase 3 (Kong *et al.*, 2014) all computers were already networked and connected to the internet (Chen, 2011). In fact, since 2014, Hong Kong has been working on providing a Wi-Fi campus for all students, and encouraging the use of mobile devices (Education Bureau, 2014). Taiwan also moved towards modernizing infrastructure in their phase 2 development, which included city-wide Wi-Fi coverage as part of the School of the Future Project (Kong *et al.*, 2014). According to Taiwan's Ministry of Education (http://english.moe.gov.tw) (2012), the TANet Whois system for management of IPv4/IPv6 protocols was developed in 2011 and the Router of their regional network centre was updated to Dual stack IPv4/IPv6, while inter-school wireless campus network roaming facilities were made available. Both jurisdictions relied on these infrastructure enhancements to establish the use of mobile devices for teaching and learning, and invested heavily in stockpiling digital resources to be made available for educational consumption.

The development of e-textbooks was also part of Beijing's education plans. However, there was significant emphasis on developing its infrastructure to support online distance education and digital schools (Kong *et al.*, 2014; Zhang *et al.*, 2010; Li *et al.*, 2009). This development objective stands out in the case of Beijing, where the substantial sub-urban and rural needs in this large city likely prompted efforts in establishing digital educational links to circumvent the problem of distance. Taiwan similarly had to develop access and connectivity in order to reach its rural areas. Whereas these two jurisdictions were concerned with building foundations for widespread access and connectivity to support distance or mobile learning, Singapore, perhaps due to her smaller geographical size and urbanisation, tended to be more pedagogy-driven. In all of the ICT masterplans for education, especially from the second ICT masterplan onwards, Singapore has adopted the principle of developing infrastructure based on pedagogical considerations. This meant that instead of building technologies first and try to use them afterwards, teaching and learning (T&L) interactions were evaluated first, particularly interactions that could not be done without the use of technologies, before searching for effective technologies to enact the T&L interactions. Some of these include the use of virtual worlds such as Second Life, blogs, wikis, podcasts, e-portfolios, animations and video productions.

Singapore, however, did share some commonalities with Beijing – the use of teaching platforms and digital resources – and with Taiwan, in terms of school-industry partnerships. For instance, in Beijing, an online teaching platform, interaction platform for teachers, and an educational information management platform were built, while in Singapore, sharing platforms such as WeSHARE and Inter-cluster Sharing of Resources (iSHARE), enabled the expansion of resource base for others to share (Ng, 2008). In Taiwan, projects such as School of the Future saw collaborations from various private and public entities, while in Singapore, examples of such partnerships could be seen in BackPack.net, which was a collaboration involving the Ministry of Education, the Infocommunications Development Authority of Singapore, and Microsoft Singapore.

Another similarity across the jurisdictions is the provision of both physical infrastructures, such as Learning Management Systems (LMS) and e-content. These have greatly facilitated the use of ICT for T&L (Voogt *et al.*, 2013; McLoughlin & Lee, 2007).

Curriculum integration is another pillar in the foundation of ICT in education. Each jurisdiction had to ensure that relevant content could be delivered appropriately in day-to-day teaching and learning. Table 2b highlights some key developments in curriculum integration.

Table 2b

Beijing	**Hong Kong**	**Singapore**	**Taiwan**
ICT-related curriculum in school (compulsory for some levels) Developed ICT resources in line	Set thresholds of ICT-integrated lesson time (25%) School-based e-learning pedagogical	Active integration of ICT into curriculum (e.g. by 2002, 30% of curriculum time to include IT-based teaching &	Substantial review of K-12 curriculum throughout masterplans Established digital literacy and

with curriculum Basic education resources available to rural and urban schools IT innovation activities that cultivate students' problem-solving abilities. New instruction software, platform tools and new style IT products, exploring new models and new ways of applying ICT in instruction, e.g. one to one e-learning, mobile education, miniature learning and digital whiteboard-based interactive learning.	innovations (e.g. Composite Information Technology Grant for schools to acquire devices, resources, or services related to e-Learning development in school) Pilot schemes on the review of existing e-Learning resources and the educational use of new ICT tools. Promote ICT integration into curriculum Curriculum-based teaching modules with ICT resources Enhance quality of e-learning resources Renewing curriculum, transforming pedagogical and assessment practices	learning), with corresponding content reduction (30%) ICT skills development in early plans Development of ICT-based/alternative pedagogies 21st Century Skills framework (i.e. through ICT integration into curriculum, pedagogy and assessment, develop 21st century skills such as IT skills, and the ability to communicate persuasively and collaborate effectively.)	assessment framework within curriculum Digital Education and e-Learning Project to integrate ICT into curriculum Promoted use of mobile technology

Across all four jurisdictions, it was recognised that specifically integrating ICT within the curriculum represented an important strategic action to ensure that ICT were actually used in day-to-day T&L. Thus, early efforts in the various ICT plans tended to include such integration. In fact, both Hong Kong and Singapore went further by actively carving out spaces within their respective curriculum to cater to the injection of ICT into T&L, taking into account that more time was needed for ICT-based lessons. Note that integration of ICT into curriculum came with specific learning objectives and outcomes. More importantly, such integration also provided the basis and motivation to develop 21st Century skills, as ICT have the potential to support the acquisition of these skills (Voogt *et al.*, 2013) well. As such, the development of such skills through curriculum integration and delivery became important goals particularly for the governments of Singapore, Hong Kong, and Taiwan (Kong *et al.*, 2014).

Teacher quality is a fundamental factor that can determine the success or otherwise of an education system. Recognising this, all four jurisdictions have substantial parts of their plans focused on developing teacher capacity.

Table 2c highlights the key initiatives for the professional development of teachers in the various ICT plans. Of the four, Hong Kong is the only jurisdiction that defines a baseline ICT standards for teachers. (This contrasts with Singapore which developed a similar standard, but only for students.) However, all have in place training programmes, such as the train-the-trainer programme for the 1st masterplan in Singapore, which aimed at ensuring that all teachers have the basic competency to use ICT in T&L.

As the ICT plans evolved, various platforms were built to encourage greater sharing of expertise among educators, taking advantage of social media tools. In Hong Kong's case, a set of self-learning web-based tools were developed for teachers, whereas sharing platforms, such as *professional learning communities*, were also constructed. The use of peer support is common, although various forms of support are being used. For instance, in Taiwan, industrial partners represent an important provider of training, often in partnership with government.

Table 2c

Beijing	**Hong Kong**	**Singapore**	**Taiwan**
Technical and pedagogical training for teachers Interactive platform for teachers to share experiences	Baseline ICT standards for teachers Technical and pedagogical training (funds allocated to schools) Self-learning web-based tools	On-going Professional Development on ICT Skills & Pedagogies Peer-mentorship approach on ground Professional learning communities Subject Chapter	Pedagogical training for teachers (peer-coaching programme) Enhanced coherence & sustainability of teacher development

Realising that centrally-provided resources and training were not sufficient, a more grounds-up level of support was considered necessary. To answer this need, Singapore put in place an *ICT mentor* structure; four senior teachers per school were selected for training and subsequently posted back to the school to serve as advisors and mentors for other teachers in the use of ICT for T&L. Such grounded support ensures not just timely support for teachers, but more importantly, also allows for adaptation of practices that suit the T&L context of the school (including learning profiles preferences of students).

Overall, there is a clear shift towards student-centred T&L interactions as evidenced in the content of the various professional development programmes and content of the sharing platforms, particularly salient moving into the 3rd masterplan (Ng, 2008).

This is an important development, and likely to remain central to future ICT plans.

Layer 2: Learning and Outcomes

As highlighted earlier, 21st Century Skills development is seen as important, although the engagement in this area is at different stages of development across the four jurisdictions. In Singapore's case, the development of these skills had an early start with its articulation of 'Thinking School, Learning Nation' in 1997 (Chang, 2001). This took the shape of a 21st Century Skills framework and the focus on *self-directed* and *collaborative* learning skills in the 2nd ICT masterplan for education. Quite often, the early stages of engagement tended to focus on ICT literacy skills, such as the ability to use productivity tools. This is illustrated by the various frameworks, such as that in Hong Kong and Singapore – see Table 2d.

Table 2d

Beijing	**Hong Kong**	**Singapore**	**Taiwan**
Integrating e-Learning elements into learning tasks	*Integrate e-elements into learning tasks* *Foster students' proficient and ethical use of ICT* *Four dimension IT literacy framework* *Explore IT-related career path*	*Baseline ICT standards (Productivity)* *Explicit focus on e-learning outcomes* *Self-directed & collaborative learning* *Cyber-wellness* *Initial e-assessment for national exam* *Education & Career Guidance Portal*	*Students encouraged to use ICT to share, learn, interact & collaborate* *Strengthen self-directed learning*

Towards the later stages of ICT plans, the ethical use of ICT gained importance as sources of values, skills and knowledge became directly available to students rather than being predominantly coming from schools and home. This has prompted the adoption of frameworks, such as the cyber-wellness framework in Singapore (MOE Singapore, 2010), as part of the skills set necessary for students to negotiate the cyber environment.

The use of ICT for national assessment has only just begun, with Singapore introducing e-assessment for selected national examinations in 2014. A further development is the use of ICT to support students in making career decisions, such as in Hong Kong, and the development of an education and career guidance portal in Singapore (MOE Singapore, 2013).

Layer 3: Towards Sustainability

It is well-documented that school leaders play an important role in education innovations (Yuen *et al.*, 2003), thus having strong and enlightened school leadership is key to the success of the ICT plans. Table 2e provides the key developments in leadership and capacity building in each jurisdiction. One thing becomes clear from the respective ICT plans for school leadership: there is a need for school leaders to be sufficiently exposed to technological advances. This is so that, while they do not need to know the full details of how each technology can be used for T&L, they can be in a position to envisage such usage and weave ideas emerging from teachers within the overall development of the school. To this end, the jurisdictions introduced programmes for school leaders targeted at pedagogical usage of technologies as well as establishing peer-led learning communities to ensure that school leaders are aware of latest developments in ICT. On top of this, Taiwan also provided support for research into the use of ICT for education, while Hong Kong and Singapore ensured that key stakeholders (e.g. parents and the public) were included as part of the larger community (Fung & Pun, 2012; MOE, 2010) that would keep the ICT in education developments sustainable.

Table 2e

Beijing	**Hong Kong**	**Singapore**	**Taiwan**
School leadership training on e-Learning, decision-making Established mechanism for resource allocation	Support school-based planning of e-Learning Enhance partnership with community, industry Community of practice for school leaders Communication with parents and engaging with community (e.g. Hong Kong Education City)	Targeted support for school leaders Leadership programmes on ICT integration Professional learning communities Engaging and educating parents in programmes e.g. role of parents in nurturing cyber wellness at home	Research community support development of policy & practices of e-learning Research on mobile learning across school curricula

Approaches of the Four Jurisdictions

While the key areas that each jurisdiction focuses on in all their respective ICT plans have been broadly similar, there are discernible differences in the adopted approaches. These tend to be dependent on the context of each jurisdiction, and are highlighted in Table 3.

Table 3: Approaches to ICT plans implementation

Beijing	Hong Kong	Singapore	Taiwan
Grand scale infrastructure build-up Highly centralized implementation Greater recent focus on curriculum development	Central planning sketches out parameters with supporting resources Strong grounds-based practices and adaptation Focused on resources and infrastructure	Plans are holistic with differing balance & aligned to other policies Centrally conceptualized, 2nd plan coincided with greater autonomy for schools – moved to ground-up with central support Aligned to professional capacity building and pushing at cutting-edge R&D focus plus scaling and dissemination structures	Strong technology development and product focus Strong government-industry partnership – tendency to promote adoption of technologies developed to schools Shift towards pedagogies in more recent years

The development of physical infrastructure in Beijing tended to be on a strong and grand scale with a fast build-up. In general, the drawing up and implementation of ICT plans were highly centralised and coordinated, resulting in a fairly uniform rate of development within the jurisdiction, which could allow the schools to interact at a similar level. As the infrastructure build-up gathered pace, the focus of the ICT plans increasingly turned towards curricula matters.

Hong Kong and Singapore have been similarly centralised in the construction of their respective ICT plans. However, while Hong Kong generally focused on spelling out the intents of the plans as well as the associated parameters within which the plans were to be implemented, a large part of the actualisation of the plans were de-centralised and left to the schools. This resulted in a strong diversity of responses to the ICT plans. Singapore, on the other hand, provided centralised support as well as putting in place structures to encourage grounds-up actualisation of the ICT plans. Importantly, Singapore's ICT plans were usually developed with a strong alignment to other key national policies, such as economic and manpower policies.

Among the four jurisdictions, Taiwan seemed to have the strongest involvement of the private sector in pushing for the use of ICT for T&L. Not only do the companies

help to develop the technologies for education, they also play important training and promotional roles in encouraging schools to adopt the developed tools. This, perhaps, is a contributing factor to the Taiwan ICT plans being generally more technology-focused than the others. Similar to Beijing, the Taiwan plans have also seen a definite shift towards pedagogies and curricula needs.

On the allocation of resources for R&D in ICT for education, Singapore perhaps has a more sustained and longer period of engagements. The R&D component to push for exploration of innovative and cutting edge use of ICT in T&L started from the first ICT masterplan. This sustained focus has led Singapore to participate meaningfully in early exploration of cutting edge areas, such as the automated scoring of 21st century skills.

Key Learning Points from Singapore's ICT in Education Masterplans

Apart from identifying the main focal areas of ICT masterplans, almost two decades of ICT masterplan development and implementation in Singapore have highlighted the importance of adapting strategies that are suitable for the context within which the plans are intended. Singapore's apparent strength in the use of ICT in education stems from its ability to anticipate and respond effectively to the changing landscape; and to realise early on that the set of so-called 'success factors' are intimately intertwined. How these factors interact and push the plans forward are hard to predict. As such, while each key area and what to do within it needs to be carefully articulated, there should be sufficient flexibility and space for refinements as the plans unfold. This broadly translates into (a) developing ground capability, i.e. teachers and school leaders, so that deeper and more effective use of ICT for T&L can be developed; and (b) ensuring sufficient structures for 'bottom-up' initiatives with 'top-down' support exist or are constructed (Tan *et al.*, 2013; MOE, 2008).

The five identified success factors overlapped with the 5 areas of focus in this paper, but contain elements expanded from the latter set. These five, after re-categorisation, are (i) 'human' infrastructure, (ii) ideas generation, (iii) ideas interactions and translation, (iv) support structures, and (v) physical infrastructure.

'Human' infrastructure refers largely to the capability-building of teachers and school leaders, which have been covered above. What is perhaps a 'new' perspective is to examine how such capacity-building evolved over the three ICT in Education masterplans, which serves to illustrate the adaptive nature of the success factors.

During the 1st ICT in education masterplan (mp1), the ICT skills level among teachers was rather uneven, and computing networks were not as pervasive in the schools. On top of this, a large proportion of teachers were fearful of the 'new' technologies and most were unused to interacting in cyberspace. The development of ICT skills needed to be systematic and comprehensive. As such, a centrally organised train-the-trainer approach was used. At the same time, 100 hours of paid professional development per year for each teacher was introduced (Koh & Lee, 2008; Lee, 2008), signalling both the importance of capacity-building as well as empathetic support from policy makers.

The 2nd ICT in education masterplan (mp2) coincided with the gradual devolving of autonomy to the schools for a wide variety of local decisions. Thus, rather than continuing with a train-the-trainer approach for teacher capacity-building, each school drew up its own ICT plan, with help from the Ministry of Education, and decided on the needs of its own teachers. Where feasible, such needs could be addressed centrally, such as when there were similar demands from a large number of schools, or the schools could choose to engage its own expertise, say, from the local university, to develop the required skills.

By the 3rd masterplan (mp3), the level of ICT use among the teachers had matured to a good extent, and there was sufficient diversity in both practice and experience that a large part of the system's expertise in ICT use for T&L actually resided within the teacher community. Recognising this, the approach to capacity-building further evolved to tap into the collective expertise of the teachers. Structures such as subject chapters, sharing platforms and professional learning communities were set up to support the interactions amongst the teachers. Centrally organised programmes were still available, but these and what the schools did strived to complement each other.

The trajectories for the other four factors tell a similar story. 'Ideas generation' refers to the system's ability to generate ideas and practices that are pedagogically-sound. These evolved from centrally-produced resources that had embedded pedagogies in mp1 to the teacher generated practices in mp3. The challenge here was how to capture the ground practices, as well as centrally-developed practices, to scale to the rest of the system. In this aspect, effective partnerships among teachers, ministry headquarters, researchers and industry partners are important.

Quite often, ideas generated in a specific context need further work to translate and broaden their applicability within the system. Thus, 'ideas interaction and translation' represents an important conduit through which a system can capture and spread its good practices. The structures for these were put in place with an increasing emphasis on direct teacher participation by the time mp3 was formulated. Similarly, 'support structures', referring largely to making tools and learnings available to schools, such as the school self-evaluation tool By(i)tes 2.0 (MOE, 2011) and the ICT mentor programme mentioned earlier. Both the nature and provision of these have changed from mp1 to mp3.

As for 'physical infrastructure', it has also changed from early central provisioning to a balance between central and school-determined provisioning. Most important, however, is the strengthening of pedagogy-led infrastructure development in the later plans.

Conclusion

Despite developing fairly independently, the ICT plans of the four jurisdictions converged on five key areas, i.e. infrastructure, curriculum, student learning outcomes, teacher professional development and school leadership. While there are considerable similarities on the broad strategies in each area, important differences indicate that details and context still matter. Given that web 3.0 tools have already emerged (Kurilovas *et al.,* 2014), i.e. tools that not only facilitate interactions among users, but also learn about the user such that tailored information and resources can be pushed to

the user, future ICT plans are likely to need to operate at a different level of complexity. In such circumstances, it becomes even more important for each jurisdiction to be clear about their central philosophy with regard to the use of ICT for T&L.

This not only serves to guide the formulation of ICT plans, but also the direction of educational development as a whole. As an illustration, there is an increasing push for the use of automated delivery systems, which can be pedagogically-sound in its design, to compensate for weak teachers (Cheah & Lee, 2015). Should such centrally-designed systems be adopted, the skills demand on the teacher could potentially be reduced, and might lead to a general de-skilling over time. This is not inevitable, but the possibility exists. On the other hand, focusing on providing ICT tools to teachers broadly means the need to increase their T&L capability, i.e. make them even more skilful to use these tools for T&L. This could potentially result in unevenness of capability within the education system, with some teachers considerably better at using ICT for T&L than others (which is probably the case for most system at present). Either way, or even with a mixture of both approaches, the philosophy adopted will affect future ICT plans, and careful considerations need to be exercised.

The use of ICT for teaching and learning is here to stay. Being able to learn from each other, particularly in today's complex and connected knowledge environment, is crucial for designing ICT plans that are coherent and which meet the needs of the education system. The main ideas presented here from the four jurisdictions serve to provide a first level attempt at understanding the key factors for success within the ICT plans.

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IEPs and the Web: Maximizing Student Potential

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
Transitioning into tertiary studies in a foreign language presents a host of challenges and opportunities, even more so when the transition is from one educational culture and set of technologies to another. Technology offers many tools with which to approach this situation. This paper will present action research into leveraging the use of Web-based technology to enhance the educational outcomes of students in a Thai university English for academic purposes (EAP) course. Through the use of VoiceThread and Google Hangouts on Air, students are able to engage interactively with their teachers and fellow students in and out of the classroom, acquire skills efficiently, and discover new methods of learning that significantly assist in achieving the program's goals of preparing students linguistically for academic life. In particular, the technology allows for opportunities to improve listening and speaking skills through online discussions and presentations, thus overcoming a significant barrier to language development; however, the goal should be for the technology to remain in the background. To ensure this, educators are able to evaluate the impact of these technologies on teaching and learning by using a number of frameworks: Bax's (2002) categories of CALL; the *RAT — Replacement, Amplification, and Transformation* framework from Hughes, Thomas, and Scharber (2006); and Davies' (2011) *Framework for Understanding and Assessing Technology Literacy*. This paper will describe methods of integrating the use of Web-based programs to optimize curriculum implementation and student assessment and will be of interest to language educators considering integrating new technology into the classroom.

Keywords: Web-based technology, intensive English program, English for academic purposes (EAP), language teaching

Introduction

This paper describes an action research study that attempts to ascertain the effectiveness of technology in developing language skills. Given the increasing ubiquity and use in language education of digital devices, connectivity, and applications, this is an area of study growing in importance. The instructors in the program described are encouraged to develop and utilize digital tools and resources to facilitate the improvement of students' language skills. As such, instructors are in a continuous dance with the technological possibilities on offer and are in need of methods to evaluate a technology's ability to effectively improve achievement of learning goals. Many aspects of a technology need to be examined in order to determine its appropriateness for use in the language classroom. These aspects could include its functionality, ease of use, and availability. This paper builds on previous action research by adding layers of scrutiny to technology use.

The context of this action research is a Thai international university English-language preparation center, the Preparation Center for Languages and Mathematics (PC). Students enter the program with intermediate English language skills and are expected to exit the program with advanced skills. The students at PC are attempting to enter Mahidol University International College, and they face the challenges of rapidly learning academic English and developing the critical thinking skills expected in a liberal arts education. Thailand as a whole does not rank well in the EF English Proficiency Index (2014), taking 48th place out of 63 countries where English is not the first language. This makes overcoming the challenges of acquiring the English language skills necessary for university study doubly difficult for the students in the program because the Thai population as a whole has a very low proficiency in English. Students are required to bring a notebook computer to every lesson and all classrooms are equipped with Wi-Fi, a class computer, a projector, and a sound system. The four levels of the program are divided into intensive 10-week periods. The students in the program are motivated to enter university classes as quickly as possible, which means that the effectiveness of the technological resources used is of constant concern. Recent Thai governments, and many other governments, have invested sizably in technology hoping for a significant improvements in student achievement (MOE, 2011); however, educators must be wary of the embellished language that normally accompanies discussions of technology in education and its potential. Selwyn's (2015) investigations of students' actual technology use underlines the exaggerated claims of technology's transformative potential. There are a number of methods and frameworks available to aid educators in this endeavor, each with specific strengths and weaknesses. Three of these frameworks, Bax's (2002) categories of CALL; the *RAT — Replacement, Amplification, and Transformation* framework from Hughes, Thomas, and Scharber (2006); and Davies' (2011) *Framework for Understanding and Assessing Technology Literacy*, will be discussed below.

Literature Review

The persistent focus on and increasing use of technology in education has rightly attracted critical attention. Some of the sharpest criticism has come from Selwyn (2015), who points to "Ed-Tech Speak" (p. 2), or the hyperbolic language used when speaking of the impact technology has on education. Most educators have come across this exaggerated language, either in the names for technologies themselves (e.g., Smart Board) or the pedagogical changes possible with some technologies (e.g., technology-enhanced learning). Implicit in much of the discussion of technology and education is the "presumption not only that learning is taking place, but that learning is being driven actively by the use of technology" (Selwyn, 2015, p. 2). It is clear that technology can serve useful purposes in achieving learning goals; however, discussions of technology in education should include the distinct possibility that it may not be helpful or impede reaching those goals. The antidote to the hyperbole in educational technology is strip away the colorful, flattering language often employed and to include in discussions social, political, historical, economic, and other aspects of context in which the decisions are being made (Selwyn, 2015). It has been found in more than one case that when students from lower socio-economic backgrounds are given tablets or computers, they are quite adept at hacking around the intended education software (Purdy, 2015). This is one way in which technology can disrupt education negatively. Learning how to hack an operating system was not the intention of the educators, but that was the main learning outcome. Recent research by Henderson, Selwyn, and Aston (2015) has confirmed technology use among university students is of the more prosaic type and that "digital technologies are clearly not 'transforming' the nature of university teaching and learning". The students in the study used many types of technology and found them extremely useful, but the promises implicit in the language used to describe the technology were not kept.

Over-reliance on technological solutions has been called the "technical fallacy" by Bax (2000, p. 200). It is important to for educators to remind themselves that rarely is there a singular solution, technological or otherwise, to problems in the classroom. Bax (2003) argues that the technology used in the classroom should be "invisible." Thus, in CALL (computer assisted language learning), the computer and related technologies should firmly reside in the background of students' and teachers' attention. This may sound counterintuitive given the value attached to computers, but it becomes clear when one considers that other forms of technology used in classrooms are taken for granted and hardly noticed, e.g., whiteboards and notepads. Bax (2003) describes and redefines how CALL has shifted in use over the years, from "Restricted" to "Open", and how educators are to prepare for it to be fully "Integrated" rendering it "invisible." Predicting over a decade ago that computer use in the language classroom would become commonplace, Bax (2003) further explained that teachers and students would use computers "without an exaggerated respect for what they can do" (p. 24) and that they "will go almost unnoticed" in classrooms with fully "Integrated CALL." This allows for educators to focus on the needs of the learner, which is where the focus should remain, and not on the concern with technology use itself. Bax (2003) describes a process of integration or "normalisation" which includes various factors such as teachers' and students' attitudes and ability to use technology, the size and location of devices, and more complete use of technology throughout the organization. A multitude of factors need

to be assessed and plans formulated then implemented for the invisibility of technology use to be realized. This process will also require "more in-depth ethnographic studies of individual environments" (p. 24) to uncover the obstacles and the smoothest paths to integration (Bax, 2003). Thus, it is crucial to understand the specific context in which CALL is being employed. Research by Chambers and Bax (2006) more specifically identified 11 problems with "normalisation," pointing out the importance of understanding the interconnectedness of the multitude of factors involved in its realization. This holistic approach to integrating CALL in the classroom presents a dynamic view, one which requires a concerted effort on many levels to achieve. In his latest research, Bax (2011) proposes a more detailed process for considering the use of any technology in the language classroom. The process includes three steps: a *Needs Audit* to determine value and necessity of any technology under consideration and whether the specific situation, in all its complexity, warrants the inclusion of the technology; a *Learning Plan* that engages with issues of access, participation, expert intervention, and other types of mediation; and, simultaneously, a *Research Programme* designed to identify and overcome obstacles to "normalisation" (Bax, 2011). Altogether, Bax's observations and recommended steps to attain "Integrated CALL" represent a challenge in themselves: to cautiously approach technology integration in the language classroom and to continuously and carefully ascertain how to meet learners' needs.

In complement to Bax's detailed elucidation of integrating technology into the classroom, there are useful frameworks for evaluating a specific technology's potential impact. Hughes et al. (2006) have proposed the *RAT — Replacement, Amplification, and Transformation* framework. Of the three levels of outlined in the framework, the last two, amplification and transformation offer the most to educators and learners. Replacement simply exchanges one technology for another, but "in no way change[s] educational practices" (Hughes et al., 2006, p. 1617). A student can type an essay rather than handwrite it; the only change is the medium of behavior. This can often be an unnecessary step, possibly a more expensive one, and offers no advantage in regards to achieving learning goals if the technology is not used further. In order to reach amplification, the technology must "[increase] the efficiency or productivity of instruction, student learning or the curriculum" (Hughes et al., 2006, p. 1618). Using a dictionary function in a word processing program increases efficiency and productivity, for it is much quicker than using a dictionary, and there is one less object to carrying around. This is an important step, potentially saving valuable time. At the highest level, transformative technology offers possibilities previously unavailable. Should the teacher use the added functionality of communication offered in applications such as Google Docs, the technology offers a transformative ability; direct communication, inside or outside of the classroom, can now take place, a possibility not available with paper or offline word processing. The asynchronous or synchronous communication between teacher and student offers clear advantages over technologies lacking communicative functionality. There are multiple ways in which learning can be transformed. The chances to engage with learning are increased, the considerations taken into account require that "mental processing [is] expanded," and the operations of the organization itself are changed (Hughes et al., 2006). Pea (1985) calls these types of technologies "instruments of cultural redefinition" (p. 168). Use of technology at the transformative level is not common (Ertmer & Ottenbreit-Leftwich, 2010), but is becoming increasingly so as

educational institutes, educators, and students engage with technologies and as new technologies become available.

One aspect of technology use in the language classroom that may be overlooked is the proficiency of its users, their technology literacy. Expert proficiency in using a technology is necessary for its effectiveness (Davies, 2011) and an important aspect of reaching Bax's "normalisation." As Selwyn and others have pointed out, technology itself is not evidence of its usefulness in education. A technology may offer transformative functionality, but to reach that level, users must become adept at using it. Davies' (2011) *Framework for Understanding and Assessing Technology Literacy* provides a description of the manner in which technology skills progress. One must become of aware of a technology first and answer the question: "what can the technology do?" (Davies, 2011, p. 48). If the technology does not offer a function that is useful in the specific situation in which it is being evaluated for use or if there are factors that prevent its use, there is no pedagogical reason to learn how to use it. At the *awareness* level, a technology may be deemed to offer clear uses in the classroom. Developing *praxis*, then, is the next step, where learning to use the technology can reveal how it may be employed to accomplish a learning task. Expectations should be tempered at this stage because a user's limited knowledge of the technology may interfere with accomplishing learning goals through its misuse or misapplication. Not all situations call for a technological solution, even if one is available. Achieving *phronesis* — the Aristotelian notion of practical wisdom — is the goal of technology literacy. When users operate at this level, they are able to determine why a technology is used and how best to integrate it (Davies, 2011). It is a level of knowledge and discernment best suited for effective use of technology.

Technology

Hangouts on Air is a part of Google+ that allows group video chats involving up to 10 members. The video can be viewed simultaneously on YouTube, stored there, and viewed later. The comment functions can be used as normal. The video is marked private as the default, so it is not searchable. This useful technology enables teachers to assign students speaking and listening practice. In the upper-level classes at PC, students' ability to engage in a discussion is assessed formally. Hangouts on Air gives students the ability to practice discussions outside of the classroom without having to meet in person. Students can engage in a discussion from anywhere with an internet connection. After reading, listening, and researching a topic such as genetically modified food or business ethics, students are either given questions to discuss or come up with their own. Assigned groups choose a time to meet online, and a group leader initiates the chat. When the chat is complete, it is automatically uploaded to YouTube, and a designated group member sends a link to the teacher.

Teachers can use the recorded discussion in many ways: clips of the video can be viewed in class; chat groups can share recordings for peer assessment; or the teacher may give feedback in the comments or in some other manner. Because there is audio and video, students' performance can be evaluated in various ways: body language, gestures, pronunciation, vocabulary, grammar, interaction, quality of the information arguments, etc. The videos are then available for use at any time to evaluate progress, student reflection, or in preparation for assessed discussions.

VoiceThread is a cloud-based application that allows users to upload, share, and comment on photos, videos, and presentation slides. Comments can be in the form of audio, text, and video, and there is an option to digitally draw on the slides to add emphasis. A link to the VoiceThread can be shared and further comments can be made by those with a link in the forms listed above. Many people can be included in the comments. The interface is simple and the thread of comments easily navigated.

VoiceThread is used at PC for presentation and oral summary practice. Students create presentation slides in PowerPoint, Google Slides, or other presentation software, and upload the slides or images to VoiceThread. The student or group of students records the audio for each slide. Multiple recordings can be made for each slide and saved in the VoiceThread. Students can practice each section until they are satisfied. Each recording can be listened to for strengths and weaknesses and the best overall recording can be kept. As the presentation is broken up by the slides, the activity is easily managed. Feedback from the teacher and peers helps the presenter pinpoint areas to improve. The task can be completed entirely outside of class, or elements of the feedback can be done in class by showing the VoiceThread. Further practice may take place, all in preparation for in-class presentations that are formally assessed.

Discussion

The web-based applications VoiceThread and Hangouts on Air are tools used in the program to improve students' listening and speaking skills. Using the three frameworks described above, and with Selwyn's cautionary message in mind, these two technologies will be evaluated to ascertain where they fall within them. The three frameworks complement each other. Bax's notion of "normalisation" acts as an umbrella under which both the *RAT — Replacement, Amplification, and Transformation* framework and the *Framework for Understanding and Assessing Technology Literacy* fit, where they highlight the transformative potential of the technology itself and the importance of practical competence and wisdom when integrating it into the classroom.

Hangouts on Air is used in the program to give students practice in academic discussions outside of the classroom. It can be a transformative technology. It has made practicing discussion skills more efficient and allows students to engage with each other in new ways that requires an added level of analysis. Formerly, practice discussions went unrecorded or were recorded in a large format digital file, which is cumbersome to use. Because Hangouts on Air uploads directly to YouTube and internet bandwidth in Thailand is sufficient, the recorded discussions can be used in new and more precise ways: the level of focus on any given skill is enhanced, the opportunity to improve upon weaknesses or mistakes is increased, and the number of people to engage with is expanded. Each of these abilities matches up with the definition of transformation and were evident when students used of the technology.

Within Davies' framework, students' use of Hangouts on Air can be placed somewhere between *praxis* and *phronesis*. It was a new technology for the students to use, so it required some in-class and out-of-class time to become familiar with. Some students continue to have problems setting it up, significantly delaying its use. Once set-up, it did not take long for students to easily use the application. This may be

because it is similar to Skype and FaceTime, two popular chat applications. Overall, Hangouts on Air is not "invisible": the internet is not sufficiently stable for it to be used at all times, the set-up process can be confusing and error prone, some students' microphones are poor quality, some students found the format unnatural or inauthentic, etc. Bax's notion of "invisibility" and Davies' formulation of *phronesis* appear to exist hand-in-glove; it seems that for a technology to become "normalized," it needs to be used with expert ease. One way to make the technology more "invisible" by improving students' competency would be to use it throughout the program. Students would then have sufficient time to familiarize themselves with the application to the point where it becomes fully integrated.

VoiceThread appears to have met the criteria for transformation, *phronesis*, and "invisibility". The application has opened up new ways of engaging with presentation practice. The segmented method of recording audio; the ability to record and review multiple recordings; peer and teacher audio commenting; and other features of the application allow students to engage with the application and learning in new, transformative ways. Anecdotal evidence points to improvements in student presentations without using more class time to help students prepare. Many of the students in the program have skills necessary to use VoiceThread with competence by the time they reach the program level in which the application is used. Those who do not have the requisite technology literacy become proficient after a few hours of practice. All students are able to use the application expertly when a second presentation assignment is given. This shows that the technology literacy necessary to reach *phronesis* is within the grasp of the students in the program, which means its use is "naturalised." VoiceThread could easily become an "invisible" application should the program attempt to integrate the application in all classes.

Conclusion

This paper has described the use of two technologies at PC and three complementary frameworks for evaluating the effectiveness of their use. The examples illustrated — VoiceThread and Hangouts on Air — and the experience gained in using them can be applied as models for the integration of other technologies. By using the three frameworks and carefully assessing their context, language educators should be able to navigate the complex process of successfully integrating technology into their programs. The process is continuous and requires detailed planning but is necessary given the pervasive nature of digital technology and the powerful drive for it to be used in education.

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Pragmatic (Im)Politeness and Group Gender Composition in Face-to-Face and Virtual Communication: Tunisian Undergraduate Students as a Case Study

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract

Although the literature on group gender composition in the classroom derives from a variety of research disciplines, including sociolinguistics and educational psychology, little attention has been paid to approaching this contextual factor pragmatically. This study, therefore, makes use of Brown and Levinson's (1987) and Culpeper's (1996) pragmatic theories of (im)politeness to investigate the extent to which group gender composition conditions (male-only (MO), female-only (FO), and evenly-mixed (MIX) groups) and communication modalities (face-to-face and online communication) influence undergraduates' linguistic choices in the Tunisian context. Twenty-four participants were divided into six groups of four participants each. Half of these groups met face-to-face, whereas the other half got in touch using *Hipchat* as a text-based online chat utility. Each group was assigned a problem-solving task on which they had to reach a consensus, with English as the communication medium. Afterwards, each participant was invited to rate their satisfaction with the group discussion process on a 7-point Likert scale. The findings reveal that gender composition, across face-to-face and online modes of communication, affected the participants' linguistic choices. FO groups were the most supportive and polite, followed by MIX and MO groups. Contrary to our expectations, both genders proved to be less impolite and confrontational online than in face-to-face encounters. They also showed satisfaction with the overall discussion process, regardless of the communication modality and the gender composition of the group to which they had been assigned. The significance of the results lies in informing the teachers of the modes of communication and group gender composition conditions that are more likely to enhance their students' learning experience.

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Introduction

Over the past three decades or so, gender-related issues have prompted a large body of research in the educational context. Researchers and scholars from a wide range of academic disciplines, including sociology (e.g., Mahony, 1985; Swann, 1992), sociolinguistics (e.g., Wilkinson, Lindow, and Chang, 1985), educational linguistics (e.g., Jones, 1993; Lee, 1996), and social psychology (e.g., Baron, 2004), have addressed gender inequalities among students in the hope of finding practical measures to prevent, or reduce, their occurrence. Broadly speaking, their interest in the gendered aspects of language education boils down to two major lines of inquiry: teaching materials and classroom interaction (Spender, 2002). With regard to teaching materials, language textbooks tend to reproduce gender biases, such as men holding both more powerful and a wider range of occupational positions than women (see Boxer and Tyler, 2004). Research undertaken on classroom interaction, on the other hand, addresses the role of gender in affecting the type and amount of talk. Decke-Cornill (2007) points out that these studies basically focus on three types of classroom discussion: teacher-student[1], student-teacher[2], and student-student.

This paper, however, concerns itself with investigating student-student talk in the classroom, with a special focus on gender-related practices in three different group gender composition conditions (male-only, female-only, and evenly-mixed groups)—both face-to-face (F-t-F) and through synchronous text-based computer-mediated communication (CMC). Although quite a few studies are unanimous in their assumption that the 'gender' variable yields much influence on the type of language male and female students use (e.g., Piliavin and Martin, 1978; Mulac et al., 1988), they do not seem to share the same findings as to the way students behave in either same-sex or mixed-sex groups. As will be discussed later in the paper, the inconsistency of their findings is partly attributed to the fact that the social, cultural, and situational contexts in which each study is conducted may differ considerably (see Eckert and McConnell-Ginet, 2003). This implies that any attempt to make broad generalizations is prone to criticism and rebuttal. Such an argument, therefore, seems to act in favour of investigating the linguistic behaviour of male and female Tunisian undergraduates, as little or no attention has been paid to the Tunisian context. Furthermore, this study makes use of the community of practice (henceforth CofP) approach to keep any generalizations obtained relative to the community of Tunisian undergraduates only.

It should also be noted that, despite the vast amount of research conducted on the role of 'gender' in the classroom, there seems to be a paucity of research approaching this contextual variable pragmatically (see Bacha et al., 2012). Further still, lack of pragmatic research on language and gender in the classroom in the Arab world[3], in general, and the Tunisian context, in particular, is another motivating reason for this study to embark on a quest for the linguistic behaviour of Tunisian undergraduates of English at the Faculty of Letters and Humanities of Sfax, Tunisia. To that end, it makes use of two modified versions of Brown and Levinson's (1987) and Culpeper's

[1] Such as investigating the criteria teachers use to evaluate male and female linguistic competence (e.g., Dweck et al., 1978), and the level of attention they pay to either gender in class (e.g., Kelly, 1988).
[2] Such as addressing male and female frequency of participation in oral communication in the classroom (e.g., Chavez, 2001).
[3] See Bacha et al., (2012).

(1996) pragmatic theories of (im)politeness and assesses the degree of (dis)satisfaction of the participants with the group discussions based on a post-experiment questionnaire.

The present study formulates the following set of hypotheses and sub-hypotheses:

H1: In both face-to-face and synchronous text-based CMC environments, the level of (im)politeness evidenced in the linguistic behaviour of undergraduates is largely contingent on the gender composition of the group to which they are assigned.

> ***H1.1:*** Male-only groups disclose more linguistic impoliteness than female-only groups do.
>
> ***H1.2.*** Female-only groups disclose more linguistic politeness than male-only groups do.
>
> ***H1.3:*** Balanced groups of males and females fall between single-gendered groups in terms of the degree of linguistic (im)politeness featuring in their conversational exchanges.

H2: Group members across the three gender composition conditions tend to be more uninhibited and aggressive in synchronous text-based CMC than in F-t-F communication.

H3: Participants show most satisfaction with the discussion process in single-gendered than in mixed-gendered groups in both communication modalities (i.e., F-t-F and through CMC).

Group Gender Composition in Face-To-Face Talk

A considerable proportion of research that has dealt with the effect of group gender composition on students' linguistic choices concurs that males' and females' styles differ substantially in same-sex and mixed-sex groups (e.g., Piliavin and Martin, 1978; Sgan & Pickert, 1980; Lockheed & Harris, 1984). Piliavin and Martin (1978), for instance, observe that, with regard to undergraduates at the University of Wisconsin, all-female groups are more associated with "socio-emotional" aspects of talk than are all-male groups, whereas all-male groups are more in favour of engaging in "task-oriented" behaviours than are female-only groups (1978: 293). Nonetheless, later in the same study, the same researchers come to realize that, when arranged in mixed-sex groups, male and female participants become less sex-role stereotyped.

Although some of the studies on gender in the classroom provide some in-depth analyses of student-student talk, they seem to turn a blind eye to a host of social, cultural, and situational variables that may have been accountable, in part or in full, for influencing male and female linguistic choices. As Decke-Cornill (2007: 81) puts it, by ignoring external influences, researchers "stay within the horizon of observable classroom interactions, thus mapping only the tip of the iceberg". Consequently, generalizations drawn from different gender composition conditions are susceptible to contradiction by other research findings (as they are not necessarily sharing the same contextual variables). Indeed, contrary to Piliavin and Martin's (1978) conclusion mentioned earlier that male students are in favour of adapting their linguistic choices in the direction of females' in mixed-sex groups, Aries (1976) observes that, in this

particular gender composition condition, male undergraduates in his study rather dominate interactions and receive more turns at talk than their female counterparts do.

As a matter of fact, to avoid falling into the trap of de-contextualising and generalizing gender-related behavioural differences, this study assumes a constructionist view to gender as a performative social construct by using the CofP approach.

The Community of Practice as a Constructionist Approach

Rather than identifying gender as stable, stand-alone, and dichotomous, the constructionist view conceptualizes gender as under constant construction, a series of practices that interplay with different contextual variables, such as age, culture, and situational context (Eckert and McConnell-Ginet, 1992; Sadiqi, 2003; Cameron, 1998). The notion of 'community of practice', as a constructionist approach, was initially put forward by Lave and Wenger (1991) as a social theory of learning, before being broadened in scope by Eckert and McConnell-Ginet (1992) in order for it to apply to all sorts of common interest groupings (e.g., a workplace, a sports team, a neighbourhood playgroup, etc.) (see Eckert, 2006). Eckert and McConnell-Ginet (1992: 464) hold the view that a CofP investigates the emergent features of the gendered identities of "an aggregate of people" (both males and females) "who come together around a mutual engagement in an endeavour". That is, members who are brought together by a common interest within a CofP develop their own system of values and beliefs over the course of regular joint activities.

However, a CofP still does not lose sight of the significant role of social stereotypes and practices in affecting—to a certain extent—the judgement of most (if not all) participants in a CofP, due to their being members of the broader social community (Eckert and McConnell-Ginet, 1992). For instance, Yepez (1994) makes the point that students come to the classroom with a set of values and prejudices that their families and society as a whole have already engraved in their mind. Accordingly, it can be concluded that the specificity of the Tunisian context in this study (as opposed to many western research findings on western undergraduates) shall yield specific findings about the linguistic behaviour of the CofP of male and female Tunisian Undergraduates [4] across different group gender composition conditions and communication modalities (CMC and F-t-F contexts).

Group Gender Composition in Computer-Mediated Communication (CMC)

Similar to face-to-face communication, the literature on CMC asserts that the gender composition variable largely affects students' linguistic choices and attitudes (e.g., Herschel, 1994; Barrett and Lally, 1999; Underwood et al., 2001). With regard to same-sex groups, a large proportion of research concurs that female participants show much satisfaction with the group process and use more personal pronouns; whereas male participants are more likely to produce put-downs, strong assertions, lengthy messages, and abusive language (see Savicki et al., 1996c; Baron, 2004). Moreover, as for mixed-gender groups, many researchers observe that language used by the non-

[4] They represent a CofP in its own right as they are all undergraduates of the same age category (between 20 and 24) who study in a public university.

dominant gender is likely to adapt in the direction of the style of the dominant gender. For instance, women in male-dominant groups are more adversarial and less supportive of others' views than are in female-dominant groups (see Cherny, 1994; Herring, 1994, 1996; Monroe, 1999). However, concerning evenly-mixed groups, Savicki et al., (1996c) concede that they take a middle ground in terms of the language used (i.e., neither typically male nor typically female type of language).

The abovementioned observations, however, are also subject to criticism and contradiction by other research findings (see, Soukup, 1999; Hayes, 2008; Fox et al., 2007). One possible reason for this contradiction is that they do not usually share the same social, cultural, and situational contexts, which act as a network of interconnected variables that bear much influence on the language of male and female students across different group gender composition conditions. Hence, for the sake of the accuracy of our research findings, this study does not presume their applicability to any other community beyond the community of Tunisian undergraduates.

Methods

Subjects

Twenty-four Tunisian undergraduate students of English at the faculty of Letters and Humanities of Sfax (ranging in age from 19 to 23 years) were randomly chosen from a list of volunteers to take part in this experiment. Half of them were asked to meet F-t-F, whereas the other half got in touch using synchronous text-based CMC only. For each communication modality, male and female participants were randomly assigned to three types of groups: male-only (MO), female-only (FO), and mixed (MIX) (i.e., equal numbers of males and females). The groups were composed of four participants each.

Task Type

All six groups in this study were assigned a problem-solving task and asked to discuss it in English, with the aim to reach a consensus within 20 minutes. This type of task requires all groups to arrange fifteen items (which they have to take with them into an underground shelter) in the order they believe best reflects their importance to survive the after-effects of a nuclear explosion[5]. Yet, before embarking on the group discussion activity, participants were invited to individually reflect upon the list of items and suggest a particular arrangement within ten minutes.

Materials

While F-t-F group discussion experiments were held in a classroom setting[6], participants choosing to discuss the problem-solving task via CMC were emailed private account information to log in to a text-based instant messaging service called HipChat[7]. They were also provided with pseudonyms for the sake of anonymity, and informed of the day and time of the experiment. Moreover, attached to the email was a PDF document including the necessary steps to log in and join the group discussion. A follow-up email was also sent to all the participants providing them with an individual-rating worksheet and a collective-rating worksheet of the fifteen items in the problem-solving task. The same email also invited them to grade their satisfaction

[5] The nuclear explosion task is adapted from Johnson and Johnson (1994).
[6] F-t-F conversational exchanges were video-recorded and transcribed in full.
[7] For more information on the instant messaging service visit: www.hipchat.com.

level on a 7-point Likert scale, subsequent to the group discussion, by clicking on the hyperlink provided. Participants in the F-t-F experiment were equally invited to grade their satisfaction level on a 7-point Likert scale, but on paper, subsequent to each group-discussion activity.

Analytical Frameworks

Subsequent to transcribing the F-t-F conversational exchanges and reproducing the online chat longs into a word-processing document, the corpus was hand-coded for pragmatic (im)politeness using modified versions of both Brown and Levinson's (1987) politeness theory and Culpeper's (1996) impoliteness theory.

Brown and Levinson's (1987) politeness theory:

Central to Brown and Levinson's (1987) politeness theory is the notion of *face*. The researchers conceive of face as a basic parameter that helps interactants determine the appropriateness of their speech and downplay any probability of disagreement or offence to the addressee. This theory makes use of Goffman's (1959) notion of *face* to argue that any individual has two types of face: positive face (i.e., the need to be valued and appreciated) and negative face (i.e., the desire to have one's actions unimpeded by others). Any speech act that is likely to threaten positive or negative face is called a 'face-threatening act' (FTA) (1987). Brown and Levinson (1987) assume that interactants are constantly concerned with maintaining both aspects of face during interaction. Based on this assumption, they propose five politeness super-strategies: (1) *Bald on-record,* (2) *Positive politeness,* (3) *Negative politeness,* (4) *Off-record,* and (5) *withhold the FTA.* See figure 1 below.

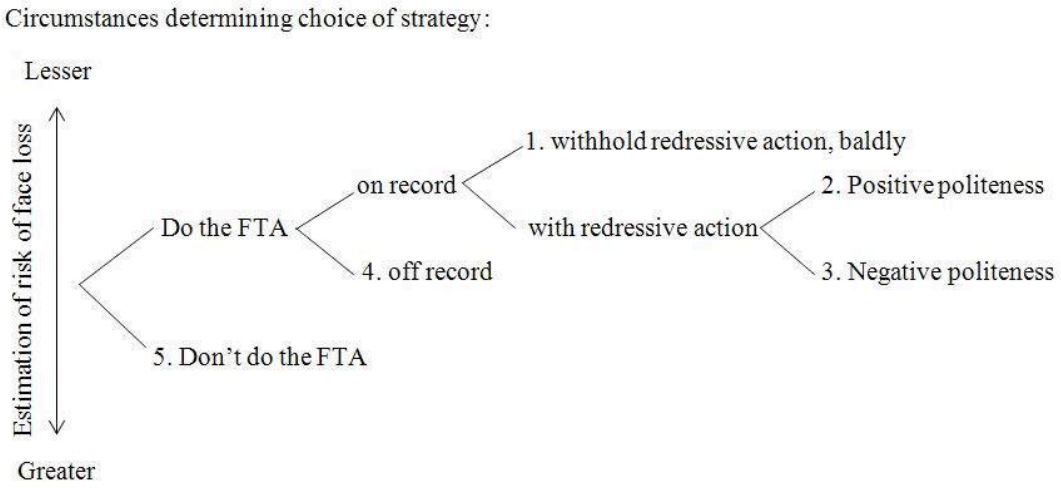

Figure 1: Strategies of doing FTAs (Brown and Levinson, 1987: 69)

Nonetheless, the fact that Brown and Levinson (1987) conceive of face as a public self-image that needs to be constantly attended to renders this theory inadequate to account for the diversity of intentional face-threatening acts by the same tokens that explain politeness (See Eelen (2001) and Mills (2001) for an in-depth criticism). As a matter of fact, this study deploys Culpeper's (1996) impoliteness theory as complementary to Brown and Levinson's (1987) theory of politeness.

Culpeper's (1996) Impoliteness Theory:
Given the fact that this theory "builds an impoliteness framework which is parallel but opposite to Brown and Levinson's (1987) theory of politeness" (Culpeper, 1996: 359), Culpeper suggests five impoliteness super-strategies modelled after Brown and Levinson's politeness super-strategies. They are as follows: (adapted from Culpeper, 1996: 356-7)

(1) Bald on-record impoliteness: the attempt to be intentionally aggressive, hence to purposefully and directly attempt to damage the addressee's face.
(2) Positive impoliteness: it is meant to intentionally damage the addressee's positive face wants; i.e., his/her want to be approved of.
(3) Negative impoliteness: it is generally used to damage the addressee's negative face and attack his/her freedom of action.
(4) Sarcasm or mock politeness: it is mainly achieved by using a surface realisation of politeness, which is meant to convey an indirect offence.
(5) Withhold politeness: it manifests itself in situations where 'politeness work' is not performed when expected. One example is not to thank someone for doing you a favour.

Worthy of note is that both theories have been subject to a number of improvements and modifications (See Culpeper et al., 2003; Bousfield, 2008). One major modification, however, is Bousfield's (2008) criticism and exclusion of the *Bald on-record* super-strategy from both frameworks. He argues that, since bald on-record utterances are not 'faceless' (as no communication can be held without face considerations), "it seems odd that such utterances would not be captured under the positive or negative im/politeness super-strategies" (Bousfield, 2008: 63).

Apart from the super-strategies outlined above, both theories anticipate a list of positive and negative output strategies. Table 1 below lists the (im)politeness strategies to be utilized in investigating the linguistic behaviour of the participants in this study.

Table 1: The constituent strategies of Brown and Levinson's (1987) and Culpeper's (1996) modified theories of (im)politeness

Brown and Levinson's Politeness theory	**Culpeper's Impoliteness theory**
• Positive politeness o Notice, attend o Exaggerate o Intensify o Use in-group identity markers o Seek agreement o Avoid disagreement o Presuppose/ raise/ assert common ground o Joke o convey understanding of addressee's wants o Offer, promise o Be optimistic o Include the addressee into the activity o give (or ask) for reasons o assume or assert reciprocity o Give gifts to the addressee (goods, sympathy, understanding, cooperation) • Negative politeness o Be conventionally indirect o Question, hedge o Be optimistic o Minimize imposition o Give deference o Apologize o Impersonalize: avoid pronouns "I" and "You" o State the FTA as a general rule o Nominalize o Go on record as incurring a debt, or as not indebting the hearer • Off-record politeness • Withhold the face-threatening act (FTA)	• Positive impoliteness o Ignore, snub the other o Exclude the other from an activity o Disassociate from the other o Be disinterested, unconcerned, unsympathetic o Use inappropriate identity markers o Use obscure or secretive language o Seek disagreement o Use taboo words o Call the other names • Negative impoliteness o Frighten o Condescend, scorn, ridicule o Invade the other's space o Explicitly associate the other with a negative aspect o Put the other's indebtedness on-record • Sarcasm or mock politeness • Withhold politeness

Findings and Discussion

Distribution of Politeness Super-Strategies and Output Strategies across Groups in Both F-t-F and Online Modes of Communication

As shown in Table 2 below, male and female participants across different groups and modes of communication seem to limit their choices of politeness super-strategies to positive and negative ones—as opposed to a total disregard of the *Off-record politeness* and *Withhold the FTA* super-strategies. One plausible reason for the absence of the *Off-record politeness* super-strategy[8] is that the problem-solving nature of the task requires all participants to be upfront and articulate when it comes to justifying their arrangement of the survival items. The same reasoning may also apply to the *Withhold the FTA* super-strategy (i.e., not to do the face-threatening act), as performing FTAs is part and parcel of disagreeing with others in the group and trying to convince them with different possible arrangements.

Table 2: Distribution of politeness super-strategies

	Modes of communication					
	F-t-F			**CMC**		
Super-strategies	MO	FO	MIX	MO	FO	MIX
Positive politeness	34	91	67	58	152	113
Negative politeness	28	39	31	36	67	53
Off-record politeness	0	0	0	0	0	0
Withhold the FTA	0	0	0	0	0	0
Total	62	130	98	94	219	166

What is also of interest is that, across F-t-F and CMC modalities, FO groups draw on *positive politeness* almost one and a half times more than mixed-gender groups do and almost three times more than MO groups do. Moreover, as for *Negative politeness*, although the values across groups are not as spread out in both communication modalities as with *Positive politeness* (*SD* = 14.88 vs. *SD* = 42.32), female participants in FO groups seem to be more in favour of maintaining each other's negative face (i.e., by avoiding imposition), followed by MIX and MO groups. These findings are in tune with Savicki et al.'s (1996c) observation that female-only groups are more inclined to focus on collaborative and socio-emotional language than male-only and mixed-gender groups are.

Moreover, in each communication modality, the MIX group is closer to the FO group in terms of the frequency distribution of the positive and negative super-strategies used. We presume, consistent with previous studies (e.g., Piliavin and Martin, 1978; Savicki et al., 1996a) that this is down to males' tendency in mixed groups to adapt their linguistic choices to those of their female counterparts, such as being less confrontational and more supportive of others' views and beliefs. Yet, the considerable disproportion between MO and MIX groups in terms of the frequency of occurrence of both super-strategies shows that the females are the least willing to modify their linguistic behaviour in the presence of the opposite gender. This finding, however, runs counter to quite a few research findings (e.g., Piliavin and Martin,

[8] It has to do with performing a speech act by means of an implicature (indirectly).

1978; Savicki et al., 1996a) of the sort that females become markedly less sex-role stereotyped in the presence of the opposite gender.

Table 3: Distribution of politeness output strategies [9]

Output strategies		Modes of communication					
		F-t-F			CMC		
		MO	FO	MIX	MO	FO	MIX
Positive output strategies	Exaggerate	2	7	4	3	14	7
	Seek agreement	11	27	17	29	72	56
	Avoid disagreement	4	11	8	6	14	9
	Joke	0	5	2	1	6	4
	Include the addressee into the activity	15	36	28	19	44	36
	Give gifts to the addressee	2	5	8	0	2	1
Negative output strategies	Question, hedge	28	36	30	34	55	48
	Apologize	0	3	1	2	12	5

With regard to the output strategies, Table 3 above demonstrates that, throughout the different group gender composition conditions and modes of communication, the strategy *Question, hedge* is the most frequently in use (N = 231), followed by *Seek agreement* (N = 212), and *Include the addressee into the activity* (N = 178). The frequency of occurrence of the remaining five strategies put together, however, does not amount to more than 24% (N = 146) of the total strategies used.

The predominance of these three output strategies across all groups could reasonably be ascribed to the nature of the activity (a problem-solving task). Indeed, the activity requires the participants to work as a team (hence the recurrence of the *Include the Addressee into the* activity strategy) and reach a consensus on the appropriate arrangement of a list of survival items (hence the recurrence of the *Seek agreement* strategy). Furthermore, the recurrence of the *Question, hedge* strategy may have been the product of inviting the participants at the beginning of each experiment not to be categorical in their assumptions in the hope of reaching a consensus that gains the satisfaction of all the members in the group. Once again, by making abundant use of these output strategies, women in FO groups are in favour of having language be attenuated and supportive. They are, then, followed by MIX and MO groups.

The modes of communication also play a major role in having male and female participants attend more or less to each other's face needs. Participants across the three group gender composition conditions seem to make less use of the strategies of politeness when not meeting face-to-face (see Table 3). Siegel et al., (1986) explain that the absence of audio-visual cues in text-based online communication makes the interactants more absorbed in sending and receiving messages and, consequently, less willing to attend to each other's face-wants and expectations.

[9] Due to space constraints, only the output strategies used during the group discussion activities have been mentioned.

Distribution of Impoliteness Super-Strategies and Output Strategies Across Groups in Both F-T-F and Online Modes of Communication

As outlined in Table 4 below, all participants across different groups and modes of communication show much impoliteness in their conversational exchanges. Yet, they seem to limit their choices of impoliteness super-strategies to positive and negative ones only. Throughout both communication modalities, the type of language in MO groups is much more uninhibited (N = 65) than in MIX (N = 54) and FO (N = 32) groups.

Table 4: Distribution of impoliteness super-strategies[10]

	Modes of communication					
	F-t-F			**CMC**		
Super-strategies	MO	FO	MIX	MO	FO	MIX
Positive impoliteness	11	8	10	7	4	8
Negative impoliteness	54	24	44	34	11	20
Sarcasm or mock politeness	0	0	0	0	0	0
Withhold politeness	0	0	0	0	0	0
Total	65	32	54	41	15	28

This finding is congruent with Savicki et al.'s (1996b: 209) observation in their study that undergraduates in MO groups "used more coarse language. . .and were the least satisfied with the group process". Moreover, following Piliavin and Martin (1978) and Savicki et al. (1996b), one possible explanation for having MIX groups take a middle ground in terms of the recurrence of the strategies outlined in Table 4 is that males tend to behave themselves more properly at the presence of the opposite gender. Yet, they also point out that female participants are in favour of adapting their linguistic choices in mixed groups in such a way as to become less sex-role stereotyped and more aggressive than they are in FO groups. This may reasonably explain the disproportionately higher frequency of occurrence of both super-strategies in the MIX groups (almost two times as frequent) compared to the FO groups.

Table 5: Distribution of impoliteness output strategies

		Modes of communication					
		F-t-F			**CMC**		
Output strategies		MO	FO	MIX	MO	FO	MIX
Positive output strategies	Be disinterested	2	4	5	0	0	1
	Use inappropriate identity markers	0	0	0	0	0	1
	Seek disagreement	9	4	5	7	4	6
Negative output strategies	Condescend, scorn, ridicule	36	16	28	22	10	15
	Invade the other's space	8	2	7	5	1	2
	Challenge	10	6	9	7	0	3

[10] Due to space constraints, only the output strategies used during the group discussion activities have been mentioned.

As for the output strategies shown in Table 5 above, the strategy *Condescend, scorn, ridicule* is the most frequently in use (N = 127), whereas the remaining ones, put together, hardly account for 45% of the total strategies used (N = 108). The predominance of this strategy could possibly be linked to the nature of the local norms of conduct set by the CofP of Tunisian undergraduates, which may tolerate the act of condescending and ridiculing others' views and beliefs as moderately face-threatening (and not as severe as to halt the discussion activity and/or evoke a verbal conflict).

The disproportionately lower recurrence of the other strategies could also be partly attributed to a set of norms typical of that CofP. Yet, following the constructionist view (see Eckert and McConnell-Ginet, 1992), contextual variables may, to some extent, be accountable for participants' decision about which strategies to be used the most (or the least) in their exchanges. For instance, the nature of the task (a problem-solving task), which requires all participants to cooperate and be serious enough in their endeavour to come to a compromise by the end of the discussion, could possibly be accountable for the low recurrence of the strategies *Seek disagreement* and *Be disinterested*, across both communication modalities. Once again, women's language in FO groups is the least impolite—and by the same token the most refined and polite—compared to the language used in MO and MIX groups (see Table 5).

A close examination of the frequency distribution of the positive and negative output strategies across both communication modalities reveals that male and female participants alike seem to be less confrontational and aggressive in online communication. This finding is in discord with the mainstream assumption that online anonymity[11] reduces social accountability and makes it easier for online interactants to express themselves more openly and engage in more disrespectful and hostile conduct (see Danet et al., 1997; Suler, 2004).

[11] Each participant in this study was assigned a pseudonym for the sake of hiding his/her identity from the rest of the participants.

Satisfaction Levels Across Groups and Modes of Communication

A two-way analysis of variance (ANOVA) indicates that the independent variables *group composition* ($F(2) = 2.751$, $p > 0.05$) and *communication modality* ($F(1) = .175$, $p > 0.05$) do not seem to significantly affect the level of (dis)satisfaction expressed by the participants in the post-discussion 7-likert scale questionnaire. These results therefore do not validate the hypothesis that male and female undergraduates show most satisfaction with the discussion process in single-gendered than in mixed-gendered groups across both communication modalities (see Table 6).

Table 6: Two-way ANOVA of satisfaction levels by group composition and communication modality

Source	*df*	*SS*	*MS*	*F*	*p*
Group composition	2	5.250	2.625	2.751	0.88
Communication modality	1	.167	.167	.175	.680
Total	24	818.000			

Overall, with the exception of two MIX group participants who felt neither satisfied nor dissatisfied with the experiment, the remaining twenty-two participants expressed their satisfaction (in part or in full) with the discussion process and the general agreement they reached, regardless of the communication modality and the gender composition of the group to which they had been assigned (see Figure 2). These results, nonetheless, are in discord with Savicki et al.'s (1996c) observation that FO groups are significantly more satisfied with the group discussion experiment than either MO or MIX groups.

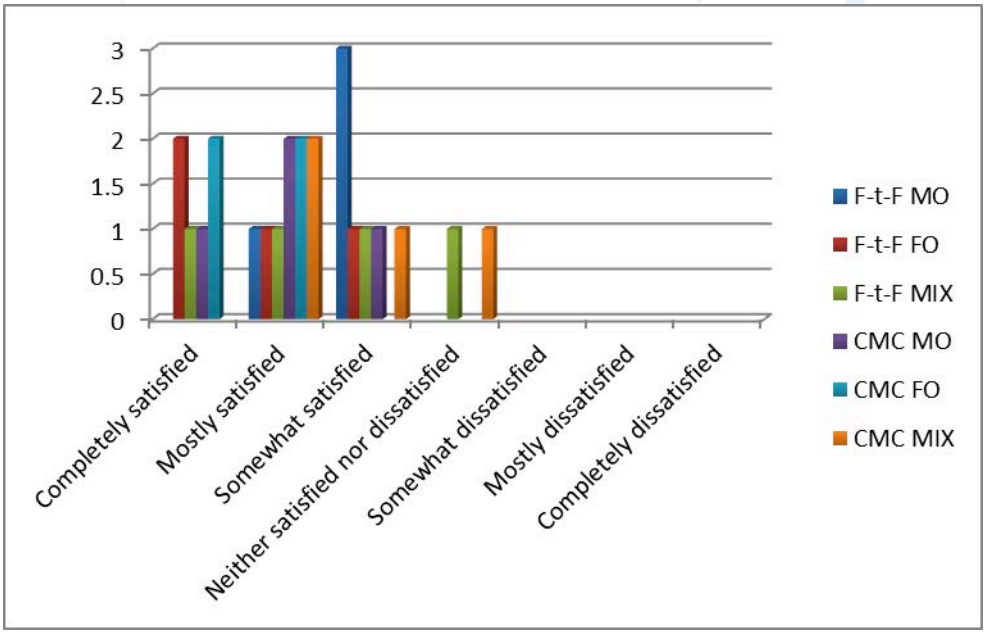

Figure 2: Satisfaction levels across groups and modes of communication

Worthy of note is that such inconsistency cannot be judged as the product of the interference of one particular variable, while turning a blind eye to a whole range of other contextual variables that may equally be suspected of influencing participants'

linguistic choices. Moreover, the set of norms regulating the CofP of Tunisian undergraduates may differ considerably from the norms recognized by the CofP of the American undergraduates studied by Savicki et al (1996c). This is because each CofP has its local norms of conduct more or less influenced by the communal values, beliefs and even stereotypes existing in the larger social and cultural contexts (see Eckert and McConnell-Ginet, 1992). Accordingly, the overall level of satisfaction among the participants may in part be ascribed to the mutual sense of respect among Tunisian undergraduates, such as not to discriminate against each other along gender lines.

Conclusion

This study has revealed that gender plays a major role in the way Tunisian undergraduates make their linguistic choices while discussing a problem-solving task. Across F-t-F and CMC communication modalities, FO groups are remarkably governed by polite, friendly, and supportive exchanges—even though they occasionally make use of some strategies of impoliteness. However, this does not deny that MO groups are by far more confrontational and upfront in their exchanges, as evidenced in the statistical findings. Moreover, as expected for mixed groups in either modality, male and female participants adapt their linguistic choices in such a way as to become less sex-role stereotyped and more supportive of the opposite gender's linguistic choices.

It has also been shown that, in line with the constructionist view, gender composition and mode of communication alone cannot be fully accountable for the linguistic decisions undergraduates make in their discussions, mainly because a plethora of other contextual variables may more or less interfere in such decisions. As the interconnectedness of gender with its surrounding contextual variables may render the process of making broad generalizations hard to implement, the CofP approach has been deployed to keep any generalizations obtained relative to the community of Tunisian undergraduates only. As such, the extent to which a speech act is deemed appropriate or inappropriate in the context of discussing a problem-solving task is largely contingent on the system of values and beliefs typical of that particular CofP.

Finally, it has been shown that, regardless of the communication modality and the gender composition of the group to which they had been assigned, all participants expressed their satisfaction with the experiment. This result, nonetheless, is but a preliminary step towards understanding the conditions in small task groups that can improve Tunisian undergraduates' learning experience. Further research, therefore, needs to consider controlling for other contextual variables (such as other types of tasks) to better learn about which group discussion conditions are more appealing for both genders.

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Student Perceptions of Using Blended Learning in Secondary Science

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
Australian school student participation in senior science subjects has declined over the last 20 years. A recent report from the Office of the Chief Scientist (2014) discussed the pedagogical approach of Australian science teachers as an area of concern. As *blended learning* is one pedagogical approach to improved student engagement, this study investigated student perceptions on the use of a blended learning approach when teaching the Australian Year 10 Earth Science curriculum. Blended learning integrates online teaching and face-to-face (classroom) teaching. The study was conducted with two Year 10 Science classes at an independent, state school in Far North Queensland, Australia. Online components were available to students using the learning management system Blackboard® as it is the preferred system supported by the state education system in Queensland.

This paper reports on a mixed methods analysis comprising both quantitative and qualitative data sources to describe aspects of blended learning the Year 10 students perceived as barriers and benefits. The study also investigated students' motivation for using eLearning within a blended learning pedagogy and opportunities for improved student engagement. This study contributes to our understanding of factors affecting students' engagement in secondary science, and the results illuminate some of the key aspects of a successful blended learning approach to teaching science.

Keywords: blended learning, pedagogies, secondary science, Australian Curriculum, Earth Science, student engagement, web-based learning

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Introduction

Several studies link the decline in post-compulsory science education in Australian secondary schools to a decline in student engagement with science in the junior secondary school (i.e. students aged 12-16) (Ainley, Kos, & Nicholas, 2008; Goodrum, Druhan, & Abbs, 2012; Lyons & Quinn, 2010; Office of the Chief Scientist, 2012). Researchers have proposed a number of measures to address declining engagement and enrolment in secondary science (Ainley et al., 2008; Goodrum et al., 2012; Lyons & Quinn, 2010; Tytler, Osborne, Williams, Tytler, & Clark, 2008). These recommendations can be summarized as: (1) improved curriculum content; (2) improved teacher quality and expertise; and (3) enhanced focus and flexibility of enacted science pedagogies.

Australian Federal Government reforms to develop a national science curriculum and implement coherent professional standards for teachers address the first two recommendations. The new Australian Curriculum for Science in 2012 addressed gaps in the curriculum, specifically the inclusion of the *Science as a Human Endeavour* strand, which connects science learning to everyday life (ACARA, 2013). The Australian Government addressed national teacher quality by establishing the Australian Institute for Teaching and School Leadership (AITSL) in 2010, and introducing policies such as the *Smarter Schools National Partnership for Teacher Quality* (AITSL, 2015). While both policies include statements on the use of Information and Communication Technology (ICT), guidance on a specific pedagogical approach to ICT integration is not included. Our research seeks to understand approaches that junior secondary science teachers can use to embed ICT to improve the flexibility of their pedagogy.

Using technology in science teaching has many benefits (Guzey & Roehrig, 2012; Hayes, 2007; Lee & Tsai, 2013). Online learning has been shown to improve student attitudes and achievement in secondary science (Chandra & Watters, 2012; Lee, Linn, Varma, & Liu, 2010; Sun & Looi, 2013); create opportunities for collaborative learning (Rosen & Nelson, 2008); and increase student engagement as a critical step to improving science pedagogy (Lyons & Quinn, 2010). For Chandra and Watters (2012), the success of online learning is linked to facilitating individual coaching, scaffolding, modelling, and more effective questioning. However, research also shows computer use is not always well integrated into classroom teaching and learning (Donnelly, McGarr, & O'Reilly, 2011; Goodrum et al., 2012; Hayes, 2007; Webb, 2013). In their report on *The Status and Quality of Year 11 and 12 Science in Australian Schools*, Goodrum et al. (2012) found the transmission model for teaching science still prevails, and 73% of science students still spend a significant amount of their time copying notes from the teacher. Also, students reported they had little choice in pursuing areas of interest, and that practical work tended to be 'recipe based' with students asked to follow a set of instructions rather than embarking on true inquiry.

Blended learning is one successful approach to integrating technology, including mobile technologies, into standard classrooms (Moskal, Dziuban, & Hartman, 2013). For the purposes of this study, blended learning is defined as a pedagogical approach that explicitly integrates online and face-to-face learning, and where students have meaningful interactions with their teacher with and without the mediation of

electronic technology (Waha & Davis, 2014). Blended learning can provide a more personalized and student-centred learning experience while still allowing students to readily access teacher support (Boulton, 2008; Staker & Horn, 2012). However, the challenge of blended learning is to create well-designed and organized content that maintains students' motivation and strengthens their time management skills (Barbour, 2008).

Quasi-experimental comparisons of traditional and blended learning favour a blended learning approach in secondary science (Chandra & Briskey, 2012; Chandra & Watters, 2012; Yapici & Akbayin, 2012). Although the majority of published research has been conducted within university settings, similar studies within secondary school mathematics and science classrooms indicate promising directions for higher student achievement and engagement (Chandra & Briskey, 2012; Chandra & Watters, 2012; Yapici & Akbayin, 2012). A case study on the effects of blended learning within four year 9 Turkish biology classes, where two classes received non-blended teaching, and two classes received online blended learning, showed increased achievements for students in the blended learning classes compared to those taught using the standard method (Yapici & Akbayin, 2012). Chandra and Watters (2012) conducted a study with Year 10 physics students to find blended learning had a positive impact on student's attitudes towards studying physics. Chandra and Briskey (2012) compared pedagogies in secondary school mathematics and showed that students participating in blended learning performed better and were more engaged. However, a blended learning approach is not equally engaging for all students and may be influenced by preferred learning style (Chandra & Briskey, 2012). Other studies investigating the use of a blended learning approach in different secondary subjects reported similar improvements in student achievement (Psycharis, Chalatxoglidis, & Kalogiannakis, 2013; Wan & Nicholas, 2010).

The initial successes led researchers to further explore the effect of different models of blended learning. Cheung and Hew (2011) investigated two models in a university setting. The first model was based on the GNOSIS framework to "integrate constructive and didactic instruction approaches"(Cheung & Hew, 2011, p. 1321). Their second model was based Blooms taxonomy (remembering, understanding, applying, analysing, evaluating, and creating). This research allowed useful insights into theoretical constructs supportive of blended learning, however these models were very labour intensive, reducing the potential for a high level of uptake in classrooms. Chen (2012) investigated two simplified models with primary school students, online plus peer interaction, and online plus student-teacher interaction. While noting improved student achievement overall, there was no significant difference between the two models of blended learning. In terms of the optimal balance of online versus face-to-face instruction, we found only one study that dealt with this matter. Chou, Chuang, and Zheng (2013) researched varying ratios of face-to-face to online teaching, and found that a time ratio of 2:1 was optimal. Effective blended learning must incorporate a robust pedagogical framework, a well-developed web interface, combined with an appropriate balance of online time versus face-to-face instruction and it is clear that further research is needed.

There is consensus that, when designed in conjunction with good teaching practices, blended learning can contribute to improved student achievements and engagement (Calderon, Ginsberg, & Ciabocchi, 2012; Chandra & Briskey, 2012; Chandra &

Fisher, 2009; Chandra & Watters, 2012; López-Pérez, Pérez-López, & Rodríguez-Ariza, 2011; Pina, 2012; Yapici & Akbayin, 2012). Improving student engagement is a key factor in improving enrolments and achievement in secondary school science.

Methodology

The aim of this study was to investigate student perceptions of a blended learning approach to teaching secondary science. To achieve this, our primary research questions were: What aspects of blended learning are important to students? What are students' attitudes towards blended learning? What aspects of online learning do students prefer? How does blended learning influence student engagement in secondary science? This study adopted a descriptive case study methodology to investigate these questions. The study was conducted in a suburban state high school (Grades 8-12), pseudo-named FNQ High School. FNQ High School is located in a culturally diverse community in Far North Queensland in a city with a population of approximately 157,000 residents. During the study, 891 students were enrolled at FNQ High School, 48% females and 52% males, with 10% of the student population identifying as Aboriginal or Torres Strait Islander and 10% of students indicating they had a language background other than English.

Two Year 10 science classes from FNQ State High School participated in this study. Year 10 science is a compulsory subject, and students are assigned to classes based on their results from Year 9 science. There were 52 participating students, 35% female and 65% male, aged 15 and 16 years. The study was conducted over one, ten-week school term during which students studied a unit on Earth and Space Science from the Australian Curriculum. A blended learning approach was designed for this study. Students accessed online content and activities using the Blackboard® learning management system available through Education Queensland's Learning Place.

The GRR Pedagogical Approach Explained

Lyons and Quinn (2010) argue engaging and inclusive science teaching is more valued by students. Carter et al. (2012) found that students perform well in learning situations that promote competence, engender autonomy, and encourage relatedness. One pedagogical model that incorporates these criteria and provides balance between Direct and Inquiry-based teaching is the *Gradual Release of Responsibility* (GRR) model (Fischer & Frey, 2003; Fisher & Frey, 2008).

The GRR model has its origins in research on meaningful cognitive processing by Rosenshine (1995), who described three key instructional implications from his research: "(a) the need to help students develop background knowledge (b) the importance of student processing (engender autonomy), and (c) the importance of organizers" (p.262). These principles are incorporated in the GRR model for teaching (Maynes, Julien-Schultz, & Dunn, 2010). Using the GRR model, new information is presented and learned in three phases: firstly, the teacher explains new information, the *I Do* stage; secondly, the teacher works with students through guided practice, the *We Do* stage; and thirdly, the students gradually work towards independence, the *You Do* stage. The first two phases of the GRR model are clearly Direct Instruction techniques, however, the last phase presents opportunities for incorporating inquiry-learning principles, enabling students to construct their own understanding.

The theoretical foundation for the *I Do* phase of the GRR model is based on Vygotsky's Zone of Proximal Development - the difference between what a child may learn on their own and what they can learn with guidance, including scaffolding (Wood, Bruner, & Ross, 1976). Scaffolding is a teaching strategy to stimulate a "child's interest in the task, establishing and maintaining an orientation towards task-relevant goals, highlighting critical features of the task that the child might overlook, demonstrating how to achieve goals, and helping to control frustration" (Wood & Wood, 1996, p. 5). Maynes et al. (2010) identify the *I Do* phase as motivation, modelling/ remodelling, and structured consolidation. The *I Do* phase is the opportunity for teachers to explicitly set out learning goals and explain key ideas and concepts.

In the *We Do* phase of the GRR model, teachers provide guided instruction to establish expectations and provide support for students to meet those expectations (Fisher & Frey, 2008). This phase of the GRR model emerges from Piaget's work on cognitive structures and schema. Piaget emphasized listening to children, "valuing their stage of learning and thinking and ensuring learning activities are developmentally appropriate" (Groundwater-Smith, Le Cornu, & Ewing, 1998, p. 80). More recent developments of cognitive learning theory are that, as people learn, new information is organised and stored, allowing the learner to more readily access the knowledge when required (Groundwater-Smith et al., 1998). Well-connected and elaborate knowledge structures enable easier retrieval of old material, allows more information to be carried in a single chunk, and facilitates integration of new information (Rosenshine, 1995). The supported practice of the *We Do* phase assists students in developing familiar pathways and improving their ability to access this information at a later date.

According to Fisher and Frey (2008) the *You Do* phase of the GRR model is better divided into two sub-phases, *You do it together*, and *You do it alone* where students have the opportunity to apply new knowledge to a new situation. In a science classroom, this means student-centred inquiry learning, such as an individual or group designed experimental investigation. The *You Do* phase is founded on Social Learning Theory (Bandura, 1977) and more recent work on personal constructivist approaches that emphasize the importance of internal reflection in the learning process. The *We Do* phase emerges from a social constructivist perspective, emphasising the importance of the social context and collaboration between peers in developing a deeper understanding. The *You Do* phase focuses the active role of the learner in building understanding and can provide an opportunity for students to construct their knowledge independently and in collaboration with peers.

A goal of any science curriculum is to develop students' scientific inquiry skills, as well as science understandings (ACARA, 2013). One of the key aspects of science education is teaching student how to pose questions and use evidence to draw valid conclusions. To achieve this, many science teachers implement some form of an Inquiry-Based teaching pedagogy. Research by Tytler, Haslam, Prain, and Hubber (2009) showed the benefits of explicitly teaching some aspects of the science curriculum, while also providing means for students to undertake inquiry learning. The GRR model is a viable approach to teaching science inclusive of both direct and inquiry-based instruction. The GRR was chosen as the pedagogical approach for this study.

The researchers modified the Year 10 Earth and Space Science program based on the Australian Curriculum (ACARA, 2013) according to the GRR model. The unit was covered in 10 weeks with three, 70 minute lessons per week. Each lesson followed the GRR model where students received a teacher directed consolidation of the previous lesson, followed by a short explanation of the key topics for the lesson (*I Do*). Students then accessed online learning materials through the subject website which they worked through in small groups with teacher assistance (*We Do*), or individually (*You Do).* Online learning materials were developed in Blackboard®, and included video clips, reading comprehension exercises, interactive learning objects, discussion board tasks, and a short quiz at the end of each lesson.

Data Collection

Student perceptions of online learning were investigated using a written survey and focus group interviews. The Web-based Learning Environment Instrument (WEBLEI) (Chandra, 2004; Chang & Fisher, 2003) was chosen to gather perception data. The Web-based Learning Environment Instrument (WEBLEI) was developed by Chang and Fisher (2003) to gather quantitative data about undergraduate and graduate students perceptions of web-based learning environments. Chandra (2004) modified the WEBLEI for use in a secondary classroom setting. The WEBLEI contains four scales, Access, Interaction, Response and Results. The WEBLEI has eight questions for each of the four scales, where participants respond using a Likert scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). The first three scales are based on the work of Tobin (1998), and aim to describe students perceptions of emancipatory activities, co-participatory activities, and qualia (e.g. interest, curiosity, enjoyment, satisfaction) in an online learning environment. The fourth scale, results, focuses on the structure and delivery of the online material. Ten short response questions were also included in the WEBLEI to give student the opportunity to more clearly articulate their perceptions. Students completed the WEBLEI questionnaire at the conclusion of the course, once they had completed all assessment and received their results. The data from the Likert scale questions were converted to numerical values: strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2, strongly disagree = 1. Descriptive statistics including mean, mode and standard deviation were calculated using SPSS 22. The Cronbach's alpha was also calculated to measure the internal consistency of each of the four WEBLEI scales

Focus group interviews were conducted to further investigate student experiences of participating in blended learning. Focus group interviews were conducted two weeks after students had completed the unit. Two, 45 minute group interview sessions were conducted with 5 students from each class. The interviews were semi-structured with all participants given an opportunity to respond and comment. The interviews were recorded, transcribed and then coded in NVIVO using the four WEBLEI scales Access, Interaction, Response and Results.

Results and Discussion

The results are presented using the four scales from the WEBLEI questionnaire, Access, Interaction, Response and Results. A total of 52 students participated in this study, 29 students completed the WEBLEI questionnaire, and 10 students participated in the focus group interviews. Overall, the Gradual Release of Responsibility model proved appropriate in this context for developing a blended learning approach in two Year 10 secondary science classrooms.

Reliability

Cronbach alpha reliability coefficients were calculated to measure the internal consistency of each of the four WEBLEI scales. The accepted cut-off for Cronbach's alpha in social science research is .70 or higher (Rovai, Baker, & Ponton, 2013). Cronbach's alphas for the four scales Access, Interaction, Response and Results were .89, .68, .80 and .91, respectively. Although the reliability of the Interaction scale is slightly below the cut off, the results of the scale can be considered relevant, and some research has advocated a lower cut-off of 0.60 (Chandra, 2004; Chang & Fisher, 2003).

Student Perceptions

The mean and standard deviation for each scale of the WEBLEI are presented in Table 1. The results were highest for the Access scale (M = 3.86, SD=0.74), and lowest for the Response scale (M=3.36, SD=0.65).

Table 1: Mean and Standard Deviations for the Four scales for student responses to the WEBLEI

WEBLEI Scales	Descriptive Statistics			Cronbach's Alpha
	N	Mean	Standard Deviation	
ACCESS	29	3.86	0.74	0.89
INTERACTION	29	3.55	0.54	0.68
RESPONSE	29	3.36	0.65	0.80
RESULTS	29	3.64	0.73	0.91

The Access scale measured students' perceptions of emancipatory activities within the blended learning environment. Overall, the mean for the Access scale was the highest of the four scales, (M=3.86, SD=0.74), and indicates students perceived the online learning environment provided convenient, accessible, independent and flexible learning opportunities. Students were particularly positive about the accessibility of the lessons and the ability to access work outside of class times, with 90% of participants agreeing that the lessons on the internet were available at locations suitable for them. This was further supported by data from focus group interviews.

> Heather (pseudonym): It teaches a more independent way of learning and it's good for kids that have been away, they can catch up on the work from the day.

> Brenda (pseudonym): You can learn at your own pace, prioritise specific things to learn, catch up at home on missed lessons, revise other passed lessons, and access online text-books.

Fifty-two per cent (52%) of students agreed blended learning allowed them more opportunity to explore their own areas of interest.

> Terry (pseudonym): I feel like I learned more then what I would have if I had just done it with the teacher in the class, because I was able to branch off of the things that interested me and that I wanted to learn.

The Interaction scale measured students' perceptions of co-participatory activities. A mean of 3.55 (*SD* = 0.54) for the Interaction scale suggested a small amount of agreement with the items in this scale. However, a more detailed analyses of the results showed this mean is strongly influenced by Question 9, "I communicate with my teacher in this subject electronically via email", where the mode of students responses was 'disagree'. By contrast, the mode of student's responses to Question 11, "I have the option to ask my teacher what I do not understand by sending an email", was 'agree'. The mode response to Question 12, "I feel comfortable asking my teacher questions via email", was 'agree'. While students agreed that they could send an email to their teacher, the majority did not choose to do so.

Focus group data also indicate a preference for more direct teacher interaction and instruction.

> Terry (pseudonym): It's better having a teacher up at the front teaching you and going over the stuff instead of having each lesson [online] to do.

> Wendy (pseudonym): I feel like a whole lesson with the teacher is interactive. You get to ask questions and you get to have class discussions about it. I feel like that's interactive enough, we don't need a computer and then specific interactive activities, I feel like I would prefer just the teacher.

However, there was some indication that students' unfamiliarity with online learning was an important factor in this study.

> Karen (pseudonym): I do think [maturity] is a pretty big factor because this is the first time we've really had this much independence with something online … and I think in order for [online learning] to work you would need to introduce it probably in year 6 or 7, in primary schools, so you got used to it throughout, because it will be something in university and probably senior schooling as well that we will need to get used to and being independent is pretty important."

The third scale, Response, measured students' perceptions of qualia such as enjoyment and confidence. The majority of students, 62% indicated they learned more with blended learning and 55% indicated they enjoyed learning in this modality. The mean result for the WEBLEI Response scale was 3.36 (SD= 0.65, Table 1) - the lowest mean of the four scales. Year 10 students had varied opinions of the blended learning approach in terms of their expressed satisfaction, interest and enjoyment.

Questions 17, 21, and 22 investigated student perceptions of their ability to work with other students in the class, and Questions 18, 19, 20, 23 and 24 investigated student enjoyment and interest. A majority of students generally enjoyed learning with using a blended learning approach as 55% of respondents agreed or strongly agreed, 31% neither agreed nor disagreed, and 14% disagreed or strongly disagreed. The novelty of blended learning may have played a role. And some students do prefer a teacher-centered approach and directed instruction. The comments show a mixed response.

> Robert (pseudonym): Some people find (online) learning easier, but others find internet learning a lot more complicated and it can get confusing, so those people fall behind.
>
> Tim (pseudonym): eLearn didn't really improve my results in science because it is hard to focus when you are just using the internet. I learn better when a teacher is telling me what to do.
>
> Karen (pseudonym): I believe it is a good idea with plenty of potential. Easier access and ability to search for alternate resources.
>
> Ben (pseudonym): I do think that eLearn has improved my results in this subject as I learned at my own pace and got to choose what elements of the topic to prioritize when revising.
>
> Daniel (pseudonym): I think it improved my learning where I think the in class teaching may have been slower to keep everyone at an even pace, but because of elearning I learnt more things that I would have in class because I used the resources I had to get a better mark on the test.

The mean for the Results scale was 3.64 (*SD* = 0.73, see Table 1), indicating students were satisfied with the structure and delivery of the online learning component. The mode for student responses in this scale was 4 (agree) for all questions. The majority of students (83%) said the organisation of each online lesson was easy to follow and 69% perceived online lessons help them better understand the content taught in class. The online content was easy for students to follow, and well sequenced. Students were particularly positive about the online, multiple-choice review quizzes at the end of lessons, as indicated in focus group interviews.

> Tim (pseudonym): The lesson quizzes helped me get better at the subject because it made me rethink what I had already learnt.
>
> Megan (pseudonym): The quizzes were good to test our knowledge and to help us improve.
>
> Bob (pseudonym): The lesson quizzes were very useful in terms of helping me understand the lesson

Conclusion

This aim of this study was to investigate student perceptions of a blended learning approach to teaching secondary Earth & Space science. The results show that students

were generally positive about the blended learning approach, particularly as to the design and development of the curriculum unit. The results support the use of the Gradual Release of Responsibility (GRR) model, as these Year 10 students still preferred a high level of teacher support. This classroom study suggests blending learning can be one approach to increasing student engagement and success in secondary science The GRR model is useful for designing a blended learning approach.

The current task for science teachers is to increase student perceptions of and engagement with Years 7 to 10 science. Improving student's perceptions of science as a career option are linked to meaningful and valued experiences in junior secondary science. This research illustrates the potential of the GRR model, and how ICT integration in secondary science through blended learning has instructional possibilities.

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Collaborative Work and ICT Tools Enabling Science Teaching and Learning in a Cross-Border Context

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract

The collaboration and cross-border communication of 14–16-year-old students from Sweden and Denmark working with various science assignments using ICT was followed in an action-influenced project. The students collaborated in a complex learning context, including searching for information, planning, executing, and reporting experiments, posing questions, collecting facts, and communicating, using the Internet, shared documents and presentations, Blog, Skype, and Adobe Connect. The a synchronous ICT communication tools used in the project enabled the teachers to include information and instructions for the students in the documents as well as following the students work online. The synchronous communication tools were important for the students to get to know each other and make friends. Most of the student groups were successful in using the ICTs provided, in executing the experiments, communicating, and sharing information. Generally the students appreciated the possibility of working with fellow students from another country; they showed good ability to work autonomously, collaborate, and communicate about science issues. The ICT tool that were most popular among the students were Google docs and Skype. The complex learning situations created within the project enabled the students to interact regardless of physical borders and to train in important key competences such as using scientific methods, developing digital skills, and communicating in the mother tongue as well as in foreign languages.

Keywords: Science education, cross-border collaboration, ICT, communication, designed learning situation, key competences

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Introduction

The use of ICT in teaching and learning is increasing worldwide. The Nordic schools are among the most well equipped in the world regarding ICT infrastructure, and the teachers' and students' access to ICT at school is generally high (Wastiau, Blamire, Kearney, Quittre, Van de Gaer & Monseur, 2013). However, the use of ICTs varies among different subjects, and in subjects such as science and mathematics, the use of ICT is generally quite low (Skolverket, 2013; Hatlevik, Egeberg, Björk Guðmundsdóttir, Loftsgarden & Loi, 2013). In this paper we report about a number of complex learning situations addressing a range of collaborative science tasks using various ICT tools engaging Swedish and Danish students in synchronous and asynchronous cross-border communication. Our aim is to observe how the ICTs in general and the shared documents in particular are used by teachers and students to collaborate and communicate about science and to evaluate the pros and cons with the different ICTs used for science teaching and learning.

The GNU-Project

The GNU-project, the abbreviation for Gränsöverskridande Nordisk Undervisning (Cross-Border Nordic Education), is a cross-border action-research-inspired project where teachers and researchers co-design collaborative pedagogical teaching models using digital technology for Swedish, Danish, and Norwegian students. A keystone in the project is that the cross-border teaching models that are developed within the project should be user-driven, practice-based, and co-designed by practitioners and researchers. Within the project, novel teaching models in the four school subjects of native language, mathematics, social sciences, and natural sciences have been developed and tested during 2012–2014. Nordic curricula share similarities in these subjects, thus creating structural possibilities for the teachers to plan and implement cross-border collaboration lessons without great problems (Pareto, Gynther, Lindhart, Spante, Vejbeæk & Wølner, 2013; Spante, Karlsen, Nortvig & Christiansen, 2013; Johansson-Svensson, Rustand, Steffensen & Sofkova Hashemi, 2013; Svedäng, Kinnerup, Andersson, Eriksen & Braaten 2015, http://projektgnu.eu/). In the GNU-project, the teachers, students, and researchers have communicated in their own languages: Swedish, Danish, and Norwegian. Thus one of the big challenges for all participants in the project has been to understand each other's related, yet quite different, languages. In this paper we focus on the science cross-border activities that took place within the GNU-project during 2012–2014, when students in two Swedish classes cooperated in a cross-border environment with two Danish classes.

Cross-Border Science

Digital technology has the potential to reduce the physical boundaries in science education and to facilitate the individual's participation in extended networks and interactive learning experiences online. Examples of ICT-mediated cross-border science work include digital collaborative learning environments enabling students to collaborate and perform experiments in remote laboratories (van Joolingen, de Jong, Lazonder, Savelsbergh & Manlove, 2004), to conduct asynchronous interactions online in asynchronous learning networks (Zion, Michalsky & Mevarech 2005), and to participate in virtual learning communities set up on Wikispaces (Chia & Pritchard 2014), as well as to implement video-channel educational tools in combination with

online spaces for shared multimedia (Torres-Ramírez, García-Domingo, Aguilera & de la Casa, 2014).

The findings from the different ICT-based cross-border science learning situations referred to above are mainly positive. For instance, Chia and Pritchard (2014) reported from the cross-border scientific research collaboration between 16-year-old students from Singapore and the United States that the students participating in the project found the virtual learning community useful for their collaboration and that the exchanges on the platform positively impacted them in cognitive, intellectual, and interpersonal aspects. Zion and colleagues (2005) found that students from different schools in Israel who used asynchronous learning networks when studying biology developed better scientific enquiry skills and understanding than students discussing and solving problems face-to-face. They concluded that this result probably was due to the fact that written communication was used in the interaction, which gave opportunities for the students to review the written parts of the communication and thus engage in metacognitive activities (Zion et al 2005).

Thus, ICTs can certainly serve as useful tools for communicating, teaching, and learning science. In this paper we report on a number of joint Swedish-Danish science learning sessions within the GNU-project involving complex learning contexts where many different skills, such as communication, collaboration, scientific method, ICT use, and the like, are taught simultaneously.

Aim

The aim of this study is to investigate how teachers and students involved in the project dealt with a number of designed learning situations, including autonomous practical and theoretical science work, use of different ICTs, and cross-border communication and collaboration. The focus of the study is to find out which ICT tools are chosen among the ICTs available to teach and learn science in the different sessions of the project. We also want to observe how the ICT tools are used, study which ICT tools are preferred by the participants in the project, and evaluate different learning outcomes.

Method

This study is a design and action-research-based case study (Majgaard, Misfeldt & Nielsen 2011) combining different qualitative research methods. Classroom observations of the cross-border communication and collaboration through different synchronous and asynchronous methods were combined with analysis of the students' shared documents and shared presentations, and of the films they produced. This was done to enable the collection of data to provide the authors with a comprehensive understanding of how the teachers implemented assignments and instructions for the students, and how the students used the different ICTs provided to communicate, collaborate, and solve the different science tasks assigned to them.
To evaluate the collaboration and learning outcomes and to find out the students´opinions about participating in the project, we gathered information from group interviews and written evaluations at the end of the different science sessions.
The rationale for this multi-method approach was linked to the aim of the study, that is, to investigate and analyse how a designed learning situation based on cross-border

collaboration and communication regarding different science topics could be implemented, and hopefully to enhance students' motivation and scientific literacy.
Because the GNU science project is action-research-influenced (Dick, Stringer & Huxham, 2009, Majgaard et al 2011), the teachers and researchers planned and developed the project collaboratively during the 2.5 years the project was running. They met each year to plan collectively which science topics would be addressed and to draw up general guidelines and goals for the teachers' and students' collaborations. The first and third meetings took place as actual face-to-face meetings in Sweden, while the second was organized as an online videoconference. During each of the three planning meetings, the teachers and the researchers discussed and compared the science curricula in Sweden and Denmark and decided on common topics covering typical goals for the science subject in the countries. Practical issues, teaching models, and ICT tools available were also discussed, and which forms of ICT would be used were collectively decided.

The first two classes participating in the project (a Swedish and a Danish eight-grade class, 14–15 years old) finished secondary school/ninth-grade in spring 2013 and were replaced by two new eighth-grade classes in fall 2013. From the Swedish school the same teacher participated during the entire project; in Denmark, the first teacher to join in the project retired in spring 2013 and was replaced by two new Danish teachers in fall 2013.

Results

The overall impression after the science part of the GNU-project was finished is that in spite of the project encountering quite a lot of technical and other problems, it certainly was successful in implementing several novel teaching and learning methods which involved different learning outcomes such as science content learning, increased communication and collaboration skills, increased ICT skills, and increased ability to communicate in native and foreign languages. The teachers and the students found it interesting and stimulating to meet and collaborate with friends from another country and to use ICTs to communicate.

Science Topics and ICT Tools

During the 2.5 years the project was running, five separate sessions with complex learning situations were set up, addressing a number of different science topics and using a variety of ICT tools (Table 1). Shared documents were used for asynchronous communication in most sessions of the project, enabling teachers and researchers to follow, give written instructions, and occasionally comment upon the students' work with the different tasks.

Session	Grade	Science Topic	ICT tools used
Spring 2012	8	Meteorology	Blog, Film (link in the blog), Skype
Fall 2012	9	The Properties of Water	Search for information on the Internet, Google Docs, Film (link in the shared document), Skype
Spring 2013	9	Environment and Wastes	Search for information on the Internet, Google Docs, Google presentation, Share links to websites in shared documents, Adobe Connect
Fall 2013	8	Organic chemistry	Google Docs, Film (link in the shared document), Skype
Spring 2014	8	Soil analysis	Google Docs, Google presentation, Skype, Oral presentation via Skype

Table 1. The science topics covered and the ICT tools used in the different sessions of the GNU science project.

The first science topic (spring 2012) addressed in the project was Meteorology. This was a pilot study to try out some ICT tools and enable the students to get to know one another. Student groups in the Swedish and the Danish class (14-15 years old) met online using Skype and shared meteorological data. The Swedish students produced a film presenting themselves and their school to the Danish students. The film was posted on the mutual blog.

In fall 2013 the student groups in the two classes (now in ninth-grade, 15-16 years old) studied different aspects of the properties of water, seeking out water experiments on the Internet and planning and exchanging ideas via Skype. Subsequently, the students executed and filmed the experiments they had selected, shared the films in the mutual blog, and reported and evaluated the experiments in shared documents and in Skype meetings.

In spring 2013 the two classes worked with environmental questions and waste management and sorting in Sweden and Denmark. The student groups posed questions to each other in the shared documents, discussed and compared waste management and sorting in the two countries, and made simple investigations about waste sorting/disposal habits by interviewing people at their schools. They answered each other's questions and presented their joint results in shared Google presentations. In fall 2013 two new classes—a Swedish and a Danish eighth-grade —joined the project because the two previous classes now had finished secondary school. The setup of the collaborative task assigned to the student groups was similar to the assignment realized in fall 2012—to seek out, plan, execute, film, and communicate science experiments; this time the experiments selected illustrated properties of carbon and organic chemistry.

The student groups in these two classes also cooperated in spring 2014 making soil analyses in different environments in Sweden and Denmark (coniferous forest, deciduous forest, agricultural land, etc.) and presenting their results in shared Google presentations. Some of the results were also reported orally to all classmates in both classes via Skype.

Teaching and Instruction

The evolution of the teachers' written instructions in the shared document during the project is shown in Table 2. Shared documents were used as a common platform for students, teachers, and researchers in all sessions in the GNU science project except in the pilot study, that is, from fall 2012. The sessions typically lasted for five weeks, with the students working with the project approximately two lessons per week. In general, the lessons were introduced by the teachers, who made a brief outline of the mission of the day, but after the introduction, the teacher assigned the students to work autonomously in their groups and was available only as a support when a group needed help during the rest of the lesson.

To use the shared documents as a platform for communication and instruction from the teacher to the students was a method that evolved during the project, and the instructions became more and more refined with time (Table 2.). The use of written instructions directly in the shared documents, as a complement to the oral instructions given when starting the lessons, was used from spring 2013. The last year the teachers also included the schedule in the shared documents, informing the students of the timetable for the project and when synchronous online meetings were planned. The teachers posed written evaluation questions in the shared documents, which the students answered by the end of each session (starting fall 2012).

Session	Shared document	Instruction in shared document	Time schedule in shared document	Evaluation in shared document	Questions in both languages (Swedish and Danish)
Spring 2012	No	-	-	No	-
Fall 2012	Yes	No	No	Yes	No
Spring 2013	Yes	Yes	No	Yes	Yes
Fall 2013	Yes	Yes	Yes	Yes	Yes
Spring 2014	Yes	Yes	Yes	Yes	Yes

Table 2. The evolution of the instructions from the teachers to the student groups in the shared documents.

The importance of frequent communication between the teachers and thorough planning cannot be underestimated in a complex project of this kind that involves teachers, students, and researchers in different countries. If the teachers had not agreed upon very distinct frames supporting the collaborative work between the student groups, the communication between the students encountered problems and sometimes failed. However, as the project evolved, the teachers realized the

importance of very clear outlines and instructions in the project, and the planning and instructions to the students improved. As one of the teachers put it:
The most important [part] for every project is that the teachers have planned well and that they give the same instructions to their students. (Teacher in written evaluation)

Learning outcomes

Classroom observations and analysis of the student reports in the shared documents and of the films produced by the students made it obvious that many different skills were developed during the project. Different types of scientific literacy—such as searching for and evaluating information, planning and making decisions, conducting practical work and communicating science— were clearly a part of the exit learning outcomes. Students were also trained in digital literacy in the form of handling and producing digital information in combination with collaboration and communicating skills.
When evaluating their work in the different sessions in the GNU science project, the students mentioned a number of experienced learning outcomes such as learning to handle new ICT tools and communicating in another language. The Swedish student groups emphasized scientific knowledge as an important learning outcome in the project, whereas the Danish student groups (which did not answer this question to as great an extent as the Swedes) stressed training in ICT and collaborative skills.

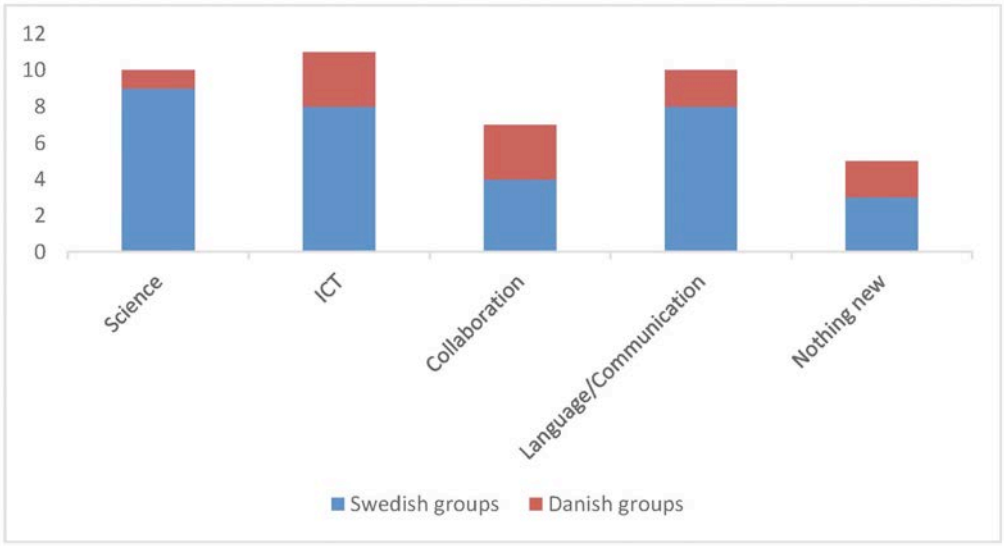

Figure 1. Students experienced learning outcomes in different areas.(y-axis: Number of student groups expressing experienced learning outcomes in a certain area in the shared documents)

Most of the student groups enjoyed participating in the project of learning science in an unusual way, involving collaborative work with fellow students in another country and using ICT. They especially appreciated the possibility of practicing cross-border communication and working autonomously with experiments.

It has been fun to talk a bit with another country and with someone speaking another language….It has been fun to do research about new stuff and to learn about different areas. It has been fun to be able to work more freely and more in [a] group than usual. (Swedish student group in written evaluation)

I think it has been thrilling to work together with the Swedes, since it has been a challenge to understand each other and work together in another language. (Danish student group in written evaluation) However, some student groups found it uninteresting to participate in the project and would have preferred to have "ordinary" science lessons instead. It has been thrilling to speak with another country, to see if we are working in the same way, but we think that the GNU (project) has been more non-serious than we had believed. (Danish student group in written evaluation).

Evaluation of the ICTs Used

During the project, technical problems occurred frequently, mainly because of an overload of the local broadband. The students, however, were patient and often managed to solve communication problems by, for example, using the chat function or sign language if the sound was failing when communicating via Skype or Adobe Connect. Due to technical problems especially when communicating synchronously, many student groups preferred to communicate asynchronously in the shared documents (Figure 2.).

In spite of some contact problems when using Adobe Connect and Skype, it is obvious that the students appreciated the real-time meetings and the possibility of seeing each other while communicating. The Swedish students were especially positive about using Skype as a tool to cooperate and communicate (Figure 2.).

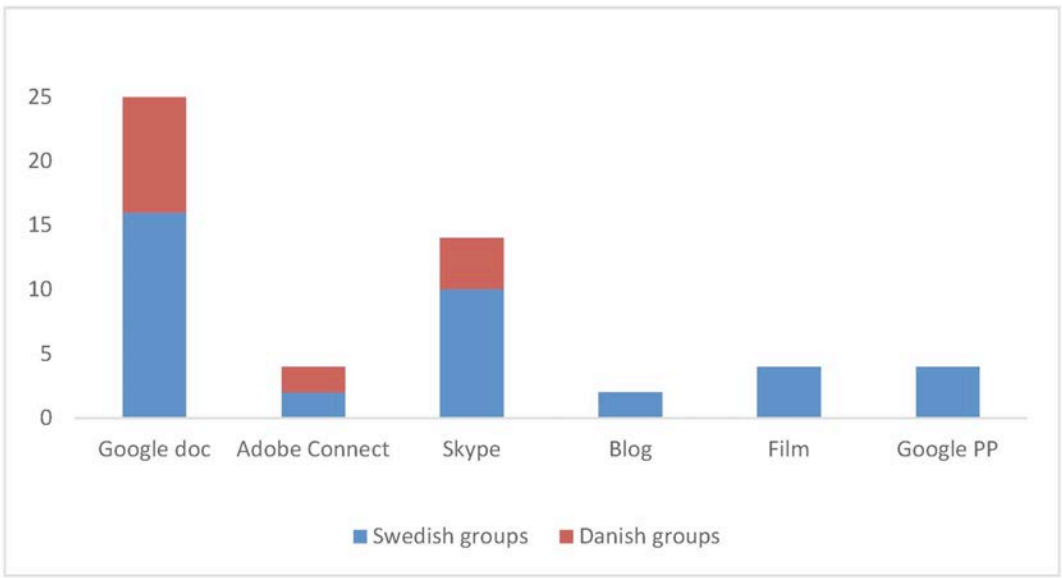

Figure 2. Positive experiences of ICT tools (y-axis: number of positive postings in the student groups' evaluations in shared documents)

Although the students were positive about the possibility of meeting and communicating with fellow students in another country, the technical problems understandably frustrated them at times. Thus, in spite of the student groups' positive attitude to the use of Skype, Skype is at the same time the ICT tool that rendered the most negative comments (Figure 3.). As can be seen when comparing Figure 1 and Figure 2, there are many more positive comments from the students than negative when evaluating the ICT tools used during the project.

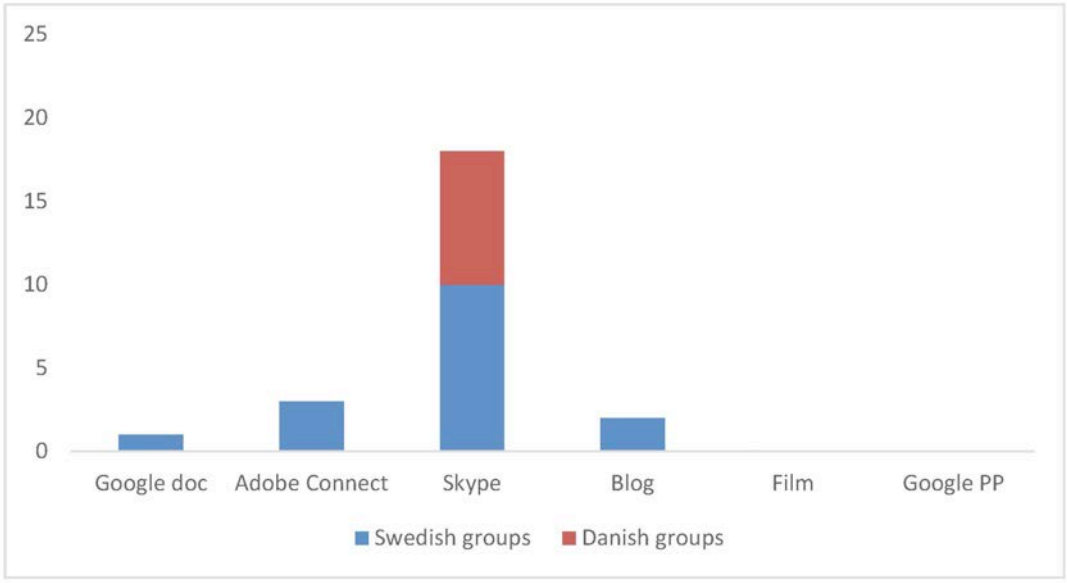

Figure 3. Negative experiences of ICT tools (y-axis: number of negative postings in the student groups' evaluations in shared documents)

The students' positive experiences with the different ICT tools used when learning and communicating science is consistent with the fact that the students stressed ICT learning as the most important learning outcome within the project (Figure 1).

Discussion

It is interesting to follow how the communication and the collaborative work evolved over time in the GNU science project. To launch a complex action-research-based project of this kind based on designed learning situations developed by teachers and researchers in collaboration, involving students from two different countries with similar, yet different languages, meeting online to work and learn together, is certainly a challenge for everyone involved. To successfully implement the different science learning sessions outlined in the project, it is crucial that the joint planning is thorough and clear and that the participants are committed and willing to reach out and communicate. The overall impression is that this was the case regarding both the teachers and the students involved in the project. Although encountering different

obstacles during the 2.5 years the project was running, the students were positive and certainly made their best effort to communicate and solve their tasks.

Key Competences

In the European Framework for Key Competences for Lifelong Learning, the EU council defines eight key competences considered to be required for personal fulfilment, active citizenship, and the like (Figel 2007). Among the key competences are, for instance, basic competences in science and technology, digital competence, learning to learn, and communication in the mother tongue and in foreign languages. These are all competences that certainly were well presented in the complex learning situations created within the GNU science project. Thus, while the collaborative tasks assigned to the students addressed different science topics, and the theoretical content they collectively produced in the project was exclusively about science, additional learning outcomes, some of them non-academic, constituted an important and desired goal in the project. The findings in this study coincide with the results of Chia and Pritchard (2014), who in their study of the cross-border collaboration by students from Singapore and the United States concluded that the use of a common online resource realized in Wikispace impacted the students positively in both academic and non-academic domains.

Collaborating using ICT

The students participating in the project showed good ICT skills, and the technical problems that emerged were almost solely due to insufficient broadband capacity. As stated earlier, schools in Sweden and Denmark are among the most technically well-equipped in Europe (Wastiau et al. 2013), ICT tools are common in several school subjects (Undervisningsministeriet, 2008, Skolverket 2013), and Swedish students' experience is that they are skilled at using ICTs (Skolverket 2013). Thus, a greater challenge to the students than handling the available ICTs was communicating and making themselves understood. Many student groups reported communication and language skills as learning outcomes in the project. Classroom observations revealed great willingness among the students to communicate, and they used many different modes of communication, such as body language, sign language, chat, and the like (Svedäng & Spante 2014).

Although the students greatly appreciated the possibility of meeting and communicating synchronously with each other, the shared documents were the most popular ICT tools among the students. This is understandable, because the shared documents were easy to use and did not suffer from technical problems. Chia and Pritchard (2014) reported that the students collaborating in the Singapore-US cross-border science project used the online working platform (the Wikispace) for joint planning of the collaborative work, data collection, and analysis of experimental data, and for discussing and drawing conclusions, which is similar to how the students in the GNU science project used the shared documents. Zion and colleagues (2005) found that students from different schools in Israel who communicated asynchronously when studying biology developed better scientific enquiry skills and understanding than students discussing and solving problems face-to-face. They suggested that this result probably was due to the fact that written communication was used in the interaction, which gave students opportunities to review the written parts

of the communication and thus engage in metacognitive activities. Thus, the use of asynchronous ICT communication tools such as Wikis and shared documents has many advantages, even though the synchronous communication is also important for the students to get to know each other and make friends.

Scientific Literacy and Attitudes

Attitudes towards science play an essential role in students' scientific literacy (Bybee & McCrae 2011), and it is crucial to understand the factors that influence student attitudes, engagement, and interest in science in order to be able to improve science education and increase scientific literacy. The situation in many countries today, however, is that the interest among students is decreasing and many students find science 'boring' (Osborne, Simon & Collins 2003; Spall, Stanisstreet, Dickson & Boyes, 2004). Previous research shows that students favour learning situations that include practical work, high levels of student involvement, interpersonal interactions, diverse methods, and challenging material (Fouts & Myers 1992; Osborne et al., 2003; Raved & Assaraf 2010; Hampten-Thompson & Bennett 2011), indicating that the way science lessons are organized and implemented is important for students' enjoyment of science and motivation to learn. The complex learning situations implemented in the GNU science project include many of these qualities—that is, the students have the opportunity to work autonomously, collaborate in groups, and use practical methods such as experiments and various types of ICT tools. Thus, we believe that this kind of designed learning situations may present the opportunity to improve the students' attitudes towards science, increase their interest, and, hopefully, also their scientific literacy.

Conclusion

After following the teachers and students collaborating in the GNU science project, we conclude that the students' learning outcomes, in addition to learning science content and methods, enabled the development of various highly useful skills such as ICT skills, communication skills, and collaboration skills. For successful implementation of the collaborative work between both teachers and students, thorough planning and clear instructions from the teachers to the students are essential.

The designed learning situations realized in the GNU science project can serve as an example of how science teaching and learning can be organized in a novel way, providing the opportunity for the students to train in many important skills as well as to improve their scientific literacy.

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Getting Students Ready for Distance Learning

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
There is a consensus among instructors in many Northwest colleges that students enroll in distance courses without knowing what they are getting into, which negatively correlates with their grades and overall satisfaction. The *Online Readiness* is an online course that was developed by Wenatchee Valley College to address this issue. The evidence-based outcomes of this course show that students have high satisfaction with this model, which goes beyond self-evaluation surveys and tutorials, to actually help students develop conceptual and practical skills they need to succeed in online courses. Similarly, the empirical analysis confirms the anticipated positive correlation between student success and online learning self-efficacy, with the same correlation for their self-reported preparedness levels. The next step forward is a longitudinal study to examine the impact of skill and knowledge transfer between the *Online Readiness course* and future online courses and across other learning environments.

Keywords: Online readiness, distance learning, learning outcomes, authentic assessment, information literacy, student support services.

Introduction

Students take distance courses because they are convenient and cost effective (Olakulehin and Panda 2011). Other students take them because they have an added value that meets their preferred learning style, program requirements, or their unique situations. On the other hand, there are common misperceptions that negatively affect their academic success (example: underestimating work required, time management skills, how to get help) (Fetzner, 2013; Li and Akins, 2005). The fact is that distance courses are as academically rigorous as face-to-face courses (Jahng, Krug, & Zhang, 2007). They are the same in terms of credit, objectives, competencies, content, and transferability. While many studies show that distances courses have equal or better student satisfaction and pass rates than comparable face to faces course sections (Lapsley, Kulik, Moody, and Araugh, J.B. 2008), there are also other studies showing the contrary. For example, a multilevel regression analysis by Jaggars and Xu, (2011) suggest that students in Washington community colleges were more likely to fail or withdraw from online courses than from face-to-face courses. This pattern was also observed across Virginia community colleges, which suggests that student difficulties with online courses in community colleges are not confined to one state (Jaggars and Xu, 2010).

Many colleges recommend basic technology skills as a prerequisite for enrollment in distance courses, but students are generally not required to demonstrate those skills prior to enrollment (See Table 1). Despite this, colleges have dedicated efforts to help potential students assess their online learning skills including self-tutorials on how to use a learning management system (LMS). However, those tutorials and self-reporting survey instruments don't really give an accurate picture of what students know and are capable of doing because students are generally unaware of their deficits (Dunning, D., Johnson, K. Ehrlinger, J. and Kurger, J., 2003) or they simply lack self-efficacy toward online learning (Hodges, 2008).

General characteristics of successful online learners (example: personal belief about online learning, self-direction and time management skills, and interpersonal communication skills) and basic technology skills (example: email, word processing, learning management system, equipment owned) have been well documented (Dray, Lowenthal, Miszkiewicz, Ruiz-Primo, & Marczynski, 2011). However, the remaining question is about the extent to which colleges and universities can use the information they have to help students develop skills they lack. While anecdotal evidence suggest correlation between student readiness for online instruction and student success, research based instruments for determining student readiness are lacking. At this point, students need a program designed to give them opportunity and motivation to develop skills they need and conclude the process with an evidence-based assessment that shows exactly what students know and are capable of doing. An example of such a program is the student development skills (SDS 102) Online Readiness course that was developed by Wenatchee Valley College.

What follows are a few examples of self-evaluation tools and tutorials used to determine online readiness. Also, the authors provide an overview of the design of their newly developed online readiness course, assessment instruments, analysis of data collected over a 6-quarter period, and feedback on student experiences. The paper concludes with results and discussions.

INSTRUMENTS FOR DETERMINING ONLINE READINESS

Table 1: Examples of instruments used to determine students' readiness for online learning.

Self-awareness surveys and online tutorials of Washington Online (WAOL).	WAOL model is based on a collaborative effort that shares resources among Washington State colleges. The system has a popular self-evaluation tool, *Is Online Learning for Me*? which provides feedback based on the assessment score. Other topics include technology skills and hardware requirements, and 2 interactive online tutorials. The *Learning-to-Learn* tutorial helps students learn how to navigate an online course, use email, browser functionality, study skills, etc. The *Week Zero Tutorial* allows students to test-drive a learning management system (LMS). The WAOL model is an excellent collaborative framework that benefits a large number of students in the system. The model works well for intrinsically motivated students, but it lacks extrinsic rewards and an introduction to academic support services.
Distance Learning Orientation of Terra Community college	A comprehensive orientation comprised of four modules which include extensive use of online tutorials: technology skills, using web navigation skills, basic communication skills, and online communication skills. The fourth module allows students to login to a course management system and try different functions. Students lack interaction with the instructor, contextualized feedback, and an introduction to academic support services
Three interactive Modules of the San Antonio college	The San Antonio Module is designed to help students develop skills they need to succeed in an online learning environment. There are live people to provide assistance at the Internet Skills Center. This closely resembles the Online Readiness Course of Wenatchee Valley College except that the students at San Antonio don't receive credit for their accomplishment and they don't have graded activities to show what they really know and are capable of doing.

Note: *All models listed above tend to work well for intrinsically motivated students, but they all lack extrinsic rewards and solid evidence of what students really know and are able to do.*

RESEARCH METHODS

Course design

The online readiness course presented in this research work was offered for the first time in fall 2011 at Wenatchee Valley College. It is a 2-week, completely online, 1-credit course using the learning management systems (LMS). The course is offered twice each quarter. The first section runs during the first 2 weeks of each quarter while the second section runs during the last two weeks of the quarter. The course starts with the Getting Started unit that provides an overview of how the course is organized and an introduction to the instructor. The unit also includes a self-efficacy survey, a syllabus, and a list of important dates (course calendar). Next, the course involves four units with emphasis on technical preparation, time management, communication in an online environment, and the ability to follow written instructions. The students also learn about the support services available for distance learners, exposure to basic information literacy concepts and practice research. Each learning module starts with by listing the desired learning objectives and a case scenario to set the context of concepts to be learned. Then, assigned readings, resources and demonstration examples followed by practice activities and assessments (assignments and a quiz) complete the module. Note that all graded activities have step-by-step instructions on how to complete any technical components and the accompanying grading rubric. The exception is module 4 that has a retroactive pre-posttest (Allen and Nimon, 2007) to conclude the module and the course.

Overall, the course design was influenced by Quality Matters guidelines, basic universal design for learning, and show-tell-do principals. Quality Matters is a faculty-centered, peer review process designed to certify quality of design in online courses and online components (Quality Matters Guidelines, Fifth Edition, 2014). Similarly, universal design for learning is a course design process that benefits all learners including those with special needs. The tell-show-do principals include; giving the learners information, providing examples, and creating exercises for learners to practice.

Assessment instruments

A careful consideration of instruments used to determine students' readiness for online learning lead us to reject the sole use of self-evaluation instruments because students tend to overestimate their ability. This is the effect of socially desirable response bias, the tendency to give answers that give positive impressions (Paulhus, 1991). This was the primary motivation for developing course modules that have authentic assessment activities that show evidence of what students really know and are able to do.

The use of pre-tests was rejected because students are unaware of what they don't know. With the traditional pre-test (administered at the beginning of the course) which is usually followed by a post-test evaluation (administered at the end of the course) students are susceptible to the response shift bias as they become aware of how much they didn't know with instruction. Instead, the retroactive pre-test was our preferred instrument. The retroactive pre-test is administered at the end of the course in conjunction with the post-test. Ratings happen at the same time thereby controlling the response shift bias (Drennan and Hyde 2008). Our retroactive pre-test consisted of 10

x2 questions framed in terms of the course learning outcomes. The questions allow students to reflect on what they know now as compared to their knowledge base before instruction.

An example of a retroactive pre-test question using the Likert rating scale:

- *My ability to make an appropriate choice of course delivery format:* ***PRIOR*** *to taking this course was: 1 Poor, 2 Fair, 3 Good, 4 Very Good, 5 Excellent*

- *My ability to make an appropriate choice of course delivery format:* ***AFTER*** *taking this course is: 1 Poor, 2 Fair, 3 Good, 4 Very Good, 5 Excellent*

As mentioned by IIgaz and Gulbahar (2015), "satisfaction of distance learners is one of the important factors that shapes the design, delivery and implementation of e-learning and almost certainly affects the quality."

In addition to the retrospective pre-test questions three additional open ended questions were added to elicit feedback about student satisfaction and suggestion for course improvement.

These 3 questions solicit feedback in 3 areas:

- What students liked about the course and content,
- How students would like to see the course improved, and
- How the instructor may improve his/her teaching style.

Overall, the retroactive pre-test instrument created reliable data with regard to perceived learning gains, what works for students, and opportunity to facilitate course improvement.

Online Learning Self-efficacy survey – Numerous research studies have shown that self-efficacy is a valid predictor of how well students do in a particular learning environment. Self-efficacy is a belief of one's ability to transfer his/her confidence among learning environments. This means that the concern is not on an individual's skills, but the judgments of what a person can do with whatever skills she possesses (McQuiggan, et al. 2008 and Bandura, 1989). The self-efficacy survey was administered at the beginning of the course to give the instructor an idea of the confidence level students brought to the course. This information provides the opportunity for timely intervention to boost the student's confidence, therefore increasing their chance to succeed.

Level of preparedness for online learning – This survey was to determine the level of skills and prior learning students brought to the course. Many questions for this instrument were borrowed from WAOL's *Is Online Learning for Me* tool; their instrument provides pre-programed feedback based on the assessment score. Our preparedness survey didn't provide instant feedback to the student, but helped the instructor know his students and implement early intervention activities.

Data analysis

The gradebook feature in the LMS was used to track and compute the overall course grades. It also helped to compute the level (low versus high) of self-efficacy ratings of each student. A t-test, a statistical test used to determine if two sets of data are significantly different from each other was also used to compare self-efficacy ratings and the overall course grades to challenge the assumptions that students with high self-efficacy and/or high preparedness for online learning will do better in the course. In addition, course content and evidence from the authentic assessment activities were reviewed in conjunction with pre-post survey data to validate perceptions of students.

RESULTS AND DISCUSSIONS

Data and findings presented in this section were collected over a 7-quarter period starting in fall 2011. Demographic data presented in Table 2 show course enrollments, student levels of self-efficacy with online learning, and overall course grades (a C grade or better shows the number of students who passed the course while a D grade or lower shows the number of those who failed.) Occasionally, there were students who enrolled in the course, but for some reason they did not participate (no record for course activities).

Table 2: Demographics and learning outcomes data from SDS 102 course

Demographics and success indicators	SU-13	F-13	W-14	SP-14	SU-14	F-14	W-15
Enrollments	18	17	25	19	12	23	22
Overall course grades							
C grade or better	14	11	20	13	7	15	16
D grade of lower	2	4	4	3	5	5	4
No activities	2	2	1	3	0	3	2
Distance Learning Self-Efficacy level							
High Self-Efficacy, earned D-F grade	1/11	2/10	2/20	3/9	0/8	5/14	2/12
Low Self-efficacy, earned A grade	3/5	1/5	0/4	1/7	1/4	2/6	1/8
Distance learning Preparedness level							
High preparedness, earned D-F grade	1/14	2/15	3/19	4/11	1/8	5/19	3/15
Low Preparedness, earned A grade	2/3	0/0	1/6	2/5	1/4	0/1	1/5

Note: SU-13 stands for summer 2013, F-13 for fall 2013, W-2014 for winter 2014, SP-14 for Spring 2014, SU-14 for summer 2014, F-14 for fall 2014, and W-15 for winter 2015 quarters.

As shown in Table 2, there are several students who started the course with a low level of self-efficacy for learning online, but some of them completed the course with an A

grade. For example, in summer 2013, three students out of five who reported low self-efficacy received A grades. The instructor believes that this positive outcome is attributed to early interventions the instructor implemented to help those who showed early signs of being at risk. The instructor promoted the concept of asking and getting help at the point of need by responding to questions and problems, in most cases, within 4 hours. This response time exceeds the expectation of a response within 24 hours during weekdays and 48 hours on weekends as outlined in the syllabus. Text messages, phone calls, emails, and online discussions were allowed for communication with the instructor. Another aspect of success was related to the immediate course improvement whenever a student provided actionable feedback.

There are many students who reported high level of preparedness, but they completed the course with a failing grade (D grade or lower). For example, in fall 2014, five out nineteen students who self-reported to have a high level of preparedness failed. Very few students who self-reported low level of preparedness earned A grades. This tells us that students tend to overestimate their ability (see Table 2). Therefore, any conclusion based on the self-reporting instrument for online readiness is a questionable.

A t-test comparing the overall grades of students with low versus high level of self-efficacy for learning online did not show any statistically significant difference. The same effect was found for self-reported preparedness levels. Sample sizes (course enrollments per quarter) were probably too small to show any meaningful statistical differences. However, on average students in the high level of self-efficacy or preparedness outperformed those within low level range as it was predicted.

Table 3: Retroactive pre-test data of SDS 102 course learning objectives

Student self-evaluation	My understanding of distance course expectations	My ability to make an appropriate choice of course delivery format	My ability to identify and navigate online course	My ability to use web-based tools for communication (WVC email, discussion forum)	My awareness of basic information literacy concepts	My time management skills required for success in online learning	My awareness of support services for distance learners	Overall success, learning gain
F-14, n=17								
PRIOR	44%	48%	59%	59%	66%	56%	48%	**54%**
AFTER	88%	91%	88%	86%	91%	83%	80%	**87%**
W-15, n=12								
PRIOR	46%	48%	53%	56%	61%	50%	45%	**51%**
AFTER	81%	79%	78%	85%	82%	86%	82%	**82%**

Note: F-14 stands for fall 2014, and W-15 for winter 2015 quarters.

The most interesting findings are presented in Table 3 show perceived learning gain in relation to learning outcomes. A retroactive pre-test compared student knowledge and skills prior to taking the course with perceived learning gains after course completion.

The ratings showed the overall learning gains of 33% in fall 2014 and 33% in winter 15. In addition, the analysis pinpointed the learning gain at the level of individual learning outcomes. For example, in fall 2014, the most learning gain was achieved on the awareness of online learning expectation (rating before: 44%, rating after: 88%) and in winter 2015, the awareness of support services for online learners (rating before: 45%, rating after: 82%). Another example relates to students ability to make an appropriate choice of course delivery format. Students at Wenatchee Valley College have to make a choice between face to face vs. fully online vs. hybrid vs. telecourse, vs. Interactive Television (ITV) courses. The fall 2014 rating was 48% before taking the course and the rating after was 91%. This tells us that the college should do more to educate students about online expectation, support services and the differences between course delivery formats. By doing this all students will benefit because web based support resources, like library and tutoring, are available to all students, yet if they don't know the resources are available they won't use them.

Finally, the comments of students gave insights on what they liked and where course improvement could be realized. For example, they repeatedly expressed how much they liked the layout and how easy it was to navigate the course. They also expressed a great deal of appreciation for multiple modes of communication: texting, phone call, emails, and online discussions that facilitate easy access to the instructor who almost always provided instant response, even during evening time and weekends. The take-away here is, today's students have different communication preferences and teaching and learning expectations. You cannot expect them to learn the same way students learned a few decades ago. A promising approach is to enter their world to accommodate the needs of their changing learning space. This requires adjustments on the part of the instructor, but it is well worth it.

Examples of unedited comments from students:

Question: Thus far, what do you like about the course and course content?
Student comments:

- *I liked how it was set up. It had pretty much step by step on what to do next. It had the list of readings to do then it had the activities with clear instructions on how it is be done.*
- *In this course I enjoyed the layout, it was set up to help you have succeed. Unfortunately I saw this easy to use course layout and overlooked it. I tried to push my due dates, and this was a recipe for failure. This is a very informative course and I did learn quite a bit.*
- *I like the instructor, the fact I could text him or call him, or stop in with a question, and the fact that I left the course knowing more than I did when I enrolled in it.*
- *I found this to be very difficult in the beginning of this class online. The more I read and understood how to follow the directions it became easier and easier and got to where I was comfortable finishing through it. I really loved the step by step directions that made it very easy to understand and comprehend. I have found that it is a lot of hard work and dedication to take an online course. I learned so much helpful information through this course.*

Questions: Based on what you learned, what would you like to see improved in the course content and how might the instructor improve his/her teaching style or teaching strategies of this course?

Student comments:

- *I really don't see much need for improvement. All of the resources needed are available if a person familiarizes themselves with the course layout.*
- *The only thing I wish were different is that this course would be offered a week or two before all other so I could have learned what I needed to before I had to start all of my other classes.*
- *A little more time on the quiz. I felt stressed to finish in the 15 minute time frame.*

CONCLUSION

This study confirmed that a promising approach for preparing students for online learning is to move beyond self-evaluation surveys and tutorials to actually teaching them the basic skills they need to succeed. The place for self-evaluation surveys is to get to know perceptions students bring to the course. This knowledge can serve as the basis for early intervention activities. Self-efficacy and level of preparedness are examples of such surveys that predict the likelihood of students' success. Best practices for teaching online, authentic assessments, easy navigation, predictable course layout and end of course retrospective pre/post evaluations and quick and quality communication using the mode the student prefers are all components for course success. Most importantly, instructors need to consider what works for students first and consider what works for the instructor next. Students in this course clearly benefited from realism of taking a distance course rather than interacting with simulations or passive tutorials. The active learning allowed them to test the water and come to an informed decision of whether or not distance learning is a natural fit for them. The way forward now is a longitudinal study to assess impact of the online readiness to the success in future distance courses.

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Evaluating Teachers' Digital Literacy

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
The rise in technological innovations and the educational benefits associated with them has resulted in an increased use of technology in education. The appropriacy and efficacy of the use of that technology, however, is not always guaranteed. Although there is an assumption among many educators that integrating technology into teaching and learning will be automatically rewarding, the degree to which that technology is pedagogically beneficial is reliant on a number of elements, including a teacher's ability to use and understand why they are using technology. Research was conducted at a preparation center to an international university in Thailand to evaluate the integration of technology in teaching and learning and to assess teachers' levels of educational technology literacy and the appropriacy and efficacy of their use of technology. It was conducted over one term and utilised questionnaires and interviews, combined with Davies' (2011) "Framework for Evaluating Educational Technology Integration."

Keywords**:** educational technology, educational technology integration, educational technology literacy

Introduction

Whether it was the introduction of the blackboard or the audio cassettes and videos that were listened to and watched by many during their school years, technology has always played a role in education. Until recently though, technology has played more of a "standardized and relatively stable [role]" (Mishra & Koehler, 2006), and there has not been too much direct emphasis from governments for educators to use technology in their lessons. With the recent technological innovations of the Internet, mobile and personal devices, technology in education is taking more of a central role with governments insisting on more integration of technology in teaching and learning. In addition, many students bring personal devices to lessons instead of traditional stationary (Glenn & D'Agostino, 2008). This has contributed to an enthusiastic adoption of a range of technologies, both institutional and personal, being integrated into learning environments. There are a number of frameworks that are being used by educational institutions to assess their integration of technology; however, most focus only on what the technology is capable of and not on how effectively the technology is being used. This article will assess the educational technology integration and educational technology literacy of teachers at the Preparation Center for Languages and Mathematics at Mahidol University International College, Thailand using Davies' (2011) Framework of Technology Integration.

Context

The preparation center is part of a Thai university. Its purpose is to increase students' academic English level, so they can enter the international college. The center has approximately 400-550 students, depending on the quarter, and roughly 20 teachers. The students are mostly Thai and come predominantly from a Thai educational system that does not encourage student-centered learning (Kantamara, Hallinger, & Jatiket, 2006) while some have attended international schools or bilingual programmes that have adopted more of a Western, collaborative discussion based approach to teaching and learning. The range of technology used by the students differs widely. Informal discussions with the students revealed that in the majority of school lessons, technology was used mainly by the teacher as an instructional tool and not by the students, unless it was in a specially designed computer lab or information technology lesson.

The instructors at the preparation center are from England, Italy, the USA, New Zealand, Australia, and Thailand. They have a range of qualifications up to master's degrees, with a number studying at the doctoral level. They have also attended a variety of teacher training programmes. The teachers have experience teaching in language programmes, schools, and universities in Thailand and internationally. They have a wealth of knowledge that they bring to the programme, which includes a mixture of experience using technology in lessons for teaching and learning.

The center is quite technologically advanced. All of the students are required to bring laptops or personal devices to each lesson. There is a student's website that provides materials for students to self-study for their respective subjects and a teacher's website for accessing subject specific resources. Many of the teachers use a variety of educational technology in the classroom as this is heavily encouraged and supported. As a result, the center's 400-550 students and 20 teachers all use technology in every

lesson to support teaching and learning. This has raised the questions of to what degree technology is being used, how well it is integrated into the curriculum, and how effective the use of that technology is. To answer these questions, a framework was required to guide this study. The following section will discuss some views of the benefits and drawbacks of using technology and a few of the more popular frameworks being used in education currently and finally outline the framework chosen for our study.

Literature Review

Why Use Technology

Before looking at how technology is integrated, a brief discussion of why it is used is required. Some suggest that students will be more engaged to study if educators use technology (Prensky, 2001). However, others (Jones, Issroff, Scanlon, Clough, & Mcandrew, 2006), suggest that this type of motivation may decrease as the technology loses its initial appeal. Many schools are looking into utilising the personal devices that students bring with them, not only because they are powerful devices that can be used for learning, but also as the institutions do not need to pay for them (Johnson & Adams, 2011). This use of personal devices has also been identified as a motivating factor for students due to the level of control and ownership that are associated with them (Jones et al., 2006). The concept of ownership and control has enabled learners to move from passive recipients of knowledge in the classroom to active creators of it by taking control of their learning and collaborating with others (Naismith, Lonsdale, Vavoula, & Sharples, 2004). The increase of cloud-based computing and web-based applications has further made collaboration between students possible (Stevenson & Hedberg, 2011).

Although there are a number of positive reasons why technology should be adopted in the classroom, the literature also identifies concerns among teachers as to why it should be adopted with caution. The element of control has raised concerns regarding students having too much agency and using their technology in ways that the teacher had not intended (Jones et at., 2006). This concern of students being distracted by technology has been central to many discussions regarding students' use of technology in the classroom (Prensky 2004, Maguth, 2013 & NMC, 2008). Activity theory suggests that technology may be a distraction as their focus may shift from completing a set task to how to use the tool (technology) to complete the task (Waycott, 2004; Donato & McCormick, 1994; and Lantolf & Thorne, 2006).

Assessment Frameworks

To understand why technology is used or not in classrooms, a framework is required. A number of frameworks exist: the RAT, SAMR, and Davies' Technology Integration Framework. The first to be discussion is Hughes, Thomas & Scharber's (2006) RAT–Replacement, Amplification, and Transformation-Framework.

RAT–Replacement, Amplification, and Transformation-Framework

Hughes,et at. (2006) suggest that it is not sufficient to be able to simply identify the technology that is available but to identify the part technology plays in education. To do this, they created a framework that separates technology use into three levels:

Technology as Replacement, Technology as Amplification; and Technology as Transformation (p. 1). Technology as Replacement looks at technology that does not change the activity or goal; it simply replaces existing tools or goals, such as replacing paper with a PDF. Technology as Amplification, according to Hughes et al. (2006), looks at whether the technology improves the productivity or efficiency of tasks or goals (p. 3). In the final area, Technology as Replacement, technology completely replaces an existing task or goal, and as it brings functionality that was not previously possible, it becomes "indispensable" (Pea, 1985, p. 175, as cited in Hughes et at., 2006).

SAMR

Another popular model, although not peer reviewed, is the SAMR model (Puentedura, 2010). This separates technology use into four levels: Substitution, Augmentation, Modification, and Redefinition. The lowest level of technology integration, Substitution, is similar to Technology as Replacement in the RAT framework, where technology replaces an existing task or goal but does not change it. In the second level, Augmentation, technology not only replaces the task or goal, but it provides improved functionality. In third level, Modification, technology allows the task to be designed differently. The final level, Redefinition, provides the ability to create new tasks that were not possible without the technology, for example, writing blogs or wikis as part of a writing task.

Davies' Technology Integration Framework

Although the previous frameworks provide a lens through which to assess technology integration, they only appear to focus on what the technology is capable of and what it is doing within a particular activity. There does not appear to be any question of why the technology is being used to achieve certain learning goals or whether it is better not to use technology at all. To answer these questions, Davies' Technology Integration Framework will be discussed.

Davies' (2011) Technology Integration Framework uses a three-level format similar to the RAT framework. However, unlike the RAT framework and the SAMR Model, Davies' framework assesses technology integration combined with educational technology literacy. The three levels of literacy are: Awareness, Praxis, and Phronesis. At the Awareness level, Davies states that a teacher is aware that certain technology is available, and they are starting to find out about the functionality of that technology. They are not a user yet, but they can answer the question: what can it do? (p. 48). In the next level, Praxis, teachers are moving from a beginner to a competent user. They are starting to investigate how they can use technology to achieve certain goals. They are becoming a confident and eager user of technology in the classroom. However, they are still not considered by Davies to have a high level of educational technology literacy. It is only at the top level, Phronesis, that they become and expert user, where teachers are choosing when it is right to use a piece of technology, and they can answer the question: why am I using it? (p. 48). This final level, Davies explains, is where teachers demonstrate technology, content and pedagogy knowledge, better known as TPACK (Mishra & Koehler, 2006, as cited in Davies, 2011). As Davies' framework offers such a broad view of teachers' technology

integration and teachers' educational technology literacy, it has been chosen as the framework for this study.

Research Methods

To investigate technology integration and teachers' educational technology literacy, a questionnaire was chosen as it provided a "an easy, quick form of data collection" (Creswell, 2008, p. 396), and it enabled the researchers to question the teachers (n=24) without having to sit down on a one-to-one basis or conduct a focus group. Some interviews were conducted, however, as some teachers were unsure how to answer some questions on the questionnaire or were more comfortable providing oral rather than written feedback.

The questionnaire was created using an online form system called Google Forms, which enabled the researchers to digitally create the form at their ease and allowed for the results to be automatically collected in a spreadsheet. The teachers were asked nine questions. The first six asked the teachers to state three pieces of technology they use to achieve certain learning goals/outcomes and why they chose to use them. The final three questions asked the teachers to state occasions, if any, where technology was available but they chose not to use it to achieve certain learning goals/outcomes. The results of the survey went through a first cycle of in vivo coding to identify salient features in the responses (Saldana, 2012). These underwent a second cycle of pattern coding to identify "emergent theme[s]" (Saldana, 2012, p. 152) in the data. These themes were then used to provide qualitative results.

Results

The results of the research identified a number of key aspects regarding the integration of technology and the teachers' educational technology literacy. Figure 1 shows the percentage of teachers using each piece of technology provided in the questionnaire. It highlights that the majority of teachers are using the cloud-based document service Google Docs (83%) and the cloud-based virtual learning environment, Edmodo (54%). There were also a number of teachers using the online plagiarism service Turnitin (29%), some using online sources (17%), and others using YouTube and VoiceThread (13%). The remainder of the technology was used by less than 10% of teachers.

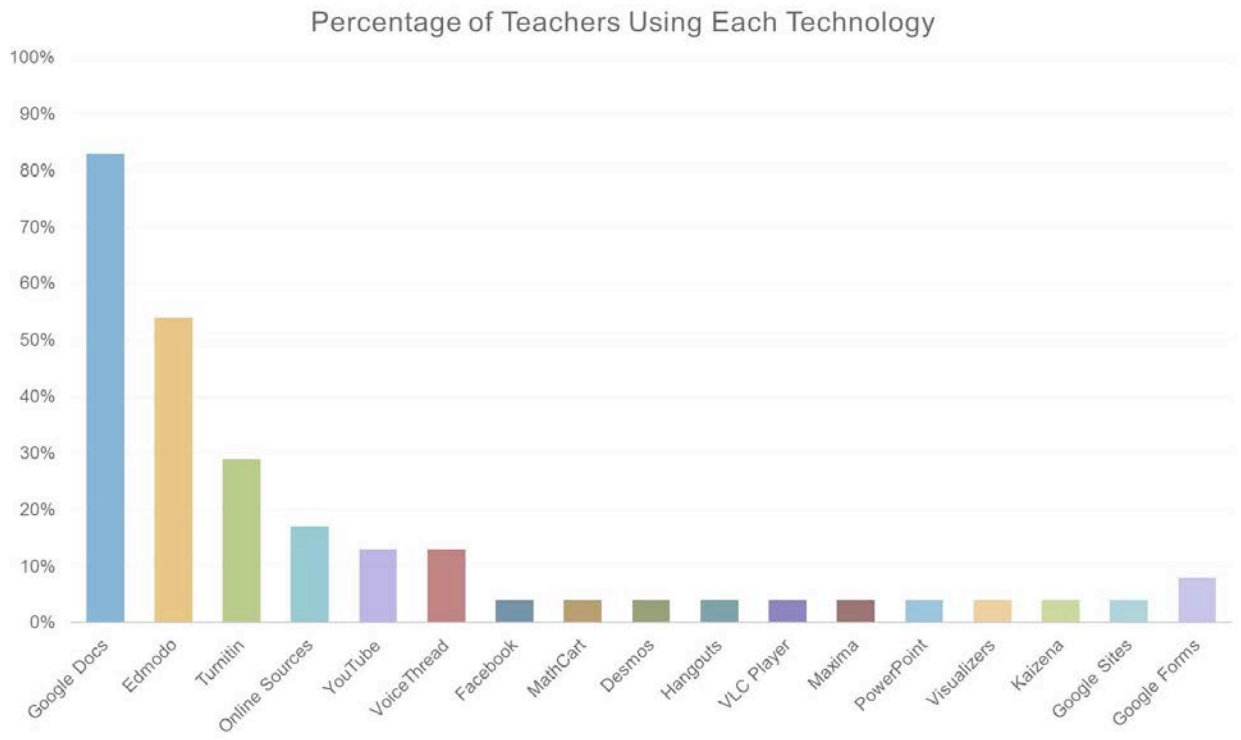

Figure 1

Figure 2 displays the results to the question of why each piece of technology was used. The majority of the teachers used technology for sharing resources, peer assessment, providing feedback, communication, collaboration, a gradebook, avoiding plagiarism, setting assignments, and keeping track of students' work. Google Docs, Edmodo, and Turnitin were used most for these. However, individual teachers did state that they used Facebook and Google Forms. The remainder of the uses for technology were less common and only used by a few individuals, pairs, or small groups of teachers.

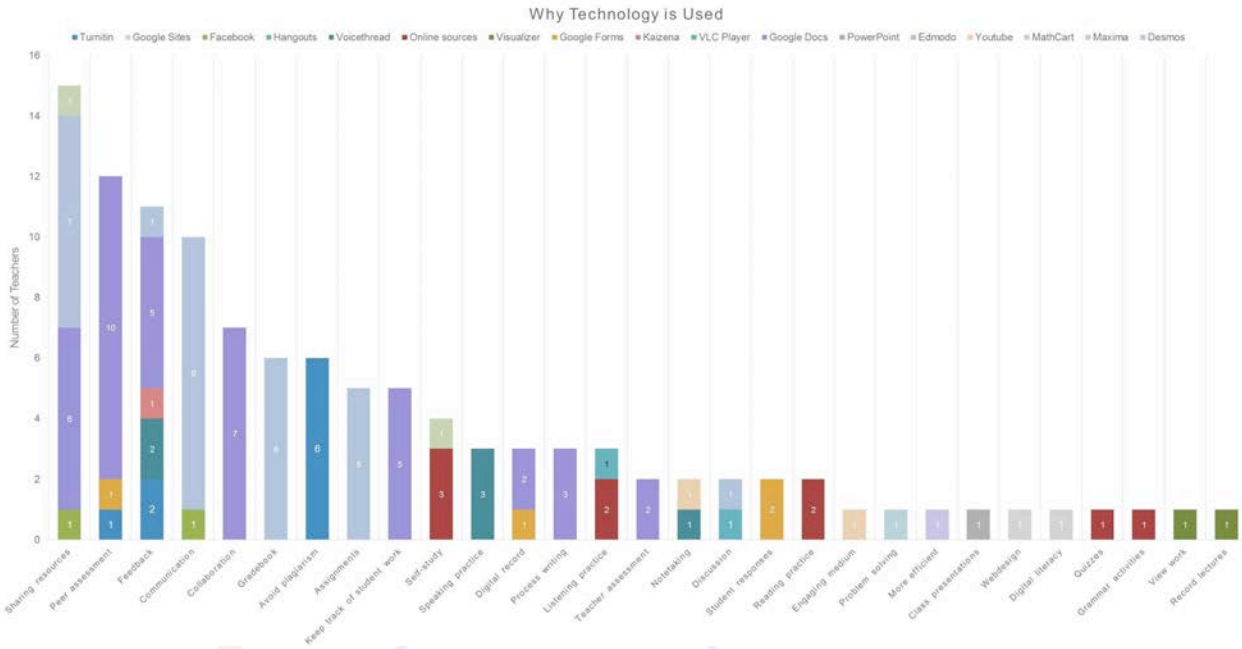

Figure 2

Why technology was not used (Figure 3) varied between the teachers. The salient reasons were that teachers found a non-tech-based approach to more authentic, such as completing a reading practice test on paper as the exam was on paper; they stated that it was easier for the students to complete certain tasks without using technology, in the case of reading and making notes; and a number of teachers found that the technology was a distraction. Some of teachers also commented that they did not want the students to rely on the technology to aid them with their writing, and others stated that they did not use technology as it was unavailable. The remainder of the reasons were stated by less than ten percent of teachers. The red bars highlight the responses that were deemed non-pedagogically justifiable reasons for not using technology with regards to the framework, and these will be discussed in the following section.

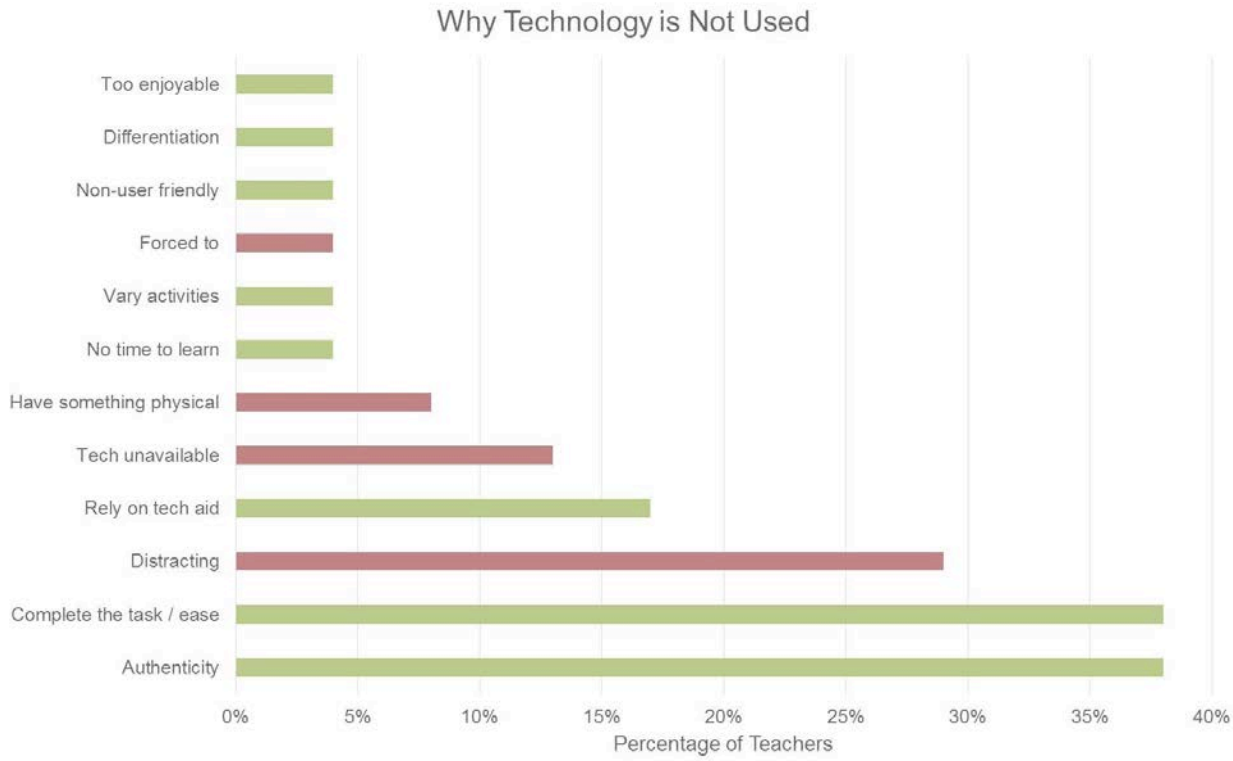

Figure 3

The majority of the teachers (Figure 4) rated themselves above average regarding their average educational technology literacy using the basic features of the technology, with only one teacher rating him or herself below 5/10 at using Google Sites. There does not appear to be any correlation between the popularity of the technology and a teacher's literacy rating. However, the complexity of the technology may be a factor as services, such as Turnitin and Google Docs received a below-average rating, and simpler-to-use applications such as YouTube received higher personal literacy ratings. An exception to this would be the two specialist mathematics applications, used by the maths teachers, who rated themselves at expert level.

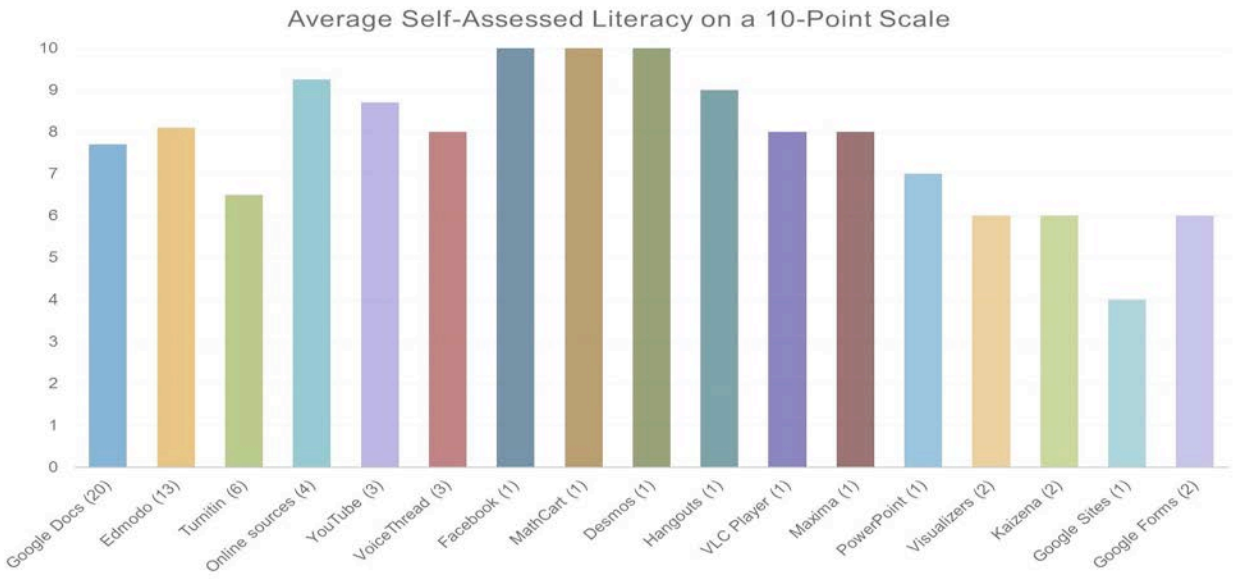

Figure 4

Finally, a comparison was drawn between each teacher's self-assessed average educational technology literacy level, the years they have been teaching, and their reasons for not using technology (Figure 5). The green bars indicate pedagogically justifiable reasons (regarding the framework) for not using technology, the amber bars identify that the teacher provided both pedagogically justifiable and non-pedagogically justifiable reasons for not using technology, and the red bars, as previously stated, represent teachers that were unable to provide any pedagogically justifiable reasons for not using technology. It can be seen that there is no direct correlation between a teacher's self-assessed literacy, the number of years they have been teaching and their reasons for not using technology.

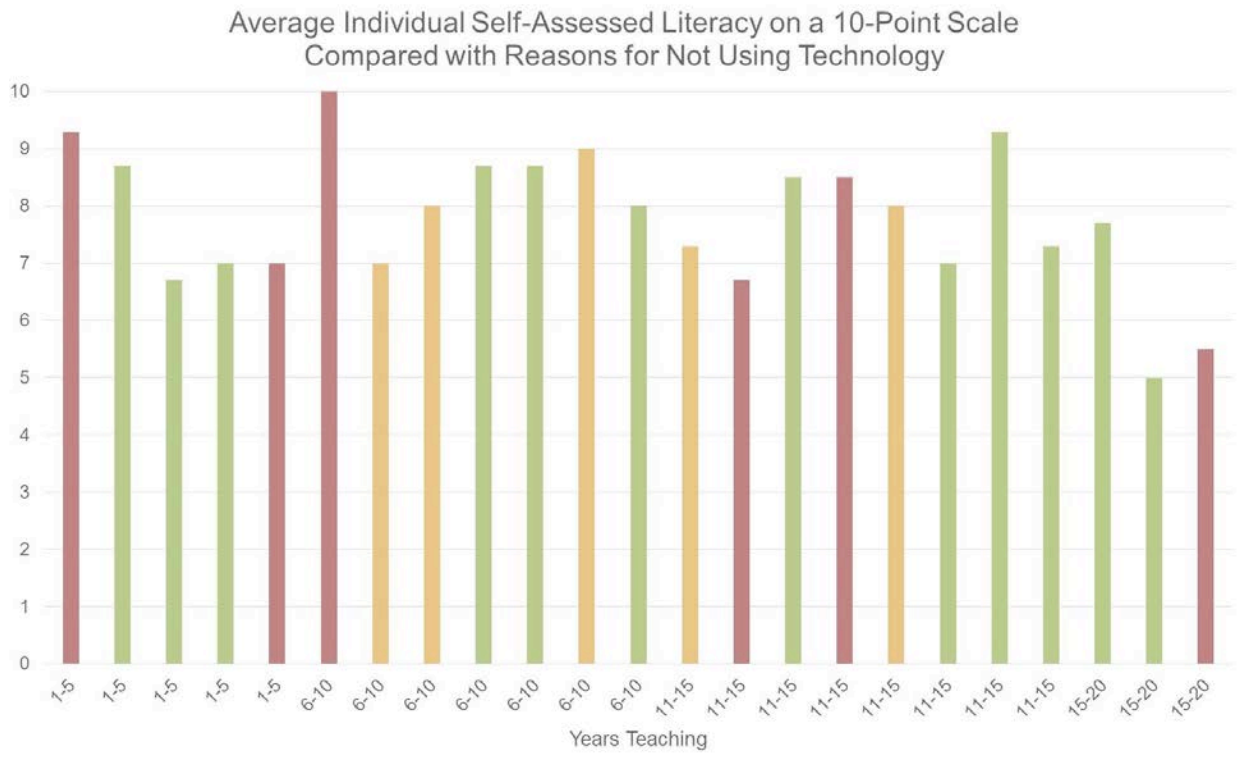

Figure 5

Discussion

The results from the research showed that all of the teachers used technology in the classroom. They also rated themselves at above average in confidence at using it, and they are all using technology at varying levels. The most common technologies used were web based collaborative tools, as identified by Stevenson and Hedberg (2011), and tools for communicating with students. In addition, teachers identified that technology enables students, as Naismith et al. (2004) stated, to not only collaborate, but also take control of their learning by peer assessing each other's work and completing many other tasks that enabled them to play more of an active role in the learning process.

There were a number of reasons why teachers chose not to use technology. Many of the teachers stated that using technology was not authentic enough for some activities. They felt that if the students were practicing for an exam that was non-tech-based, then they should not use technology while practicing. In addition to this, a number stated that the technology did not enable students to complete some tasks as well as they would be able to without tech as Waycott (2004), Donato and McCormick (1994), and Lantolf and Thorne (2006) stated with activity theory. The teachers found that completing tasks like reading, taking notes, and highlighting were made more difficult by using technology. There were, however, a number of teachers who agreed with what Prensky (2004), Maguth (2013), NMC (2008) and Jones et al. (2006) highlighted regarding students getting distracted by the technology or completing tasks that teacher had not set, and therefore, the teachers chose not to use technology for this reason.

Regarding the educational technology literacy of the teachers, all of the teachers are, at least, at the middle level of literacy (Praxis), according to Davies' framework. This was due to the fact that there are no non-users of technology. The majority of teachers identified themselves as being better than average at using the technology, and they use a variety of it in their lessons. To move to the highest level of literacy (Phronesis), Davies states that a teacher should be able to make pedagogically justifiable decisions as to why they would choose a non-tech-based approach to achieve certain learning goals. This would show they have achieved what Mishra and Koehler (2006) refer to as technology, content, and pedagogy knowledge (TPACK) and educational technology literacy, at least in a certain context (Davies, 2011). In this study, many teachers identified a variety of reasons why they do not use technology, but only half of them were able to provide pedagogically justifiable reasons for not using it in all of their responses. Almost a quarter of the teachers were able to provide some justifiable reasons, while the remainder were unable to provide any. The reasons that were considered non-pedagogically justifiable were such reasons as being forced not to use it, the technology was unavailable, they did not have time to learn to use the technology, and it was too much of a distraction. These were considered unjustifiable as teachers had not made a pedagogical choice to use a non-tech-based approach that would better achieve the goals of the lessons. The first three are not related to achieving the task, and the final reason, distraction, was considered to be a matter of classroom management and was not a choice to use a non-tech-based approach to better achieve the learning goals.

Recommendations

The study was moderately successful at identifying how teachers are integrating technology and has shed light onto their educational technology literacy. However, Davies' framework does not assess the degree to which technology is used within an activity. One possible way to do this would be to use a combination of Davies' framework with the RAT (Hughes et al., 2006) and SAMR (Puentedura, 2010) frameworks. This would not only assess whether the teachers were making sound pedagogical choices to use or not use technology, it would identify what effect that technology is having on the activities it is being used with; and therefore, provide a much broader picture of technology integration and the educational technology literacy of teachers. In addition, future research should be conducted over a longer period of time and include observations of teacher making choices to use or not use technology in different contexts, which is an element that Davies (2011) included in his study but was not possible in this study due to time constraints.

Conclusion

To conclude, this study used Davies' Framework for Evaluating Educational Technology Integration to investigate the technology integration and educational technology literacy at a preparation center to an international university. It found that all of the teachers were confidently using technology in their lessons. They stated various types of technology that they use and numerous reasons why they use that technology. Many of the teachers were also able to make pedagogically sound judgments to not use technology in their lessons, which, according to Davies, showed they were operating at the highest level of educational technology literacy. The study also made recommendations for future research, which suggested combining the

RAT, SAMR, and Davies' frameworks to provide a more rounded view of teachers' literacy and technology integration. In addition, a longer study that includes observation was also recommended to gain a greater understanding of teachers' educational technology literacy.

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The Impact of Mobile Learning Environment on EFL Students' Learning of English Idioms through Concept Cartoons

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
Today, the most important form of communication among teenagers is carried out through mobile devices. Mobile technologies have also various pedagogical practices and issues, which are conceptualised as mobile learning (m-learning). Definitions of m-learning have focused on access, mobility and support for learning in multiple locations without physical network connections. Considering these features of m-learning, it was supposed that exposing students to learning materials –such as idioms in English- at regular time intervals in an m-learning environment would facilitate learning. In addition, using concept cartoons as language learning materials and delivering them via m-learning can make these materials pedagogically valuable sources.

Thus, this study included English idioms to be taught by using concept cartoons via mobile phone's instant messages (IM). To this end, the following question stands out: "Are there any significant differences in students' learning of idioms via SMS vis-à-vis the other method of delivery, posters in classes?" During the study, thirty four 7th grade students (age 12-13) were recruited as experimental and control groups. The first group of participants were exposed to concept cartoons via IM in m-learning environment, and the second group was exposed to the same cartoons in the form of posters in the classroom. The findings revealed that the implemented treatment significantly increased English idiom comprehension levels of both experimental and control group students. However, no difference was observed in students' learning of idioms via IM vis-à-vis the other method of delivery- posters in classes.

Keywords: Mobile learning, Integrating Technology into Education, ESL, Concept cartoons

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Introduction

In this new digital era, it is clear that almost everybody even in developing countries has a mobile phone. Table 1 shows the growth in the ratio of subscriptions (per 100 inhabitants) for mobile-cellular telephones over the last decade (International Telecommunication Union (ITU), 2015a). It is estimated that, all over the world, mobile-cellular telephone subscriptions reached 95,5% in 2014 (ITU, 2015b).

Table 1. Statistical data about mobile-cellular telephone subscriptions

		2003	2013
Mobile-cellular telephone subscriptions per 100 inhabitants	Turkey	42,29%	92,96%
	Japan	68,49%	117,63%
	UK	90,88%	124,61%

Parallel to this trend, the most important form of communication among teenagers is carried out through mobile devices. In fact, depending on the statistics of 2013, for Turkish children between the ages 6 -15, age to start using mobile phones is ten, and the rate of mobile phone usage is 50,9% (Turkish Statistical Institute, 2013). These children use mobile phones for talking (92,8%), messaging (65,4%), and using the Internet (30,7%) (Turkish Statistical Institute, 2013). High usage of mobile technologies among children can be used as an opportunity to enable users to "re-interpret their everyday life contexts as potential resources for learning (Vavoula, Pachler & Kukulska-Hulme, 2009, p.5)."

Mobile digital tools, with their small size, ubiquity and functional convergence, enable new possibilities for learning. Owing to the range of connectivity functions, mobile devices offer the socio-cultural dimension of learning by enabling users to communicate readily with other users (Vavoula, Pachler & Kukulska-Hulme, 2009). O'Malley et al. (2005, p.7) have defined mobile learning as taking place when the learner is not at a stabilized location, or when the learner 'takes advantage of the learning opportunities offered by mobile technologies'. Mobile learning can be "spontaneous, portable, personal, situated; it can be informal, unobtrusive, ubiquitous and disruptive" (Kukulska-Hulme & Traxler, 2005, p.42). In other words, mobile learning is "the processes of coming to know through conversations across multiple contexts among people and personal interactive technologies" (Sharples, Taylor & Vavoula, 2007, p. 225). This definition emphasizes cognitive and social aspects over technical considerations along with aspects that allow content provision and transmission; in these cases the emphasis is on "contexts, context generation and context crossing" (Vavoula, Pachler, and Kukulska-Hulme, 2009, p.5).

Pachler asserts that, 'mobile learning is maturing as an academic discipline' (2009, p.1). Table 2 includes the number of article results for queries on education related to academic electronic databases with subject 'elementary' or 'higher education' in addition to the keyword 'mobile learning'. Only scholarly (peer reviewed) journals were included in the query.

Table 2. Query results on three different electronic databases with keyword "mobile learning" and "higher education" or "elementary education"

Databases	Keyword: Higher Education Result #	Oldest	Newest	Keyword: Elementary Education Results #	Oldest	Newest
Academic Search Complete	187	1997	Jul, 2015	19	2003	Feb, 2015
Education Source	566	1997	Jul, 2015	32	2003	Apr, 2015
ERIC	252	1997	Jan, 2015	56	2004	2014
Total	1005			107		

Query results in Table 2 show that the majority of research has been done with higher education students, however only 10% of the articles involved elementary school students. These numbers reveal the need for more research on mobile learning of elementary level students. In this study, considering the features of m-learning, it was supposed that exposing students to learning materials –such as idioms in English- at regular time intervals in an m-learning environment would facilitate learning.

Learning English Idioms using Concept Cartoons

Acquisition of conversational competence in a language requires an understanding of the use and meanings of idiomatic expressions (Sexton, Gervasoni, & Brandenburg, 2009). An idiom has an alternate, figurative meaning, which cannot be determined from the combination of the meanings of the individual words (Cronk & Schweigert, 1992). Idioms constitute a notably difficult area in foreign language learning and teaching. Idiomatic meanings are typically assigned to chunks of words that do not bear their individual meanings and their syntactic features (Levorato & Cacciari, 1992). For young learners, the comprehension of idiomatic expressions are facilitated by the help of contextual information (Cacciari & Levorato, 1989). Context helps suspend the literal interpretation of the idiom and provides the semantic information needed to make sense of the text and to understand the figurative sense of the idiom (Levorato & Cacciari, 1992). To present the idioms in a context, concept cartoons can be considered as a useful tool.

Cartoons have a significant role in education. They introduce notable and enjoyable activities for enhancing learning and student participation. A concept cartoon is a learning and a teaching tool which integrates written text in the form of dialogue accompanied with a visual stimulus (Chin, 2001). Although they do not employ humor or satire, concept cartoons have a cartoon-style design to demonstrate dialogues inside speech bubbles (Keogh & Naylor, 1999). Concept cartoons can facilitate both assessment and learning in a number of ways: i.they elicit students' misconceptions, ii. they promote questioning and reflective thinking in students,
iii.they stimulate talk and argumentation that help students to develop conceptual understanding (Chin & Teou, 2009).

Research Question

This study included English idioms to be taught by using concept cartoons via mobile phone's instant messages (IM). To this end, the following question stands out: "Are there any significant differences in students' learning of idioms via IM vis-à-vis the other method of delivery, posters in classes?"

Study Group

The study was carried out with 7th-grade classes at an elementary private school. The experimental group was chosen according to their possession of smart phones. In experimental group, each student has a smart phone. The students study German as their first foreign language and English as their second. The following table shows the distribution of students in control and experimental groups.

Table 3: Gender distribution in experimental and control groups

	Female		**Male**		**Total**	
	f	%	f	%	f	%
Experimental Group	8	50	8	50	16	47
Control Group	7	39	11	61	18	53
Total	15	44	19	56	34	100

Implementation Phases

Implementation phase -1: The idioms were selected on the basis of students' curriculum and on the themes they would be studying in the rest of the course. Idioms were extracted from various website sources, such as www.idiomsite.com.

Table 4: List of idioms in Arts and Sports categories

Theme	ARTS		SPORTS	
Weeks	**1st Week**	**2nd Week**	**3rd Week**	**4th Week**
Idioms	culture vulture	break the ice	all ears (and eyes)	get out of town
	my cup of tea	ring a bell	get a head start	hit the bull's-eye
	an arm and a leg	bat a thousand	hit a snag	get a second wind
	on the same page	a Work of Art	out of question	on the ball
	far cry from	have a ball	hot shot (big shot)	change your tune
	have one's finger in the pie	show up	to be just the ticket	jump the
	in the nick of time	walk on	hot on something	lose your bottle
	look like a million dollars	It's raining cats and dogs!	take sides	neck and neck
	top flight	learn (something) by heart	kick the bucket	take place
	a piece of cake	tickled pink	time out	

Implementation phase -2: One week before the implementation, an achievement test was given as a pre-test to both groups in order to assess students' comprehension of idioms.
The achievement test was developed by the researchers. The test has 5 sections and consisted of 40 questions as seen in Table 5. It was a 20-min individual assessment for measuring the students' previous knowledge of idioms. Three experts from English faculty and classroom language teacher were consulted. A total of 40 idioms were identified. The content and construct validity of the test was evaluated by three experts from English faculty. Final version was presented to the classroom language teacher and head of English department for their approval. The final test was administered to all 7th grade students (n=47) in the school. The students' scores ranged between 6 and 31 with an average score of 15.19 (SD=5.384) with a normal distribution.

Table 5: Achievement test sections and number of questions

Idiom-picture matching	**Idiom-meaning matching**	**Multiple choice**	**Gap completion**	**Identification of the appropriate idiom**	**Total**
8	8	8	8	8	40

Upon examining Shapiro-Wilk test results, it was seen that pre-test results were normally distributed. Consequently, the difference in pre-test scores between two groups was calculated. Independent t-test result is presented in Table 6.

Table 6: Independent t-test results comparing control and experimental groups' pre-test scores

Groups	N	$\bar{X}$	S	sd	t	p
Control	18	16,61	6,29	32	1,03	0,312
Experimental	16	14,69	4,30			

As seen in Table 6, there is not a significant difference in the scores of control group ($\bar{X}$=16,61, SD=6,29) and experimental group ($\bar{X}$ = 14,69, SD=4,30) conditions. ($t_{(32)}$=1,03, p=0.3). In addition, students' first term English scores were obtained and it was seen that the mean scores of both groups were normally distributed and there is no statistically significant difference between two groups [$t_{(32)}$= -.388]. By taking into consideration both their first term English grades and pre-test scores, it was assumed that control and experimental groups were equal and correspondingly experimental process continued.

Implementation phase -3: The implementation was conducted on the same day (the first day of the week) with both groups for four weeks. Ten idioms were taught each week. Every week, role-play texts were presented on the LMS "kidblog" used by school before each class so that they would read the texts and come to class prepared. The presentation stage involved dramatization of role plays by different students twice during the first or the last 10 minutes of the lesson. This step was then followed by explaining the meanings of idioms used in the texts.

Implementation phase - 4: Each week, two cartoons were created for each idiom which makes 2 x 10 cartoons per week. The first cartoon displayed the use of idiom in a context. The function of the second cartoon was to test students' understanding of the idioms. Two sample cartoons are presented in Figure 1 and Figure 2.

Figure 1: First and second delivered sample cartoons for idiom "an arm and a leg"

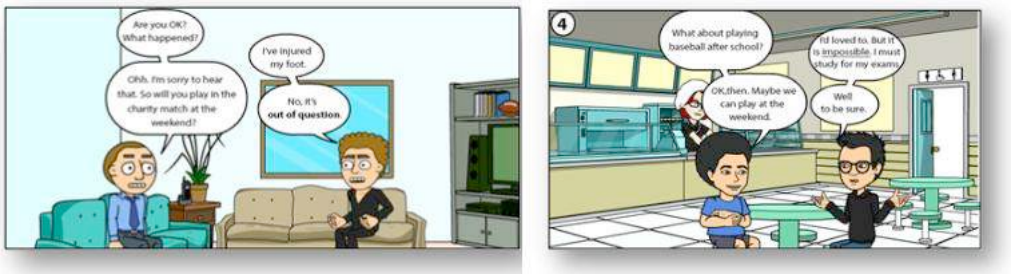

Figure 2: First and second delivered sample cartoons for idiom "out of question"

The cartoons were delivered in different ways to the students in experimental and control groups after being presented in the form of role-plays each week. For the experimental group, after role-play sessions each week, the first group of cartoons, which expressed the meaning of the idiom, were delivered to students between 5 p.m. and 9 p.m. on three consecutive days. Cartoons were passed over to students via WhatsApp groups that were created in order to encourage students to discuss the idioms and in order to create a social environment. In order to understand the experimental group's comprehension of idioms, the testing cartoons were sent to students via WhatsApp from Friday evening until Sunday evening and their answers were gathered individually.

For the control group, after role-play sessions each week, the posters of the cartoons were hung on the classroom wall where they can be easily viewed (see Figure 3) and they were kept there for three days until Friday. The cartoons that were prepared to elicit students' understanding of the idioms were hung on the wall while the previous cartoons were removed. In order to understand the control group's comprehension of idioms an "answer box" (see Figure 4) was prepared and the students were requested to write their answers and their names on notepads and insert them into the box.

Figure 3: Sample cartoons on classroom wall

Figure 4: Sample answer boxes in the classroom

Implementation phase - 5: At the end of four weeks, the achievement test was given to both groups as a post-test. T-test, two related sample test (Wilcoxon), and two independent sample test (Mann-Whitney U Test) were used. The significance level was taken as 0.05.

Findings and Discussion

In order to answer to the research question, pre-test and post-test scores of control and experimental groups were analyzed. Descriptive statistics of pre-test and post-test scores are presented in Table 7.

Table 7: Descriptive statistics for pre-test and post-test scores for control and experimental groups

		N	Mean	Std. Dev.	Min	Max
Experimental Group	Pre-Test	16	14,69	4,301	8	22
	Post-Test	16	18,12	9,157	9	40
Control Group	Pre-Test	18	16,61	6,298	7	31
	Post-Test	18	20,50	8,361	11	37

On post-test scores of both groups, normal distribution was tested in order to understand the kind of statistical analyses that will be carried out. Since we had only 34 elements, the Shapiro-Wilk test was used. As non-normal distribution was observed, a Wilcoxon Signed-Ranks Test was conducted to determine if there is a significant difference in students' academic achievement scores between pre-test and post-test for each group. The results are presented in Table 8.

Table 8: Results of the Wilcoxon Signed-Ranks Test on the Pre-test and Post-test Score Levels of Students in the Experimental Group and Control Group

		N	Rank Average	Sum of Ranks	Z	p
Experimental Group	Negative Rank	3	6,83	20,50	2,01	.044
	Positive Rank	11	7,68	84,50		
	Equal	2				
Control Group	Negative Rank	3	7,67	23,00	2,33	.020
	Positive Rank	13	8,69	113,00		
	Equal	2				

On the basis of the results obtained, it could be argued that the treatment implemented significantly increased English idiom academic achievement levels of the experimental and control group students. In order to find the answer to the research question and to understand whether the increase in achievement level differs according to control and experimental groups, Mann Whitney U test was computed. The results are presented in Table 9.

Table 9: Mann Whitney U Test Results to Compare the Groups' Post-test Academic Achievement Scores

	N	Rank Average	Sum of Ranks	U	Z	p
Experimental Group	16	15,31	245,00	109,00	-2,212	.226
Control Group	18	19,44	350,00			

As seen in Table 9, there is no difference in students' learning of idioms via IM vis-à-vis the other method of delivery, posters in classes. This case is another new example to show that using technology in education will not always bring the most effective learning outcomes. Regardless of integration of technology, an effective instruction will ultimately lead to learning. Technology is not a guarantee of success in education and it is not always a panacea for all of our educational problems.

There is a consensus that technology has not had a significant impact on language and literacy teaching and learning in grades K-12 in the USA (e.g., Cuban 2001; Blok et al. 2002; Cheung and Slavin 2012). Therefore, there is a need to investigate the reasons why the students in the control group performed better than their counterparts.

This study does not focus on students' mobile technology usage habits during their classes. The practice of using smart phones was performed only throughout the course of this study to support instruction. Hence, the implemented mobile learning could not be a natural part of school climate. Indeed, Niemi, Kynäslahti, & Vahtivuori-Hänninen (2013) identify in their research that successful integration of ICT requires strategic planning, as part of school culture. On the other hand, the cartoons which were transmitted to students in the form of posters in the classroom environment might have succeeded in becoming a natural part of the natural classroom climate. Therefore, while similar technology integration and implementation procedures are carried out in classes, it is important that this process should be as natural as possible. In addition, for the purpose of testing the effectiveness of teaching, allowing a time period during which the students can indigenize and naturalize the process might be helpful. As another factor; this result might lead us to consider the time spent by students as a variable. Amer (2010), in his study on a mobile application (Idiomobile), found that the more time students spent using the program, the higher they achieved on the tests.

As cartoons were continuously displayed in the classroom, the students were exposed to these materials consciously or unconsciously all the time. On the contrary, students who received the cartoons as IM did not have such exposure. We do not know whether the students examined the cartoons sent to their smart phones once or more than once or how much time they spent on these materials. Thus, the time students spend on a specific material delivered to them within the scope of mobile learning can be considered as an important aspect to further investigate.

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University Students' User Expectations Concerning E-Textbook Features

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
The purpose of this study is to investigate how university students evaluate the importance of specific features and applications within e-textbooks for their learning process. Participants were 92 future teachers on primary level. A questionaire consisting of Likert-scale questions was used in this study. The results indicate that the students found the features which they already know from the traditional textbook most important. Our study is in line with previous studies which indicate that the shift to an active e-learning culture is in the early stages among higher education students. Future studies are needed which investigate what kind of support students need while studying with e-textbooks to promote more efficient design.

Keywords: E-learning, e-textbook, user expectations, higher education, preservice teachers

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Introduction

E-textbooks are becoming more and more part of the teaching and learning process also in higher education. An e-learning environment such as e-textbooks can offer a great deal of new active learning possibilities to the students. According to the constructivist learning model learner actively creates knowledge on his or her own way. So the adaptiveness of e-textbooks can offer support as an essential learning tool on all levels (e.g. Rockinson et al. 2013). But the acceptance among students seems to be quite low and they often prefer the traditional paper format textbooks (Marques, 2012; Daniel & Woody, 2013). Hence, the purpose of this study is to investigate how university students evaluate the importance of specific features and applications within e-textbooks for their learning process. By features we refer to possibilities direct related to the e-textbook like taking notes, high lightning, looking for additional information from the Internet in form of video clips or virtual simulations. On the other hand we are interested in how students consider the collaborative possibilities within e-textbooks. What kind of features in e-textbook are considered as important among future teachers?

Methods

The participants of this study were preservice teachers (n = 92). Future primary school teachers can be considered as important target group for future implementation of next generation e-textbooks. The students took part in an intervention study (Mikkilä-Erdmann et al. 2014) and used e-textbook for Ipad. After the intervention a questionnaire was given which consisted of 24 statements on seven-point likert scale. Students had to evaluate how important specific features are for their learning. Seven point likert scale concerning the level of importance was used: From 1 (Not at all important), 2 (Low important), 3 (Slightly important), 4 (Neutral), 5 (Moderately important), 6 (Very important), to 7 (Extremely important).

Results

The results indicate four different levels of importance concerning e-textbook characteristics. The features which are typically used while studying with traditional paper books like underlining, writing comments in the text and using notebook for making notes in all kind of forms have the highest importance (M = 5.74, Sd =1.09) for future teacher. Students found moderatly important features which are dealing with review questions (M=5.29, SD=1.59) as well as to make a printout from the text (M=5.03, SD=1.53). Searching further information on topic (M=4.98, SD=1.41) was also moderately important. Additional explanations on the topic through games, or virtual labs or a video clips are considered moderately important (M=4.52, SD=1.27). Students rated more or less important (neutral) the features which help to manage knowledge, e.g. to search, evaluate and arrange links (M=4.07, SD=1.27) as well as the the possibility to communicate with other students or with the teacher (M=4.36, SD=1.52). The least important features for the students are voice services, like the device which is reading out the text (M=2.9, SD=1.55).

Conclusion

The study indicates that the students require from e-Textbooks traditional features like underlining words, making notes and using the index, what is very common from the former experience learning with paper books. The students rather like to stay inside the text. If the eTextbook is nicely organized students seem to accept links as extra knowledge sources, but are not willing to manage knowledge on their own. It seems that the students like a rather closed and linear learning environment relating to the e-Textbook. Other possibilities for example to integrate more flexible information into the e-Textbook have sparce importance. New possibilities to learn via games and virtual labs were not found very important among teachers students. It can be assumed that the text and dealing with the text is considered as the main and the most efficient tool for learning.

Even collaboration and communications possibilities face to face or virtually are not seen relevat for future teacher students regarding e-Texbooks. Maybe learning with the e-Texbook is seen as a special individual phase of learning with a certain knowledge and on own time and rhythms, so that questions and communication are seen more disturbing than helping them to learn. Our study is in line with previous studies (e.g. Daniel & Woody, 2013) which indicate that the shift to an active e-learning culture is in the early stages among higher education students. Future studies are needed which investigate what kind of support students need while studying with e-textbooks to promote more efficient design.

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An Evaluation of the Joint Admission and Matriculation Board's (JAMB) Computer Based Test Effectiveness in Post Secondary Schools in Nigeria

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
Computer Based Test (CBT) is defined as a test or assessment administered with the use of computer and ICT devices. CBT has become widespread in recent years in developed countries. For more than a decade CBT has been called the “new frontier of testing” (Thompson et al., 2002). CBT among other benefits enhances fair and precise evaluation of a candidate’s competency, rapid turnaround of exam results, and more choices as to when and where to take the exam and easier registration. The Joint admission and Matriculation Board (JAMB) in Nigeria saddled with the responsibility of conducting examinations for selecting students of Post Secondary schools into Nigerian Universities, Polytechnics, and Colleges of Education conducted the 2014 examinations using the traditional Paper based system and Computer based testing. Having experimented, the board has therefore perfected plans to conduct the 2015 examinations with CBT only for the purpose of curbing examinations malpractice with no missing result and answer scripts. This paper tends to evaluate the effectiveness; the infrastructure required and examines the attitude and views of Post Secondary School Students towards the use of CBT.

Keywords: Computer Based Test (CBT), Paper Based System, ICT

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Introduction

A Computer-Based Assessment (CBA), also known as Computer-Based Testing (CBT), e-assessment, computerized testing and computer-administered testing, is a method of administering tests in which the responses are electronically recorded, assessed, or both. As the name implies, Computer-Based Assessment makes use of a computer or an equivalent electronic device such as a cell phone or PDA. CBA systems enable educators and trainers to author, schedule, deliver, and report on surveys, quizzes, tests and exams. Computer- Based Assessment may be a stand-alone system or a part of a virtual learning environment, possibly accessed via the World Wide Web (Georgiy 2011)

In any Educational Sector, the relevance of the body saddled with the responsibility of conducting Examinations for students is stressed because it is the only institution that exists to ensure the survival of Education through its pivotal role of ensuring that only the best candidates are selected. This, therefore, calls for the need to have a strong and viable method of conducting this examination that will produce quality and best brains into different courses in Colleges of Education, Polytechnics and Universities as might be desired by students in Post Secondary schools in Nigeria. Computer and related technologies provide powerful tools to meet the new challenges of designing and implementing assessments methods that go beyond the conventional practices and facilitate to record a broader repertoire of cognitive skills and knowledge (Mubashrah, 2012). In the developed world, the use of CBT has been widely accepted and it is lauded as the answer to having cheaper and speedier test delivery for state and district-wide assessments. It is also seen by some as an avenue toward greater accessibility for students with disabilities (Thurlow, 2010). The Joint Admissions and Matriculation Board (JAMB) established by the Government of Nigeria as sole body to conduct this examination have concluded plans to use the Computer Based Test for assessments of new intakes into higher institutions to enhance fair and precise evaluation of a candidate's competency, rapid turnaround of exam results, more choices as to when and where to take the exam, easier registration and fortified examination security.

Computer-based testing is viewed by many policy makers as a way to meet the requirements of the No Child Left behind Act of 2001 (NCLB) (Thompson, et al., 2003) and it is the belief of these policy makers that Computer based testing allows candidates to take his or her examination in a convenient testing centre, saving time and money. The advantage is that these testing centres are located close to home, so travel expenses and time are saved. Further, the centres offer privacy along with a quiet and comfortable environment.
It is generally recognized that examinations determine the extent to which educational objectives have been achieved as well as the extent to which educational institutions have served the needs of community and society and assessment is an important component of a learning process in a formal Education.

A Brief introduction to the Joint Admission and Matriculation Board (JAMB) in Nigeria

The Joint Admissions and Matriculations Board (JAMB) is a Nigerian entrance examination board for tertiary-level institutions. The board conducts entrance examinations for prospective undergraduates into Nigerian universities. The board is also charged with the responsibility to administer similar examinations for applicants to Nigerian public and private Monotechnics, Polytechnics, and Colleges of Educations. All of these candidates must have obtained the West Africa School Certificate, now Senior School Certificate Examination, SSCE or its equivalent, National Examination Council, NECO.

By 1974, there were seven federal universities in the country. Every one of these existing universities conducted its own concessional examination and admitted its students. However, these systems of admission revealed serious limitations and quite often waste of resources in the process of administering the concessional examination, especially on the part of the candidates. The general untidiness in the uncoordinated system of admissions into universities and the attendant problems were sufficient cause for concern to the committee of vice chancellors.

These problems had assumed new dimensions when by 1976, the then federal military government, under the leadership of General Olusẹgun Ọbasanjọ, established six additional universities. Consequently, the government set up a national committee on University entrance under the chairmanship of M. S. Angulu.
The legal instrument establishing the Board was promulgated by the Act (No. 2 of 1978) of the Federal Military Government on 13th February, 1978. By August 1988, the Federal Executive Council amended Decree No. 2 of 1978. The amendments have since been codified into Decree No. 33 of 1989, which took effect from 7th December, 1989. Decree No. 2 of 1978 (amended by Decree No. 33 of 1989) empowered the Joint Admissions and Matriculations Board to:
(a) conduct Matriculation Examination for entry into all Universities, Polytechnics and Colleges of Education (by whatever name called) in Nigeria

(b) appoint Examiners, Moderators, Invigilators, members of the Subject Panels and committees and other persons with respect to matriculation examinations and any other matters incidental thereto or connected therewith.

(c) place suitably qualified candidates in the tertiary institutions after having taken into account:
(i) the vacancies available in each tertiary institution
(ii) the guidelines approved for each tertiary institution by its proprietors or other competent authorities
(iii) the preference expressed or otherwise indicated by the candidates for certain tertiary institutions and courses
(iv) Such other matters as the Board may be directed by the Honourable Minister to consider or the Board itself may consider appropriate in the circumstances.

(d) Collate and disseminate information on all matters relating to admissions into tertiary institutions or any other matter relevant to the discharge of functions of the board.

(e) Carry out other activities as are necessary or expedient for the full discharge of all or any of the functions conferred on it under or pursuant to this Decree. (Dare 2008).

The board had kept this mandate of conducting the examination over the years using the paper and pencil system but not without a lot of hitches and condemnation from other stake holders. This was now vividly clear when in 2009 University Matriculation Examination grading system of the normally reputable examination body was subject to serious controversy because the overall performance was one of the poorest on records. Much to Jamb's embarrassment, it was later revealed that the machines which optically graded the papers had erroneous answers and the JAMB changed some student's scores by as much as 15% (Ladipo et al. 2012).

Post-UME Screening Examination

The shortfalls of JAMB conducting the University Matriculation Examinations over the years with the use of the traditional paper and pen system created serious attention from the Federal Government of Nigeria through the minister of Education Mrs. Chinwe Obaji to introduce the Policy of Post-JAMB screening by universities in 2005. This policy made it mandatory for all tertiary institutions to screen candidates after their JAMB results and before giving admission using aptitude tests, oral interviews, or even another examination. The introduction of Post- UME in the Polytechnics and Universities further exposed JAMB as a body to conduct examination that will produce quality graduates.

Ogunleye (2008) reports that the Wesley University of Science and Technology (WUSTO), established by the Methodist Church Nigeria (MCN), licensed by the Federal Government in May 2007, has conducted its first UME screening. Oyedele (2008) quotes the University of Ado Ekiti Vice-Chancellor, Professor Dipo Kolawole, a well-known supporter of the post-UME test, as saying that "in the past a student will score 289, automatically he comes in, but with the Post-UME now, you find that such a student is scoring a very poor mark and cannot even write. If we desire sanitation of our educational system … it does not make sense for anybody to be against the post-UME. If there are other built in mechanisms to purify the admission process … it should be a welcome idea.." (Isaac 2010).

Below is the summary data on UME Malpractice and the Nature of Malpractice from Prof. Dibu Ojerinde, Jamb Registrar/ Chief Executive in a paper presented at the 35th IAEA Conference Brisbane, Australia in September, 2009.

Data on UME Malpractice and the Nature with the Use of Pencil and Paper System

S/N	NATURE OF MALPRACTICE	2005		2006		2007		2008	
		UME	MPCEME	UME	UME	UME	MPCEME	UME	MPCEME
1	No e-Registration Slip	1,289	185	808	86	2,006	85	1,687	102
2	Absconding with	161	257	1,783	256	670	31	297	40

	Answer scripts								
3	Spying/copying from prepared answers	6,314	3,007	3,419	217	2,362	1,604	1,187	271
4	Impersonation	226	81	216	22	253	74	152	69
5	Swapping of examination documents	248	139	455	31	144	209	45	119
6	No Registration Detail	-	-	69	-	-	-	3	-
7	Violent/Unruly to examiners	2,783	15	1,150	30	749	234	2,521	81
8	Lateness to examination hall without valid reasons	5,511	2,829	4,178	587	1,0470	256	3,549	313
9	Use of GSM phone	66	112	198	47	1,139	372	2,647	523
10	Smuggling out of Question papers/Answer sheets	974	367	601	186	257	149	860	52
11	Colluding with other candidates/examiners/ external agents	8,2312	4,474	42,737	1,080	255	87	1,366	78
12	Leaving examination hall without permission	44	3	19	-	47	5	49	3
13	Absent with script	2	-	2	-	4	-	2	-
14	Wide-spread cheating	41,042	11,797	50,224	1,620	591	2,700	18,437	1,740
15	Incomplete result	20,797	-	2642		30,155		25,552	

TOTAL	161,769	23,266	108,501	4,182	49,102	5,906	58,354	3,391

Table1: Source: Jamb Registrar Speech Delivered At 35th IAEA Conference Brisbane, Australia In September, 2009.

From table1 above, it is very clear that the paper and pencil used in the conduct of the UTME by JAMB since inception has been long over due for change to a better method like the CBT. The paper and pencil method was characterised by Examination racketeering i.e., creation of special centres with the intention of assisting students during the examination, smuggling of question papers outside the hall, bribery and manhandling of invigilators, students sometimes make stray marks or messy erasures that can result in inaccurate scoring of an exam etc. This therefore necessitated the conduct of 2014 UTME with the mixed method and later conducted the 2015 UTME with only CBT because of the challenges encountered. The major question now is, how ready is JAMB to the task of conducting the examination with CBT considering the increasing number of prospective students intending to write the UTME, and the infrastructure required for its implementation?

Computer Based Testing

Computer-based testing has been called the “next frontier in testing” as educators, testing companies, and state departments quickly work to transform paper/pencil tests into technology-based formats (Thompson, 2003).
Moreover, offering different test formats and the immediate presentation of different types of feedback, either to students or testers, are also some of the great advantages of CBT
The standardization of test administration conditions is one of the benefits offered by computer-based testing (CBT). No matter what the tests’ population size is, CBT helps test developers to set the same test conditions for all participants. It also improves all aspects of test security by storing questions and responses in encrypted databases and enables testers to create randomized questions and answers from vast question pools (Saad, 2007).
There are many opportunities created when computer-based tests are used. These include more efficient test administrations, the availability of immediate results etc. In addition, computer-based testing opens up the possibility for built-in accommodations, student selection of testing options, and increased authenticity in items that are included. Other benefits have been identified as well, so there is considerable pressure to move toward computer-based testing (Thompson, S., Thurlow, M., & Moore, M., 2003).

Methodology

The research method used in this research is based on the quantitative research methodology and it was used to analyze the views and opinions of Post Secondary School Students, which involved the use of questionnaires to explore the current trends and impact of CBT on the conduct of UTME.

The methodology as described by Black (1999) is a research methodology involving the use of structured questions (questionnaires) where the response options have been predetermined and a large number of respondents are involved.

Data Collection

This research was mainly based on primary data gathered from selected JAMB lecture houses at different locations in Edo State, Nigeria and we consider that each has about 30 to 120 students. The questionnaires were administered by teachers and proprietors of the lecture houses as it appeared to be the fastest and cheapest way of getting result from the students.
All the questionnaires sent out that go with the study, all were returned and used, making the response rate to be at a 100 percent. The participants of the questionnaire remain anonymous throughout the research as responses they provide would be untraceable and unidentifiable to the participant who provided them

Research Findings and Deductions

(i) Attitude and Views towards Computer Based Test
From the analysis of survey, about 88% of the respondents are somehow familiar with the concept and application of CBT, 9% are not sure when it comes to the concept and application of CBT. Only 5% declared that their familiarity with CBT is low. Also, 91% believe that CBT will have a major effect on the students while just 2% are not sure if CBT will have an effect.
On the importance of implementation of CBT to the respondents, 52% believe that it is very important for Students to embrace and use CBT while 44% are not sure how the implementation of CBT will be of importance to Students. Only 4% of the respondents believe that the implementation of CBT is not important.

Deduction

We can deduce that more than half of the respondents are familiar with the concept and application of CBT which goes to show that most of the respondents are already aware of what to face. This selected sample has enabled us to extend and generalize the result obtained from the survey to almost all other students preparing for UTME in Nigeria.
Also, almost all the respondents except less than 2% found that CBT will definitely have a great effect on the conduct of the examination in curbing exam malpractices and other problems associating with the paper and pencil system. This goes on to show that it is of great importance for JAMB to adopt Computer Based Test. Based on the analyses; we can conclude that students have the positive attitudes and views towards the concept and application of CBT.

(ii) Infrastructure Requirement

We categorize the basic elements of infrastructure requirements into four groups:

- Hardware and network (computers, internet, e-mail, modem, intranet and extranet etc)
- Software (standardized processes and Question bank etc)
- IT experts

- Skilled staff (in CBT)

Findings show that more 86% of the respondents believe that JAMB has the infrastructure requirement on hardware and network whereas 8% are not sure of the hardware and network available in adopting CBT. Only 6% believe that it does not have the infrastructure required.
Also, 84% believe that the board has the necessary software (Question bank) required for CBT implementation while 10% are not sure if it has the required software. 6% believe that the board does not have enough questions in a question bank to cater for all the centers nationwide for all the periods for the exam to implement CBT.

When it comes to the deployment of CBT, the availability of IT expert with necessary skills are required in order to put things right for the student when the need arises, 50% believe that the board has the needed IT expert to embrace and deploy while 42% are not sure if it has the required and needed skilled IT expert for implementation. 8% of the respondents believe that JAMB does not at all have the needed skilled IT expert required.
Following the information provided, about 60% of the respondents believe that the board has the required skilled and competent staff in CBT while only 7% of the respondents are not sure if the board has the skilled staffs required. 33% of the respondents believe that JAMB does not have the skilled staffs required for implementation.

Findings revealed that majority of respondents believed that JAMB is well equipped in terms of hardware and networking and equipped software needed for CBT implementation. Though, it was observed that IT expert could be moderately equipped from the response of the respondents.

(iii) Major Obstacle

Based on the literature and preliminary study, respondents were asked to evaluate these items accordingly:

- Economic factor.
- Security factor.
- Poor ICT culture, policy and implementation.
- Poor ICT funding.
- Power failure.
- Inadequate manpower/skills.

Findings shows that majority of the respondents believe that all of these major obstacles outline will hinder CBT adoption. They strongly agree on all obstacles but the strength of agreement slightly varied. The most important obstacles according to the respondents are listed in order of percentage below:
Economic factor - (63%)
Poor ICT culture, policy and implementation - (54%)
Security fears – (67%)
Poor ICT funding – (60%)
Power failure - (65%)
Inadequate manpower/skills – (70%)

This goes to show that these barriers are real and needs to be addressed if JAMB will need to adopt CBT effectively and continuously.

(iv) Perceived Benefits of CBT

In the final part, which is the last research question, the perceived benefits and advantages of CBT implementation were the main question asked from the respondents. To answer this question, the following benefits of CBT application was asked the respondents and they are:
(i) Curbing of Examinations Malpractice
(ii) JAMB Image promotion
(iii) Increase in reliability and efficiency
(iv) Improved administration and scoring efficiency
(v) Fast responses of result
(vi) Lower Cost as a result of elimination of shipping materials
(vii) Improved Test Security
(viii) Consistency and Reliability
Findings reveal that almost all respondents highly believed that in the case of CBT implementation, Curbing of Examination Malpractice will be a great benefit. This resulted in 90% agreement with respondents thus being regarded as the most important benefit among the top benefits. 10% are not sure if CBT implementations will Curb Examination Malpractice.
The second important benefit according to the respondent's idea is JAMB Image Promotion. About 91% of the respondents believe it is highly important to implement CBT in order to regain the confidence of stake holders in the Education industry.
The results of respondent's answers to other questions are shown below:
Increase in reliability and efficiency - 94%
Improved administration and scoring efficiency – 88%
Fast responses of result- 95%
Lower Cost as a result of elimination of shipping materials- 92%
Improved Test Security- 80%
Consistency and Reliability- 70%

Readiness to CBT Implementation

The last question in the questionnaire was designed to sum-up the respondents overall attitudes towards the implementation of CBT.
The research reveals that about 60% of the respondents believe that students are ready to embrace CBT in while 40% of the respondents are not sure if students are ready to embrace CBT application and this we believed to be the phobia to the use of Computer and ICT infrastructure.
In general, the readiness of any student adopting CBT application varies and this strictly depends on many factors surrounding the student.

Conclusion And Recommendations

Conclusion

The application of CBT can either be a challenge or even become a threat to JAMB considering the enormous task of CBT, i.e., staff training on ICT, infrastructure required and the large number of prospective students.
The adoption of CBT technology is one that is necessary in any examination process and for Joint Admission and Matriculation Board especially in obtaining a competitive leading and being able to compete with global educational institutions. It can be confirmed that from the related studies and the research findings that CBT not only serves on benefits and opportunities, it also brings a number of barriers if the technology is to be adopted successfully. Also we observed that CBT adoption will be a great opportunity for JAMB as a means of improving the standard of Education in Nigeria, stake holder's trust with good quality students that can defend their scores when the need arises.
The challenge before JAMB is enormous especially with some issues and questions that need to be addressed; Computer malfunctioning mid way into the examination, fixing of exam in the early hours (6am) in one of the sessions making students to leave homes at risk before 6am to be at the venue and most time not within reach of the students, delay in the start of exam thereby overlapping to the next session etc. The Infrastructure required for the implementation of CBT is enormous and it is our concern and believes that the credibility and integrity of private firms partnering with JAMB in the process should not be compromised.

Recommendations

In other to extend the present research, it is worthy to note the limitation of this study and its findings. Thus it is recommended that this research be repeated again to compare with a post-implementation study.
The Federal Government should as a matter of urgency put policy in place to make it mandatory for Secondary schools to practically teach students on the use of Computer in order to have the skills that can remove the phobia of students towards Computer.

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An Attempt on the Support for Self-Teaching in the Elementary Physics Education

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
As the percentage of students enrolling in universities reaches more than 50% in Japan, a lot of Japanese university takes on students who do not have a sufficient basic level of academic ability. As to the education of physics, not a few students are a lack of basic concepts and basic knowledge of physics. In this study, an effect of a review test on academic ability of physics in class was examined for the students of our university. The review test is implemented in learning management system, Moodle. The course investigated in this study is an elementary physics course offered for second-year students. This course is optional and offers a lecture once a week throughout one university year. The total number of students who chose this course is approximately 100. The review test is composed of two parts: one is a part of formulation of a concept of physical phenomena and another is a part of understanding of equations and symbols. During the review test, students have to refer to the text, their notes and other reference materials. It takes approximately 15 min. As a result of several years' trial, the effect was in evidence in the term examination.

Keywords: elementary physics course, university, review test, basic concept, basic knowledge, Moodle

Introduction

The percentage of students enrolling in universities has increased gradually and it reached approximately 50% in Japan [1]. Under this situation, a lot of Japanese universities take on students who do not have a sufficient basic level of academic ability. Namely, there is a lack of high school level knowledge and skills, autonomy, endurance and so on. Additionally, regarding the education of physics, a lot of students lack of a basic understanding of concepts and basic knowledge of Physics. Private universities have this tendency remarkably. In Japan, private universities accounts for about 75% of all universities [1]. Therefore, a lot of private universities accept a considerable number of such students. In Japan, the issue of the improvement of academic achievement of university students is an important problem.

Increase in the percentage of students enrolling in universities is not an issue only in Japan but also in other countries. In United States, United Kingdom, France and Germany, it is over about 40% [2]. In Korea, it exceeds 90% [2]. This tendency is common in nations with advanced economy. The issue of the improvement of academic achievement of university students will be a serious problem for many nations. In United States, a lot of universities have grappled with such difficult problem for many years [3]-[5].

On the other hand, it is often said that active learning methodology induces deep understandings and stimulates students' spontaneous willingness to learning. Many teachers try to adopt the active learning to their classes recently. However, basic knowledge is necessary to bear fruits. Even if the active learning is adopted in the class with so many students who lack of basic knowledge, it is not expected big fruits. In such class, fixing the basic knowledge is prior to the active learning.

This study is an attempt on the support for self-teaching in the elementary physics education. It aims fixing the basic concepts and basic knowledge of physics for the students who do not have enough autonomy and endurance. For this purpose, a review test was introduced in the class of elementary physics course in our university. The review test was originally introduced in our university in the year of 2005 [6]. As a result of several years' trial, the effect was in evidence in the term examination. In this study, the review test is implemented in learning management system, Moodle, with the view of improving the effect of the review test more.

Progress of teaching in classes

Proceeding of classes in semesters is shown in Figure 1. The elementary physics course is composed by two subjects of Physics I and Physics II. The former includes Mechanics and Electromagnetism and is available in first semester. The latter includes Thermodynamics and Optics and is available in the second semester. This course is offered for the second-year students of Hokkaido Information University. Students can take both of the subjects or one of these. The contents of both the subjects are elementary physics as liberal arts subjects. One semester is composed of 15 classes and it takes 90 min for each class. In the semester, the class is offered once a week. Almost all students forget the contents of lecture. The review test is offered at the beginning of the class to remind students of the contents of one week before. In the class, short quiz is offered approximately every 20 minutes and homework is offered.

However, it was confirmed that the review test is the most effective for fixing memory [6]. Quiz is considered to be effective to help their understanding of the concept of the law of physics.

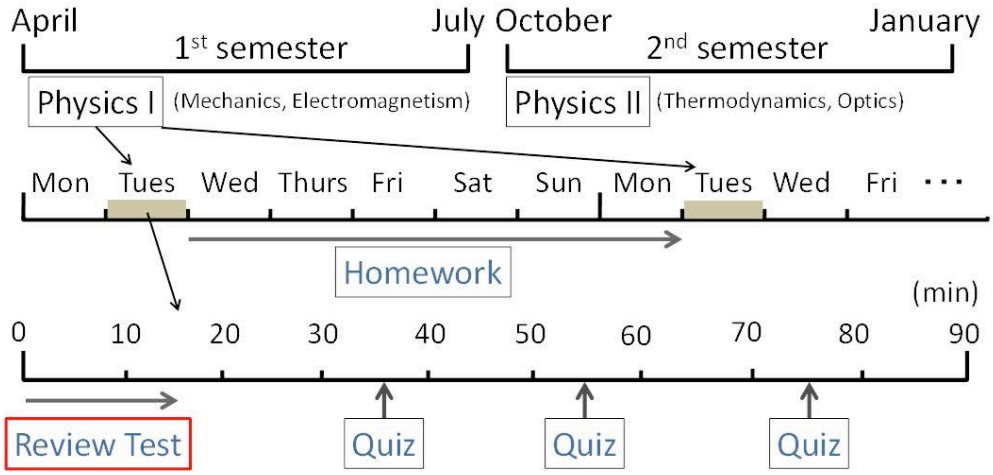

Figure 1: Proceeding of Physics I and Physics II in the semesters

Review Test

The review test is composed of two parts. One is a part of meaning of terms. It reviews formation of a concept of the laws of physics and comprehension of physical phenomena. Another is a part of reviewing formulae and symbols. The review test is originally paper-based form. Students submit a mark card entered with their answer. An example of the mark card and the review test is shown in Figure 2 and Figure 3 respectively. During the review test, students have to refer to the text, their notes and other reference materials because the aim of the review test is recall the memory of the previous lecture. It takes approximately 15 min for students to grapple with the problems including collection time of the mark card. The paper-based review test was introduced in 2005. The effect appeared immediately as explained in the previous paper [6]. The effect has been confirmed in the average mark of the term examination of the class. The average marks increased 10 points on the bases of 100 points in Physics I and 25 points in Physics II on average. The verification of the effect of the review test has been continued up to the present [7] [8]. The good effect has been kept.

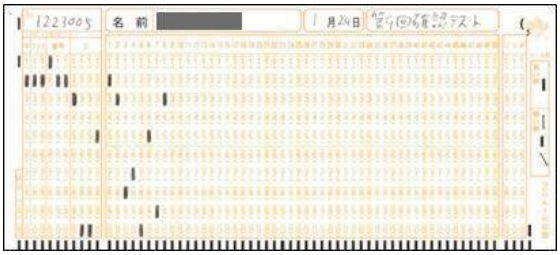

Figure 2: Mark card used int paper-based review test

Physics Ⅱ The 6th Review Test

Department	Class	Student ID	Name

Chose the suitable answer from the CHOISES.

	Meaning of terms		Formulas, Symbols	
Internal energy of ideal gas	1		4	
The 1st law of thermodynamics	2		5	
Principal of a heat engine	3		— —	————
State quantity	—	————	6	
			7	
			8	

〔CHOISES: Meaning of terms〕

[1] The law which means the work is equal to the heat.

[2] The fundamental quantity representing the amount of material. It is counted by the unit of the Avogadro number.

[3] Internal energy a system increases if the heat or the work is took out from the system.

[4] The ability of working which occurs by keeping a distance between the attracted objects.

[5] The internal energy of the ideal gas is inversely proportional to the absolute temperature.

[6] The internal energy of the ideal gas is proportional to the absolute temperature.

[7] Internal energy of a system increases if the heat or the work is given to the system.

[8] Taking out the work from a system by using thermal expansion of material.

[9] The energy necessary for heating a material of 1 g by 1℃.

[0] The relationship between the volume, the temperature and the pressure.

〔CHOISES: Formulae, Symbols〕

[1] $\boldsymbol{Q}$

[2] $PV = nRT$

[3] $\boldsymbol{\Delta U = Q + W}$

[4] $\boldsymbol{U}$

[5] $\boldsymbol{U = \frac{3}{2} NkT}$

[6] $\boldsymbol{W}$

[7] $\boldsymbol{V}$

[8] T

[9] $\boldsymbol{J}$

[0] N_A

Figure 3: An example of paper-based review test

Change of Medium of Review Test

In this study, the medium of the review test is changed from paper-based form to Moodle which is a kind of the learning management system in e-learning. Purpose of the change from the paper-based form to the Moodle-based system is summarized as follows:

1. Immediate marking
2. Reflection
3. Accumulation and analysis
4. Reduction of teacher's burden

Regarding the 1st aim, in the paper-based review test, in fact, the immediate marking and the return of it to the students is difficult, even though the reading device of mark card is used. Even if the earliest case, the return will be one week later. In the Moodle, the review test is marked immediately. As the students are able to check their results then and there, they make reflection naturally. In the Moodle-based review test, for the sake of urging the students to make reflection, a function of writing their reflection is implemented. It concerns with the above 2nd aim. In the 15 minutes of the review test time at the beginning of the lecture, students solve the problems and write their reflection on the review test system on the Moodle. As mentioned in the 3rd aim, the results of the review test are accumulated automatically in the Moodle-based review test system. Therefore, it is easy to analyze the results. Finally, the 4th aim is reduction of teacher's burden. It does not mean negligence. Faculty members are very busy on their many kinds of work, for example, many lectures, marking of homework, many meetings and affairs of faculty and university, and so on. The reduction of burden ensures a sufficient time for faculty members to educate students. A screen shot of the interface and the source code of the review test are shown in Figure 4 and Figure 5. TeX [9] is used in the part of equations and symbols.

Figure 4: Interface of review test

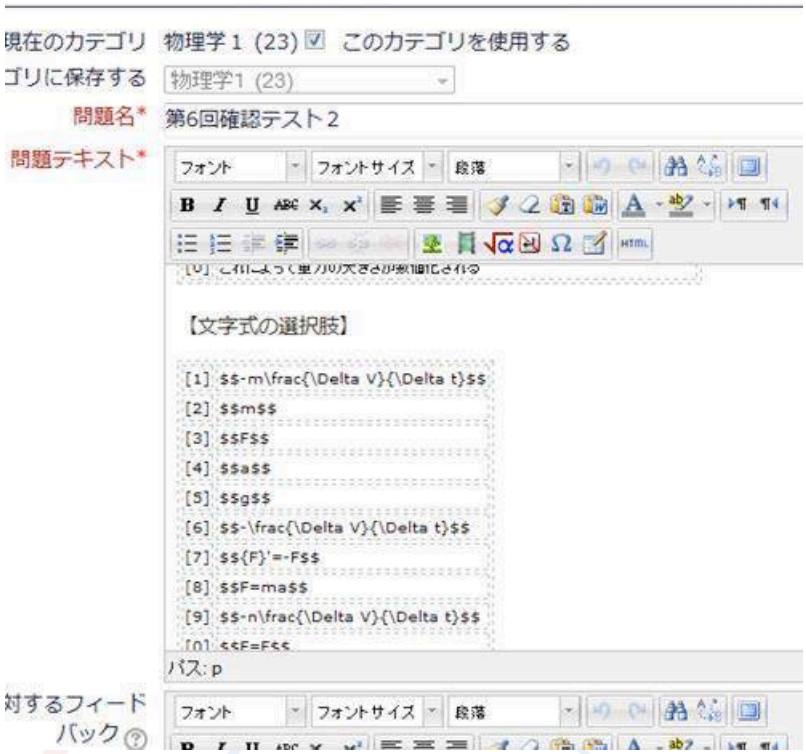

Figure 5: Source code of review test

The number of the review test transferred from the paper-based to Moodle-based is 22 for Physics I and 25 for Physics II. The number of questions is 6 at minimum and 10 at maximum per each review test.

Results of Attempt

The effect of the Moodle-based review test is discussed below by comparison with that of the paper-based review test. The students were classified into two groups. One is the group A whose students are second year and another is the group B whose students are third and fourth year. Before 2013, the students of both groups took the paper-based review test but in 2014, the students of the group A took the Moodle-based test and the students of the group B took the paper-based test. The reason is that all of the first and second year students of our university have iPad which is lent by the university in 2014, but others are not. Consequently, students are able to take the Moodle-based review test in a normal classroom. The snapshot of the classroom is shown in Figure 6.

The students of both groups took a pretest and a posttest at the beginning and the end of the semester in 2014. The results of these tests are summarized in Table 1. The Average marks, the standard deviations and number of students are entered in this table. *G* is a gain of the posttest over the pretest as defined by a next equation.

$$G = \frac{post - pre}{full - pre}$$

Here, *pre* is the average mark of the pretest in the class and *post* is that of the posttest. *full* is a perfect score, that is 50 points. We can see from the Table 1 that there is a good effect of learning because G value is ca.40% at maximum and ca.20% even at minimum.

Table 1: Results of Pretest and Posttest

		2011			2012			2013			2014		
		pre	post	G	pre	post	G	pre	post	G	pre	post	G
Group A	Average	10.5	27.8	0.44	8.7	22.1	0.32	9.0	21.8	0.31	8.3	23.7	0.37
	SD	6.7	11.3		6.3	9.3		5.4	9.7		6.5	9.4	
	no.Candi.	54	54		41	41		78	78		40	40	
Group B	Average	10.5	26.3	0.40	10.1	26.8	0.42	9.5	23.4	0.34	7.5	17.3	0.23
	SD	5.7	11.8		4.1	8.8		5.4	10.0		5.4	7.5	
	no.Candi.	22	22		17	17		14	14		8	8	

Subsequently, it is investigated whether there is a difference between the Moodle-based group A and the paper-based group B. Figure 7 shows a ratio G of group A (GA) to G of group B (GB) for the class of Physics I. The number of the candidate students at the end of semester is from ca.70 to ca.110 in depending on the year.

Figure 6: Snapshot in classroom

The ratio GA/GB is around 1.0 before 2013 but it increased up to about 1.6 in 2014. As described above, the group A and the group B took the paper-based review test though the group A took the Moodle-based review test in 2014. From this result, it is considered that the characteristics called the immediate marking and the reflection of the Moodle-based review test achieved a good effect on fixing the basic knowledge and the basic concept of elementary physics.

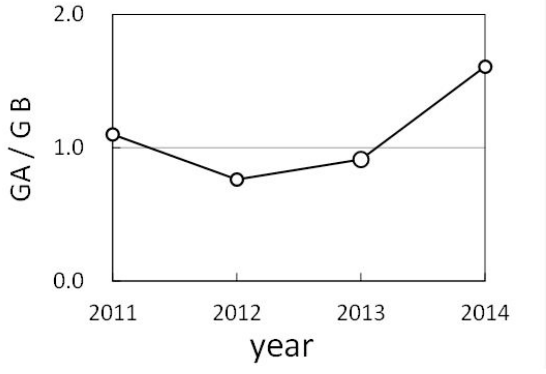

Figure 7: Ratio GA to GB against academic year for Physics I

However, regarding Physics II, the good effect is not clear as shown in Figure 8. The interpretation of this result is as follows. Physics II is also optional subject as same as physics I and the students should just take one of them. Normally, the great majority of the students takes Physics I. It is obvious from the registration number of students: approximately 100 for Physics I and 40 for Physics II. Therefore, it is considered that the students who take Physics II have an interest in study more than Physics I. This might be the reason why there is not difference between GA and GB in 2014 in Physics II.

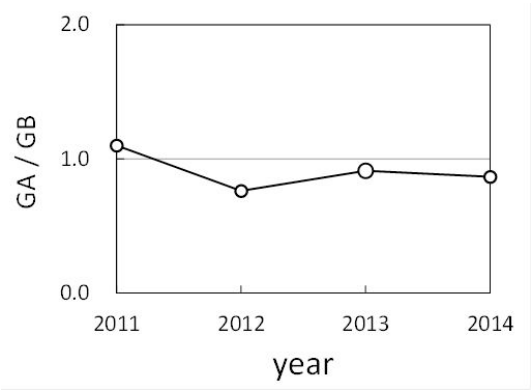

Figure 8: Ratio GA to GB against academic year for Physics II

Conclusion

The review test in class is useful as support for self-teaching in elementary physics class in our university. In this study, the medium of the review test is transferred from paper to Moodle in order to improve the effect of this test. The effect was investigated by using the pretest and the posttest. As a result, it is considered that the improvement of the test achieved good effect on fixing the basic knowledge and ensuring the understanding of the basic concept of physics. In the Moodle-based review test accumulates the reflection data. We may obtain useful intelligent from these data by doing the cluster analysis.

Acknowledgment

This work is supported by MEXT KAKENHI Grant Number 25350291.

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Blended Learning for the Softer Side of Computing

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
Computing students tend to like '2+2=4' types of modules, where the topics are clear and logical and have a definite right answer. They like structured materials and this ties in well with their programming skills. However, most computing students will end up interacting with non-computing personnel in the workplace and this can sometimes be a challenge for them. In recent years, industry leaders have said that computing students need to improve their soft skills. They want students who are not only technically competent, but can also communicate well with others. This paper describes two different university courses that use Moodle to provide a blended learning environment for students. Course A (n=75) focuses on technical communication skills for third year computing students, while course B (n=130) focuses on digital innovation and enterprise. Both courses make extensive use of Moodle, not only for lecture notes, but also for quizzes, group wikis, questionnaires and webinars. Moodle enables the lecturer to deliver materials in a variety of ways as well as the option to receive feedback from students throughout the semester. This is especially important as many of the students are outside their comfort zone in these modules. This paper notes some of the problems that can occur and provides suggestions for future improvements.

Keywords: soft skills, blended learning, problem based learning, Moodle

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Introduction

Computing students favor the 'hard' subjects. These include subjects such as computer programming, logic, databases software engineering and technology related subjects. They prefer subjects where there are clear answers and a systematic approach can be adopted. On the other hand, computing students tend not to like the 'softer' subject, where softer skills are required. These skills include writing, presentation skills, project management, group work and general communications skills. These softer skills can sometimes be more challenging for computing students, as they can be harder to define, and initially at least, seem less logical and straightforward. However, computing students need soft skills. Unless they are working exclusively with other computing specialists, they will need to interact with non-computing people. They will need to be able to understand clients and end-users and communicate with them in an accessible manner. They will need to improve their writing skills and learn how to write in a professional manner. They need to learn presentation skills, as they may be required to give presentations to both technical colleagues and non-technical clients. They must understand project management concepts, both for general projects and software projects. Group work is a key feature in the software industry and it is a skill sought by employers, so it is important for computing students to work in groups.

While it may be easier from a delivery point of view to simply give lectures on the soft skills, it is not an effective means of educating students. They need to learn the skills by actually doing and producing work.

Approach

There are three main pedagogical features in use in the two courses described in this paper. An active learning approach (Bonwell and Eison, 1991) means that the students are not just told what to do, they have to go and do the activity. Co-operative learning is another pedagogical feature of the soft skills courses. Co-operative learning means that the students learn and work together in groups. It can be intellectually demanding yet creative, open-ended and involve higher order thinking tasks (Ross and Smyth, 1995).

A Project Based Learning (PBL) approach (Blumenfeld et al., 1991) is adopted in these soft-skills courses. The students learn through engagement in a real-world problem, where they are expected to develop and use thinking strategies and apply and enhance their domain knowledge. PBL is not a new concept, but is has become increasing popular in recent years. With a traditional learning approach, students are told what they need to know, they memorise it and problems are often simplified to show how to solve them. With PBL, students may be assigned a problem or choose a suitable one. They then have to identify what they need to know in order to deal with the problem. They have to go and find out the information and learn and apply new skills and knowledge to solve the problem.

The goals of PBL include developing flexible knowledge, foster effective problem solving skills and effective collaboration. It also aims to encourage self-directed learning and intrinsic motivation. These are important skills for 21st century learners, and while not all of them will be developed with a given PBL scenario, it is good

pedagogical practice to design courses with these goals in mind. In the context of this paper, striving for flexible knowledge is important for computing students. They will need to have adaptive expertise as the skills and knowledge they will require in the future are constantly changing. They cannot expect to learn everything they need to know during their time at university. Obviously, problem solving is a key skill for computing students, as it is a core component of their work. They will need to work and liaise with people of different computing abilities and therefore they will need to be comfortable working collaboratively. While self-directed learning and intrinsic motivation are desirable, given the confines of the course structure, they are somewhat aspirational goals for the majority of the students.

A blended learning approach (Garrison and Kanuka, 2004) was used for the two courses. There was a combination of face-to-face lectures, and the use of a Virtual Learning Environment (VLE). The lectures were given by the module co-ordinator, along with guest speakers from research centres. The students on course A were provided with hands-on online research skills training and told that websites were not the only source of knowledge. They were told the importance of searching for academic resources and were shown how to use the online academic resources of the library. Students were required to give 2 presentations. These presentations were recorded and sent to students individually. Email was the main out-of-class communications mechanism. Individual student queries were replied and sent to the entire class where appropriate.

Moodle (Moodle, 2015) was used as the VLE on both courses. It was used to disseminate lecture notes, run quizzes and questionnaires and provide links to relevant/interesting material. It was also used for group wikis, assignment submission and webinars. Assignment rubrics and associated feedback were also available on Moodle

Overview of Course A

Course A was a technical communications skills and project management course for 3rd year computing students. The students had to give two oral presentations, one on a non-technical subject and the other on a technical topic, but with a non-technical audience in mind. They had an individual and group writing component. The students learnt about project analysis and the alphabet soup of acronyms associated with it (e.g. SWOT SWOC, PEST, STEEPLE) and project management. They covered professional ethics from legal and moral viewpoints. The course is designed as a 12-week course, delivered in three weeks so it is very intensive. The students take the course just before going to work on a 6-month industry placement. The course materials include information on presentation, writing, research and group skills. They also learn about screen casting and project management tools.

As part of the course assessment, the students in groups have to assume the role of a software consultancy company. They have to research a ‘technology in society’ topic. Sample topics include “Improving IT in the Irish Health Service”, “The role of technology in Irish sport” and “Technology in Irish schools: future changes in the classroom”. The groups have to prepare a short screencast, providing an executive overview of the report’s findings. They have to give a group presentation to the whole class as well as writing a professional standard final report. The groups are

mainly self-selecting and the students are expected to make their contributions to the group's work visible via the group wiki. All outputs (apart from those to the group wiki) must be technically correct and intelligible to a non-technical audience.

Students were provided with rubrics for each of the assessed components. A rubric is a coherent group of criteria used to access students' work (Brookhart, 2013). A rubric generally includes descriptions of levels of performance quality on the criteria. The purpose of rubrics is to show students what is required for each assignment and enable the lecturer to focus on learning and not teaching. Rubrics help to co-ordinate instruction and assessment (Andrade, 2000). They provide students with clear information of what is expected of them and make the marking process transparent to them. For example, the rubrics for the writing components assessed students on the quality of the content, organisation and language of the report. Levels of achievement ranged from poor to professional and for each achievement level, students were provided with a text description of what standard would be expected for that level.

Overview of Course B

Course B was a course on Digital Innovation Management and Enterprise (DIME). It was delivered to 1st year computing students. It was the first soft skills course for this cohort of students and some of them would have preferred a more 'technical' course. The students attended seminars with speakers from technical research centres, as well as talks on digital marketing, e-commerce, tech start-ups and associated technical, legal and ethical issues. They also had some lectures on writing, general research skills, group skills and project management. Moodle quizzes were used to check their knowledge of the research areas. Students had to write an individual (reflective) blog after each seminar/lecture. Each group had to come up with an idea for a website or a mobile app as part of the PBL component of the course. App ideas included a sensor for a cow's neck, a smart dog/cat flap for a door and an interactive food allergy website. They had to produce a poster, a group website and write a group report. They also had to learn a new programming language (javascript) to add an interactive component to their website. They had to learn this without lecturer support or direct instruction. App ideas included a sensor for a cow's neck, a smart dog/cat flap and an interactive food allergy website.

Discussion

There were several components of the courses that were successful. Although blended, the face-to-face aspect was important, especially to clear up any confusion about course assessments. It was good to have a hands-on session with the library's online resources, including academic journals and ebooks. The process of recording each individual student's presentation and sending them the video file was a little tricky, but it was good for the students to watch themselves and see what areas could be improved. They were provided with immediate feedback after their presentation, but the ability to view their video file gave them more time to reflect on it. The strategy of answering questions to the whole class cut down on repeat query emails.
The VLE was essential to both courses – it would not have been possible to run and administer the courses otherwise. The students expect the lecture notes to be available online. The online quizzes were good for low-stakes assessment. They were marked automatically and feedback to the students was immediate. The

importance of immediate, individual feedback has been extensively reported in the literature, but without a VLE (or some other technical support), it would have been difficult, if not impossible, to provide.

Apart from providing students with a facility to share materials and ideas, the group wiki provided a means of checking student participation in the group activities. Some courses carry out a module review at the end of the module. However, if there are problems with the module and the lecturer is only made aware of them after the module has finished, it is too late to fix them. For this reason, a module review is carried out in week 6 (of Course B). It is anonymous and students are encouraged to provide honest feedback and can raise any problems or issues with the module.

Moodle provides a facility to host webinars and this is useful for students as their future work environments may involve working with developers in different continents via online communications tools and webinars. Also, some students enjoy different format and the different mode of interaction. The Moodle link facility worked well for providing supplementary materials toe the students. The online assignment submission was more efficient, convenient and environmentally-friendly than paper-based submission. It was essential for the screencast submissions. Also, the use of online submissions makes the tasks of plagiarism detection easier (via TurnItin). The assessment rubrics were clear and the grading feature of Moodle meant that marks and feedback could be provided to the students more quickly than before.

While there were many things that worked, there were also some components that did not work. As part of the process of improving the modules, it is important to reflect on what areas can be improved. Due to the fact that different speakers delivered the lectures and seminars, it meant that the style of each lecture was different and there were some different assumptions made as to the prior knowledge of the students. In future, the lecturer should make sure that each guest speaker is aware of the students' level of knowledge on each topic.

Although the students are probably classified as digital natives, they did not really use their online skills as much as the lecturer intended. Their participation in the group wiki was limited and most read far more often than they posted. Training users in how to use a system is important to ensure that they actually do use the system (Hubbard, 2004) and perhaps more training is required for this component. While the video recordings of the presentations are helpful from a pedagogical point of view, the process of recording and sending each student presentation is only semi-automatic and still requires a manual review component. It is important to make sure that each student only gets his or her presentation video. Students can sometimes expect an almost immediate response to emails, but sometimes there is a time-lag when replying to emails – this can be an issue, especially around assessment deadlines.

The VLE was an essential tool for the courses. However, there is room for improvement. Sometimes there was a delay in putting the lecture notes online. This arose when the guest lecturer delayed sending the notes to the module lecturer. This was problematic for the students, as they would have liked to have access to the notes as soon as possible after each talk, in order to write their blog. Also, the notes served

as a record of the talk and the students could review them to see if there were any interesting ideas for their group project.
From a student point of view, the quizzes were fine, but from a lecturer point of view there was a lot of effort involved. It is challenging to design good questions with suitable distractors. The area of question design is interesting and complex and there are many factors to be taken into consideration. For example, it is important that the correct answer and the distractors have more or less the same number of words. If there is a discrepancy between answers, some students will automatically pick the one with the largest number of words. As a matter of course, the answers should be shown in random order – otherwise, there might be a tendency to place the correct answer in the same order each time. Also, care needs to be taken with "All of the above" or "None of the above" type answers. Research has shown that males are more likely to select these as the correct answer. Therefore, while setting questions and answers, it is important to be aware of the literature in the area to ensure that quizzes are well-designed.

The module questionnaire can provide useful information to the lecturer. However, sometimes the response rate could be better. The number of students that respond to the questionnaires is linked to when they are asked to answer it. If the students are in the lab for a lab-based activity, it is convenient for them to fill it out either at the start or the end of the lab. However, if the students are asked to fill out the questionnaire "in their own time" the response rate will be much lower. One short-term trend identified in the Horizon Report on Education (Johnson et al., 2014) is that of Bring Your Own Device (BYOD). In this case, a period of time could be set aside before, during or after a lecture for students to answer the questionnaire.

The webinar was interesting for the students. However, from a lecturer's point of view, they require more preparation and are more challenging for the lecturer. It is harder to gauge students' level of engagement due to the lack of face-to-face contact. Also there is a need to keep talking during the webinar and to encourage interaction. If students 'hear' silence during a webinar, they may incorrectly assume that there is a problem with the internet connection and this may cause confusion. While a lecturer may want to see a lot of student participation during a webinar, it is important to be aware of passive participants and not to assume that they are not benefiting from the webinar just because they are not visibly participating. As expected, there were no major problems with the links, but obviously, they should be checked to make sure they are valid.

Moodle assignments can have submission deadlines and occasionally there may be issues with late submissions. The Moodle rubrics and grading facilities are very useful for providing feedback. However, there is a trade-off between the granularity of feedback and providing it in a speedy manner. For example, if a course-grained approach is adopted, the lecturer can provide feedback quickly, however, this feedback may fail to capture differences between students. It is difficult to achieve a balance between quick feedback and informative feedback. One final observation, is that one occasion, there were some problems with file submission formats, especially for the screencasts and the presentations. These problems could be addressed by providing students with better specifications for the assignments.

Module Feedback

Student Feedback

It is important to hear the student feedback on modules. Sometimes the feedback confirms things the lecturer may have already expected and sometimes there are surprises. Students on Course A reported that the presentations and writing skills were very useful. On the other hand, some of them did not find the writing skills useful as they thought they were not necessary for them. However, this does not seem to be the case in reality. For example, one student said "First few Lecturers on grammar, punctuation etc for me werent necessary for me".

Students on Course B reported that they liked the research information and the different delivery and assessment approaches. When asked what they liked, student comments include "You get to see the lecture slides after and research further if interested", "Get to explore areas of IT other than core programming" and "Flexibility of module as a whole". However, some students would have liked to see the module lecturer more often (probably more administration reasons) ("I dislike how infrequently we get to see our lecturer"). They disliked having to learn something new without lecturer support and guidance. For example, one student reported that s/he disliked being ".. left to figure out things by ourself", while another student commented "Don't expect students to self learn javascript".

Lecturer Feedback

While overall both modules were successful and the students attained the learning outcomes, it is important to reflect on areas for future improvement. Sometimes it was hard to motivate students. In some cases, they think the already know and have mastered a particular skill. As the grammatically incorrect comment from one student shows ("First few Lecturers on grammar, punctuation etc for me werent necessary for me"), this is not always the case. Also, there was some confusion about what was expected in the screencast. Students said they knew how to do a screencast, but it transpired that they knew how to record a screencast, but were unaware of how to design and delivery a good screencast. Another issue is that sometimes students felt that a particular skill was not relevant to them, and it was hard to motivate them to learn it in this situation. In many cases, the module assignments deadlines for these courses clashed with assignment deadlines on other courses and students occasionally took a pragmatic decision as to which assignment merited their attention. As both courses were 100% continuous assessment, with no written end of module exam, there were quite a few pieces of assessment in each course. Clashing assignment deadlines was particularly acute near the end of semester.

Using rubrics helps to make the marking process more transparent and helps to standardise the marking process. The students can see what is expected of them, and with large class sizes it facilitates marking by several assessors. There are many rubrics available and the ones used in these courses have evolved over several years. However, a rubric is never perfect and each year, it is important to review the rubrics and make changes as necessary.

Both these courses are based on practical skills. However, there is a need to make the courses even more practical than they are now. There is a need to have more workshops rather than just lectures on some of the module components. For these skills, students learn by doing, rather than by just listening. Although workshops involve more pre-planning on the lecturer's part, they are beneficial for the learners and are particularly useful for practical skills.

One final lecturer observation is that the increasing numbers of students taking the courses means that it makes the assessment process more challenging. There are logistical issues to be handled, especially in Course A, which is particularly intensive. For example, given the window of time available for the assessment of the presentations, it is almost logistically impossible for one person to assess all the presentations. Future iterations of the course will need the help of other assessors to be able to run smoothly.

Suggestions for Improvement

It is important to listen to the student voice in education. Lecturers are not 'all seeing, all knowing' and can learn from students. Students were asked for their suggestions for improvements to the course and they came up with several suggestions. In Course A, it was surprising to see that they wanted more presentations. Most students do not enjoy doing the presentations, while some of them actually dread them. However, they realise the benefit of giving presentations and would like the opportunity to do more. They would like to do more practical work in class and this makes sense for some of the practical skills involved in the course. Their other suggestions were mainly administrative, including having more information no assignment deliverables and improvements to the timetable.

Based on experience and the student feedback, the lecturer would also like to see improvements in the modules. There is a need to make some course elements, particularly the writing component, more practical and this will be addressed in the next iteration of the courses. Given the increasing student numbers, it is necessary to have additional assistance on the courses, especially for marking assessments. This is especially important for the presentations in order to be able to fit all students into the limited window available for these assessments. There is also room to improve blending on the courses. For example, when assessing the student presentations, instead of writing the students' marks on paper and manually transferring them online, it makes more sense to enter the marks into the VLE in real-time. Another potentially useful avenue for investigation is the use of computational linguistics tools to help analyse the students' writing. This could be informative for both the students and the lecturer. Gamification and learning analytics are two of the emerging buzz words in the field of education. It would be interesting to introduce 'gameful' aspects to the courses. Badges might be a gameful approach that might help in terms of student motivation. Learning analytics could provide insights into how the students are actually using the VLE and provide near real-time analysis to the lecturer on students' progress.

Conclusion

Soft skills are important for computing students. The following observations can be made when reflecting on the two courses described in this paper. A blended learning approach is required for both courses. In the past, there were student complaints that Course A was "*boring*". While it may not be the most exciting course for the students, it is now at least less boring, as few students mention this. Using a VLE facilitates working with large numbers. While the number of students on these courses is relatively small, as Massively Open Online Courses (MOOCs) become more popular, it will be interesting to learn from the experience of others when dealing with larg(ish) classes. The multi-faceted, multi-modal approach used on both courses was suitable and will be continued. One thing to note is that the courses are not frozen in stone. They are constantly evolving and hopefully, constantly improving. Features such as BYOD (Bring Your Own Device) and real-time in-class quizzes can help improve the course. The flipped classroom approach might work with Course A (the third year cohort), but may be less suitable for the first year cohort of Course B. There is a lot of emerging research in the area of learning analytics, but some thought will be required to figure out how this can be applied to both courses.

The key thing to remember is to use technology to aid the teaching and learning process. It should not be the driver, only the facilitator. The pedagogy come first and the technology second. It is important to learn from others. Finally, remember that no one size fits all, and what works in one context may not work in another. However, it is beneficial to be aware of what others have tried and to see if it would work in your context – only you can be the judge of that.

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The Impact of Social Media for Students' Motivation in Learning Medical Terminologies

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
Learning medical terminology is not easy and it needs the students to be well-motivated. Social media such as Twitter, Blackboard and Instagram are the most feasible techniques towards enhancing EFL medical students' motivation through collaboration. This study aims at investigating the impact of social media on the students' motivation learning medical terminologies. This research aims to use social media tools as a supportive means to increase students' motivation to learn Medical Terminologies in Jazan University. It examines how the combination of Social Media enhances higher education students' motivation to collaborate on creating creative stories by using medical terminologies. The research adopted the descriptive, analytical and empirical methods. A survey of 20 items distributed to 60 Medical students in 2015. It's analysed by (SPSS), the results reached indicate that social media has a great influence on students' motivation and better achievements. Students are active in sharing information, knowledge and responsibility for complex medical problem-solving activities and in achieving the targeted cases in collaboration. The analysis reveals that learning through social media proves to be an effective, suitable and interesting technique for students. Basing on these findings, the study recommends the application of social media in EFL classroom interaction for it creates a healthy environment which will provide ample opportunities for enabling the learners making good relations with each other. In addition, the observations were based on students' performance in classroom and social networks. The study recommends extra curricula activities and modern technological strategies to be concerned as motivating factors in the EFL classes.

Keywords: Social media, terminology, medical technology, collaboration, motivation, Instagram, Twitter

Introduction

Most of the techniques and strategies used for enhancing and fostering students' motivation and interactivity inside EFL medical classes are somehow insufficient. The fact behind that, most of EFL learners are still having a problem in communicating effectively and sufficiently. As I observed during my working as a lecturer at Jazan University since 2009, the reasons behind that, some of students if not all of them think that English is the most complicated subject. This attitude forces them to act passively in classes and neglect testing their own learning experiences. The traditional mode of teaching and learning does not encourage students to be appositive learners. Since motivation, desires and attitudes constitute a crucial element in acquiring a language, EFL students needs to be motivated in a new learning environment. Therefore, the implementation of social media tools has taken a place in the education process and have shown value in the learning practice. Studies have found that social media played an important role in increasing students' motivation which leads to the their positive attitudes towards the target language.

Statement of the Problem

Saudi medical students at university level are suffering from a severe shortage of their proper motivate resources. These are clearly reflected when they are communicating and interacting with native speakers through social settings. In addition, students' production in their writing to their teachers and peers shows that they use little English and fixed expressions. They cannot use medical terminologies as future doctors or use it to write stories. In the same regard, students are still having problems in adopting accurate pronunciation patterns for medical terminologies.

On the other hand, EFL faculty members are still lagging behind. They are still restricted to the traditional teaching methods. They are not sure that using social media applications and resources in enhancing their teaching experiences would bring the same success which had been seen in science and discoveries. Teachers need to understand that their students' needs are completely altered due to the dynamic and changing world practices. They have to prepare them to be able to communicate with the whole world through different technological tools such as Twitter and Instagram for instance, synchronically and asynchronically.

Objectives of the Research

The objectives of the research can be summarized in the following

- To investigate the ways in which the application of social media can affect students' integrative and instrumental motivation.
- To enable medical students to communicate effectively in a survival digital era.
- Involve target students in creating creative stories related to medical issues through twitter.
- Using videos in Instagram as teaching tools in order to motivate students to learn medical terminologies.
- To create a place for students to interact in collaboration with their instructor and with each other outside of the classroom.
- To learn from others and help others learn through social media.
- Observe students' collaboration and performance on learning medical terminologies through social media.

The Significance of the Study

Application of social media for enhancing classroom instruction has become a trend. This paper attempts to investigate the effectiveness of using social media instruction on EFL students' motivation and to approach their interaction in a creative way. Many studies and researches have been carried out investigating the ways in which social media can be successfully integrated along with methods of teaching English as a foreign language in Saudi Arabia.

The importance of this study is that using social media in the Saudi classes enhances the students' motivation, engagement and willingness to learn collaboratively through Twitter, Instagram, room chat, blackboard… etc..

The study attempts to examine the learning opportunities and possibilities the technology may offer for fresh EFL students at universities and higher institutions to pave their way to master the language. In addition, the investigators hope that using social media may increase their motivation and interest level and turn them into a positive attitude towards learning English language.

Literature review

Social Media for Second Language Learning

"*Differently instruct me, I'll internalize.*
Use technology with me, I'll participate, I'll transfer, I'll enjoy and I'll create.
Erben et all" (2009:80)

Nowadays, the technological applications of Social Media provide second language learners with active and creative learning communities. Social media can be a tool for collaborative learning and creativity (Peppler & Solomou, 2011). Borau et al (2009) write the majority of English learners do not call for additional passive input from different types of resources such as texts and lectures. They want opportunities to effectively create and practice English language as a tool of communication. English learners need active learning that offers chances for them to utilize the target language. The social networks have a great effect in supporting and improving medical leaerning. In preparing and fulfil coming interventions, educators should examine ways to magnify the opportunities, providing by social media. They have to involve students in active learning through engaging them in creating content and enable them for intercommunication and feedback, collaboration, and give them an admittance to resources and interaction without geographical regulation (Cheston, 2013). Social Media such as Twitter and Instagram can offer active learning situations of communication with English just as the dominating language. Twitter encourages students to contact with clear and concise thinking, as Skiba, (2008) explained it as a unique technique to enhance students' abilities of connecting through writing briefly and clearly when the teacher asks his/her students to write a story of 140 characters at once. English teachers can ask students to write a story on twitter. One of the students begins by writing a couple of lines and afterward the next student takes turns and so on."*The exercises that force students communicate in brief, clear and concise format can help develop student focus on the essentials of patient care. These skills are valuable in clinical practice, and apply directly to real-life contexts in health care where important information must be shared accurately, such as in patient handovers and transfers*" (Forgie et at. 2013). Also, Instagram is a smart phone application that allows users taking photos or posting 15 seconds videos and then share them

on Instagram and numerous social networks such as Twitter, and Facebook. Instagram is an enjoyable learning tool that used by Powell Library staff in order to teach students about medical and surgical tools during the Civil War. For instance, they posted a picture of a small saw that use to cut off body by surgery with the question, "Can anyone guess what that saw was used for?" Salomon, (2013). According to the social media research, Instagram can provide students with a chance to communicate their experiences by selecting photos and decorating it as they want to present them. Weilenmann et al, (2013). The above studies show that with Twitter and Instagram, students can create stories and sharing information collaboratively and creatively. There is a relationship between social media and visual and active learning that enhance thinking skills in students. For example, students can use videos and images as well as short stories to display large amounts of information when they use social media. This verbal and visual information can help students making connections, understanding the relationships of ideas, and recalling related details, as well as assisting them to express their thoughts through writing. A learning via social media drives student's curiosity and improve their creativity. "*Teacher: knowledge is not rooted in facts; it is rooted in curiosity. One inspired teacher can alter a student for life by instilling curiosity*". Chopra & Tanzi, (2012:7)

Jazan Jump (Blackboard)

In order to achieve its vision, Jazan university is growing fast to transit from a traditional education to modern web-based education. Therefore, the university adopted e-learning methods and programs in a healthy learning environment and initiated Jazan Jump Program. Jazan Jump is the university blackboard that designs an international electronic education equipped with the latest technology with full options that allows learners and professors to communicate 24/7 through blackboard.

Jazan Jump Objectives

The provision of modern infrastructure by providing and deigning a style of modern education. The main objectives of this blackboard are:
1. Provision of modern infrastructure.
2. The university considered e-learning and distance learning as a strategic option.
3. To adapt the latest educational methods and modern technology.
4. To provide both faculty members and their students with the latest technical support and training. (http://jump.jazanu.edu.sa/)

Social Media and Motativation

Motivation is a main factor that plays a significant role in the second language acquisition. Research has shown that students want to be motivated to decrease their distraction or weariness in lectures. (Ornstein, 1995)."Understanding the different attitudes, motivations, and approaches to learning by this new generation in adult class is essential to enhance learning for all students", Worley, (2011:31). Researches have found that social media play an important role to increase students' motivation, enhancing student learning environment with innovative ways of education that altering the nature of learning boundaries, that cause in developing student learning (Cited from IIknur Celik et al 2014). The implement of social media tools have taken a place in education and have shown value in the learning practice. Combining social network applications into medical humanities class activities provided a wide range of advantages over traditional academic resources and techniques. Social network applications can change old-style medical humanities teaching system and

maybe even develop it, yet as getting students prepared for a future during which social media will play a main role in medicine (Daniel George & Cheryl dellasega, 2011). There is a study suggests that "students in an educationally structured social networking environment can be guided to join learning communities quickly and access course materials". King et al, (2009:1)

According to Krashen (1988:22) that motivation has two types relating to the ability of a second or a foreign language acquisition (ESL/ EFL):

1. Integrative motivation is considered as using ESL/EFL for social interaction when learners want to be part of social community speech or local society. It means a desire in students when learning a target language, they like to engage with people who speak such language and they are socialize to communicate with such community and admire its culture and being integrated into that society in which the language is used. In other word, it relies on interest in practicing second or a foreign language as an aspiration to study it or accompany with the people who utilize it for romance goals or for the sharing purposes or using it to join the second or a foreign language new community that uses the target language in its social interactions, integrative motivation by develop of proficiency level in the target language. (Saville-Troike, 2012:101)

2. Instrumental motivation means that students learn a second language in order developing their professional or working chances, getting respect and authority, gaining access to experiential and practical information, or just to get good marks on school works (Saville-Troike, (2012: 101).

Mobile learning and language development

World today lives in a very fast digital era, therefore, people are doing everything quickly, learning included. Self-study is obviously important in language learning. From my experience, as little as an hour a week of self-study for a student to learn immediately. Yet the majority of our medical students have chosen to study through social media for extra activities to be more creative and well-motive via their mobile at any time.

As the use of mobile technology is increasing, why not offer students the possibility to study anytime, anyplace and at their own convenience through their mobile devices? We get my students started with small, realistic homework activities, particularly, through Twitter and Instagram. We request that my students spend just a few minutes a day in English and learning medical terminologies. We introduce them to some of the amazing short medical terms via available mobiles and we encourage them to learn in a mobile way.

Research Methodology

In order to find persuasive answers to the research questions and find out the practical solutions of the problems and also the practicality of Social media, the paper will adopt the empirical method in which two kinds of treatments will be involved i.e. control and experimental groups.

The Participants

The participants of the study are 60 EFL medical students of the second semester , course code 164-prep3 at Medial College (PYP) from Jazan University in Saudi Arabia in this academic year 2015. All students who participated in this study are Saudi and their native language is Arabic. Their average age is 20.

Research Instrument

- The researchers use three instrumental tools for this study:
  (a) survey (b) experiments (c) Observation
- These instruments were used as tools for collecting evidence and justification for questions.

The instrument used in this study is a 5 point Likert Scale ranged from 'Strongly Agree' to 'Strongly Disagree' to gather information on participants' motivation through social media. There are 20 questions in the survey. The questionnaire consists of two parts:

(1) Questions (1-10) are for integrative motivation.
(2) Questions (11-20) are for intrumental motivation.

Data Collection

The questionnaires were distributed to the 60 students during regular class session which time they were given clear instruction and explanation in both L1 an L2 for filling out the questionnaire. All questionnaires were collected upon completion by helping of our colleagues**.** The researchers qualitative and quantitative standard of research.

Research Questions

- To what extent can application of social media affect students' integrative and instrumental motivation?
- Are videos in Instagram motivating students to learn medical terminologies?
- To what extent does social media enable medical students to communicate effectively in a survival digital era?
- To what extent do social media tools create a place for students to interact in collaboration with their instructor and with each other outside of the classroom?
- To what extent can students be involved in creating creative stories related to medical issues through Twitter.

Assumptions

- Application of social media develops students' integrative and instrumental motivation videos in Instagram motivate students to learn medical terminologies.
- Social media enables medical students to communicate effectively in a survival digital era.
- Social media creates a place for students to interact in collaboration with their instructor and with each other outside of the classroom.
- Students an be involved through Twitter in creating creative stories related to medical issues.

Discussion and Analysis:

This study followed the statistical analysis for overall results of social media that used in teaching and learning English as a foreign language. The paper is in the form of tabular charts and graphs, and the analysis was done in the form of the comparison of the percentage of the groups of learning through social media and continual observation of the impact of the social media application on the students' integrative and instrumental motivation so as to have better interaction, communication, ceativity and performance.

	S. Agree	**Agree**	**Neural**	**S. Disagree**	**Disagree**
N valid	20	20	20	20	20
Missing	0	0	0	0	0
Mean	18.10	22.20	14.90	4.05	0.75
Std. Error of Mean	1.285	0.631	0.926	0.564	0.362
Median	19.00	22.50	15.00	4.50	0.00
Mode	20	20a	15	5	0
Std. Dev.	5.748	2.821	4.141	2.523	1.618
Variance	33.042	7.958	17.147	6.366	2.618
Range	27	12	15		
Minimum	3	15	9	0	0
Maximum	30	27	24	10	6
Sum	362	444	298	81	15

Table (1) Statsitics of the Mean and Standard Deviation
*Mutiple Mode Exist. The smallest value is shown

Table (2) Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Dev.
SA	20	3	30	18.10	5.748
Agree	20	15	27	22.20	2.821
Neutral	20	9	24	14.90	4.141
SD	20	0	10	4.05	2.523
Disagree	20	0	6	.75	1.618
Valid N(listwise)	20				

Question 6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	10	16.7	16.7	16.7
	Agree	20	33.3	33.3	50.0
	Strongly Agree	30	50.0	50.0	100.0
	Total	60	100.0	100.0	

Question 11

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	4	6.7	6.7	6.7
	Neutral	11	18.3	18.3	25.0
	Agree	21	35.0	35.0	60.0
	Strongly Agree	24	40.0	40.0	100.0
	Total	60	100.0	100.0	

Question 13

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	4	6.7	6.7	6.7
	Neutral	9	15.0	15.0	21.7
	Agree	24	40.0	40.0	61.7
	Strongly Agree	23	38.3	38.3	100.0
	Total	60	100.0	100.0	

Question 14

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	1.7	1.7	1.7
	Neutral	17	28.3	28.3	30.0
	Agree	22	36.7	36.7	66.7
	Strongly Agree	20	33.3	33.3	100.0
	Total	60	100.0	100.0	

Question 15

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.7	1.7	1.7
	Neutral	15	25.0	25.0	26.7
	Agree	24	40.0	40.0	66.7
	Strongly Agree	20	33.3	33.3	100.0
	Total	60	100.0	100.0	

Question 16

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	13	21.7	21.7	21.7
	Agree	27	45.0	45.0	66.7
	Strongly Agree	20	33.3	33.3	100.0
	Total	60	100.0	100.0	

Regarding the participants' perception of the social media application (question number 6), results showed positive perception of this effectiveness (see Table 1). The participants' mean score on the utility variable was quite positive. Participants reported that social networks increased their course achievement, performance, and grades in questions such Q3 (50=83.33%) of the students agreed that Learning Medical Terminologies need collaboration through social media such Twitter, Blackboard and Instagram, while 0% of them disagreed. About (75%) of them have positive effective on their creativity when they use social media(Q11) (Q14=66%) , Q15 (66.7%) agreed and (1.7% disagree). The majorty of the students (47=66.7%) agreed that social networks are interesting while 21.7% are neutral and 0% disagre, that means the majority of the students prefer to study medical terminologies through social media. In addition, they reported that social networks usage increased their writing production and creativity in learning medical terminologies by keeping in touch with the instructor and colleagues via social media.

Findings and Conclusion:

In the light of the findings of this study, the researchers concluded that:

- From the data analysis, results indicate that social media have a great influence on students' integrative and instrumental motivation.
- Using social media materials generate a higher degree of interaction and communication among EFL students.
- Using social media technology devices are better than using traditional methods in learning a language specially for medical terminologies.
- Medical students have positive thoughts toward using social networks in classrooms.
- Medical students have positive experiences of communicating effectively and collaboratively on social media.
- Computers and internet is effective at helping students learning a language improving their creativity and having better performance.

Implication for Further Research and Development

There is much that is good about social media and much that still students can learn more effectively from using them. As this study is limited in its nature many possibilities are open for further research. There is need for further studies with different age groups, and with a larger population in other colleges and institutions in and outside Saudi Arabia.

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Appendix
Students' Questionnaire

No	Questions	SA	A	N	D	SD
1	I use blackboard , Twitter, and Instagram only just for passing class than learning medical terminology through it	20	20	10	6	4
2	I use blackboard , Twitter, and Instagram only for reading my teachers posts and listening to videos but I do not make any comment or express my ideas about videos and class topics.	15	23	16	5	1
3	Using blackboard , Twitter and Instagram for learning Medical Terminologies is prestige full.	18	19	11	6	6
4	Using Twitter, Instagram and blackboard in my medical terminology class help me to pass my examination .	17	21	15	5	2
5	Studying medical terminology through twitter and Instagram is useful to become more knowledgeable.	20	20	13	5	2
6	I study medical terminology through twitter and Instagram because it is class requirement.	30	20	10	0	0
7	Studying medical terminology through twitter and Instagram make me more professional on using them in future.	19	15	19	7	0
8	Using medical terminology through blackboard , Twitter and Instagram and discussing health issues make people respect me.	6	26	22	6	0
9	Learning Medical Terminologies through Instagram , blackboard and Twitter is very essential for increasing Followers.	3	23	24	10	0
10	Studying Medical technologies through Instagram , Twitter and blackboard improve my English skills for my further study.	18	20	19	3	0
11	Studying English through blackboard , Twitter, and Instagram help me to understand Medical terminologies more.	24	21	11	4	0
12	Studying English via blackboard , Twitter, and Instagram motivate me to discuss Medical terminologies with my classmates and teacher.	18	26	11	5	0
13	Studying English through blackboard , twitter and Instagram enable me to keep in touch with my teachers and classmates.	23	24	9	4	0
14	Studying English through blackboard, Twitter, and Instagram motivate me to be creative on using medical terminologies.	20	22	17	1	0
15	Studying English through blackboard, Twitter, and Instagram motivate me to be social person with my classmates.	20	24	15	1	0
16	I enjoy studying English through blackboard, Twitter, and Instagram.	20	27	13	0	0
17	Studying English through blackboard , Twitter, and Instagram make my appreciate using social media for learning medical terminologies.	16	24	15	5	0
18	Studying English through blackboard, Twitter, and Instagram give me freedom to participate on my group.	15	24	19	2	0
19	I am motivated to learn Medical terminologies through Twitter and blackboard, Instagram in order to share my knowledge.	19	22	15	4	0
20	Studying Medical terminologies through blackboard, Twitter, and Instagram improve my writing skills.	21	23	14	2	0

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Design Critique: Teaching Design Students to Be Effective Communicators Using Open Broadcaster Software

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Official Conference Proceedings

Abstract
Peer review is vital to the growth and performance of the student and design critique and jury is a staple in basic and advanced studios since their teaching and learning process are different and more complicated than theory courses. Evaluation and grading systems in art, design and architecture studio-based courses are more difficult than other majors and fields [1]. Learning in an architectural design studio depends upon the communication of creative ideas, the fit between learning styles of the students and instructional design [2]. Open Broadcaster Software is a free and open source software for video recording and live streaming [3]. Varying techniques for critique of graphic design, principles and elements of design and color is useful in technical communication. Using OBS as a technique provides a different perspective and mode for evaluation for the student that not only teaches them but emphasizes how graphic and design disciplines overlap in visual media. This interactive presentation will reveal how interdisciplinary portfolio [4] [5] [6] critique using OBS provided ways to create effectively enhance student outcomes. Pre and post survey suggest students' perspective of critique changed as a result and students were actually motivated to learn new software. Students themselves were inducted directly into the processes of making academic judgments so as to help them make more sense of and assume greater control over their own learning and therefore become more self-monitoring [1] [7]. Participants will engage in a discussion while viewing examples of this potent visual communication technique.

Keywords: Design education, design process, learning style, technology, experiential learning, innovation

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Introduction

Peer review is vital to the growth and performance of the student and design critique and jury is a staple in basic and advanced studios since their teaching and learning process are different and more complicated than theory courses. Evaluation and grading systems in art, design and architecture studio-based courses are more difficult than other majors and fields [1]. Learning in an architectural design studio depends upon the communication of creative ideas, the fit between learning styles of the students and instructional design [2].

Open Broadcaster Software is a free and open source software for video recording and live streaming [3]. Varying techniques for critique of graphic design, principles and elements of design and color is useful in technical communication. Using OBS as a technique provides a different perspective and mode for evaluation for the student that not only teaches them but emphasizes how graphic and design disciplines overlap in visual media.

This interactive presentation will reveal how interdisciplinary portfolio [4] [5] [6] critique using OBS provided ways to create effectively enhance student outcomes.

Methodology

Students were given a pre assessment. Students were required to submit portfolio electronically. Faculty mentors reviewed each file in OBS and made video clips of suggested changes, red lines on the actual presentations. Students reviewed each video clip file with faculty and then individually. Appropriate changes were made and students resubmitted. Students were given post assessments. Open ended questions were available. Students commented the not threatening perspective of the mentors provided insight into graphic media. Students commented that it helped them to develop a more critical and graphic eye for their presentations. Students commented it helped them removed bias and review their work more critically. Resulting revisions were dramatically improved.

Conclusion

Pre and post survey suggest students' perspective of critique changed as a result and students were actually motivated to learn new software. Students themselves were inducted directly into the processes of making academic judgments so as to help them make more sense of and assume greater control over their own learning and therefore become more self-monitoring [1] [7]. Participants will engage in a discussion while viewing examples of this potent visual communication technique.

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Sustainable Design Practices, Analysis and Assessment Tools for Students Using Openstudio

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Official Conference Proceedings

Abstract
Integration of sustainability and its vision across multiple disciplines has become standard in many industries. The vision for sustainability embraces the goals of environmental, social, and economic vitality with the understanding that the needs of the present be met without compromising the ability of future generations to meet their own needs. Sustainability promotes interconnectivity of sources and communities, diversity, relationships between global environmental and economic trends, and holistic thinking which are key ingredients for success in many economic arenas. The author teaches a studio in the department of engineering technology surveying and digital media. The course requires the student to synthesize and apply subject matter studies in previous required courses and apply them to a realistic design problem solving effort. Typically students identify a design problem in their area of expertise and design a solution by working in a team. Sustainability is a key learning outcome of the course and students are required to develop a sustainable solution of the problem identified. The author identified a sustainability design, analysis and assessment tool named OpenStudio (https://openstudio.nrel.gov/). The tool is developed by National Renewable Energy Laboratory (NREL) and the US Department of Energy. OpenStudio is a cross-platform (Windows, Mac, and Linux) collection of software tools to support whole building energy modeling using EnergyPlus and advanced daylight analysis using Radiance. OpenStudio is an open source tool i.e. free to download and use. Students were exposed to OpenStudio's capabilities both for creating custom energy conservation measures and for generating useful summary and detailed output.

Keywords: Innovation, technology, research projects, OpenStudio, sustainability, interdisciplinary engagement

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Introduction

Integration of sustainability and its vision across multiple disciplines has become standard in many industries. The vision for sustainability embraces the goals of environmental, social, and economic vitality with the understanding that the needs of the present be met without compromising the ability of future generations to meet their own needs. Sustainability promotes interconnectivity of sources and communities, diversity, relationships between global environmental and economic trends, and holistic thinking which are key ingredients for success in many economic arenas. As educators, therefore, we need to integrate sustainability across curriculum and equip our students with sustainability skills and competencies.

The author teaches a junior and senior level required course in the department of engineering technology surveying and digital media. The course requires the student to synthesize and apply subject matter studies in previous required courses and apply them to a realistic design and engineering problem solving effort. Typically students identify a design problem in their area of expertise and design a solution by working in a team. Sustainability is a key learning outcome of the course and students are required to develop a sustainable solution of the problem identified. Even though students incorporate sustainable practices in their design processes they are unable to assess them. This is mainly due to limited availability of tools, subscription based tools and software that department can't afford, and lack of expertise among faculties. But without proper assessment and evaluation of sustainability in design and engineering solutions there is less value of such practices and limited learning and applications.

As a professional designer and educator, the author has extensive knowledge on design, development and project management, however, has limited expertise on sustainability assessment tools. These tools are relatively new and highly specialized. There are few commercial vendors who offer such tools and training but they are very expensive. The author identified a sustainability design, analysis and assessment tool named OpenStudio (https://openstudio.nrel.gov/). The tool is developed by National Renewable Energy Laboratory (NREL) and the US Department of Energy. OpenStudio is a cross-platform (Windows, Mac, and Linux) collection of software tools to support whole building energy modeling using EnergyPlus and advanced daylight analysis using Radiance. OpenStudio is an open source tool i.e. free to download and use. The author incorporated this tool for ENTC 4900 and INTD 3215 in the spring of 2015 for sustainable design practices, analysis, and assessment of student projects.

The OpenStudio Application integrates with NREL's Building Component Library (BCL), providing libraries of pre-defined configurable energy conservation measures for easily modifying energy models. PAT (Parametric Analysis Tool) will be used to demonstrate how model variants can be configured to run in cloud computing environments (Amazon EC2). Students were exposed to OpenStudio's capabilities for extension through Ruby Scripting, both for creating custom energy conservation measures and for generating useful summary and detailed output with a basic exercise.

Open Studio Exercise

Students were required to use a small project from facilities design drawing. They were required to model the building envelope, customize the envelope, fenestration and add site shading, assign building activities and thermal zones and run a basic simulation in OpenStudio application. Students were instructed to adjust the internal load and construction values, use energy conservation measure to shift operating hours for the building and then run simulations in the parametric analysis tool.

Conclusion

The exercise brought three fold benefits:
1) The exercise helped the students and author to develop a module for sustainability design, analysis and assessment for INTD 3215 and ENTC 4900 (new skills for students that industries require).
2) The exercise helped the students and author to engage in sustainability related undergraduate and graduate research with regional and national organizations such as Tennessee Valley Authority, Tennessee Department of Environmental Conservation and Department of Energy (faculty development in teaching and research).
3) The students and author shared the experiences with Facilities Management and Department of Sustainability to incorporate sustainable design practices, analysis and assessment to improve life, quality, and health of ETSU community and built environment (contribution to ETSU community).

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E-Learning for Distance Students: A Case Study from a UK Masters Programme

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Official Conference Proceedings

Abstract
The MSc Intelligent Systems (IS) and the MSc Intelligent Systems and Robotics (ISR) programmes at De Montfort University are Masters level courses that are delivered both on-site and by distance learning. The courses have been running successfully on-site for 11 years and are now in the 8th year with a distance learning mode. In this paper we discuss some of the techniques adopted to overcome the challenges of delivering a practical course to both distance and on-site students. Information collected from student case studies is used to enhance our observations about the delivery methods, the backgrounds of those that join the course and the value it can add to their employment opportunities. We present the course as a case study illustrating: possible approaches for distance and e-learning; the range of people (and their employment) to which it is relevant.

Keywords: Post-graduate, e-learning, distance learning

Introduction

The MSc Intelligent Systems (IS) and the MSc Intelligent Systems and Robotics (ISR) programmes at De Montfort University are Masters level courses that are delivered both on-site and by distance learning (DL). The courses are delivered mainly by the members of the Centre for Computational Intelligence (CCI) at De Montfort University. Their development enabled us to capitalise on the research taking place within the CCI and therefore on the strengths of the staff delivering the modules.
Each MSc consists of 8 taught modules and an independent project which is equivalent to 4 modules. Each module is worth 15 credits (7.5 ECTS). The MSc ISR includes two mobile robots modules whilst MSc IS replaces one of these with a Data Mining module. Given their substantial overlap, from this point they will be referred to in the singular, for example, as 'the course'. A Research Methods module is delivered in semester 1 to ensure that students are equipped with the necessary skills to carry out literature searches, write project proposals and so on. An overview of the course content and delivery pattern for part-time distance students is shown in Figure 1. Full time students complete the course in one calendar year (all 4 semester 1 modules together, all 4 semester 2 modules together and the project over the summer period). In this paper we discuss the issues associated with delivering such a course at a distance and investigate the motivation of the students for embarking on it. Some short case studies were used to provide more detailed insights.

Pre-programme	Induction Unit
Semester 1 (Year 1)	Research Methods Fuzzy logic
Semester 2 (Year 1)	Artificial Neural Networks Computational Intelligence Optimisation
Semester 1 (Year 2)	Artificial Intelligence Programming Mobile Robots
Semester 2 (Year 2)	Applied Computational Intelligence Intelligent Mobile Robots (ISR) or Data Mining (IS)
Year 3 (typically) or on successful completion of 4 of the above taught modules)	Master's thesis project.

Figure 1: The course structure

The remainder of the paper is structured as follows: Section 2 discusses approaches to e-learning on the MSc programmes and how this fits with recognised approaches from the associated literature; Section 3 presents and discusses the student case-study information. Section 4 draws conclusions from this work.

Approaches to E-Learning on the MSc Programme

E-learning offers methods and facilities for both learners and teachers to develop and enrich their learning and teaching experience through the learning environment.
Although there are many definitions for e-learning in the literature, most of them focus on the same features that can be provided in e-learning environments, primarily that electronic media is used for the delivery of content in order to facilitate the learning process [7], [17], [18]. The use of technology has facilitated the learning process so that learners can learn anywhere at any time. The philosophy of e-learning is to provide learners with tools and facilities to allow them to learn anywhere at any time in which flexibility is gained in terms of knowledge acquisition. Other related approaches include Blended Learning [14] where there is a mix of face to face and on-line learning taking place.

A review of research into evidence based practices in on-line learning [13] found that "In recent experimental and quasi-experimental studies contrasting blends of online and face-to face instruction with conventional face-to-face classes, blended instruction has been more effective, providing a rationale for the effort required to design and implement blended approaches. When used by itself, online learning appears to be as effective as conventional classroom instruction, but not more so." This is interesting to us as it shows that pedagogic value is not lost with on-line delivery and that where it can be blended, such as with our on-site students, there is likely to be more learning taking place. Feedback from our on-site students supports this too and additionally many of the on-site students appreciate the opportunity to interact and work with the DL students; they are often working in interesting application areas, are distributed around the world and therefore bring their experience as added value.

The finding reported in [13], along with those from our study that seems to verify the efficacy of the content, suggests potential ways of the developing the course to make the experience more blended for our students. In particular the on-site students can be asked to do more independent work using the on-line materials and then use the face to face time to develop the work and apply the knowledge. This is also similar to the notion of Flipped Learning. [15].

On our course we have both distance and on-site students. The distance students are on-line learners for the majority of their work although face to face time is used via mediums such as Skype for individual discussions with tutors and for demonstrations, presentations and viva voce examinations. Finding ways to increase face to face engagement where possible with DL students would be more difficult but achievable at least with some of them and this is an aim for the future. All modules are assessed by 100% coursework. The on-site students can make use of the same on-line materials but also have face to face lectures, tutorials and lab sessions with their tutors.
While planning the delivery of the course it has been useful to consider approaches to learning and teaching in higher education more generally. Most of the modules include both theoretical and practical work and the assessments are usually open enough to allow the students to investigate appropriate topics in their own way thus there is an attempt to facilitate experiential learning as defined by [1]. We believe it to be very important for our students to draw on non-course experiences as many of them have work experience: for example, DL students are often in full time

employment, there is a wide variety of first degree subjects amongst them and some have already studied for higher degrees.

The Quality Assurance Agency (QAA) for Higher Education in the UK provides codes of practice for all types of learning. There is a section of the documentation that is aimed specifically at flexible and distributed learning and within this they include e-learning and formative feedback [2]. The QAA documentation defines what the students should be able to expect from their institution, their learning materials, their tutors and so on when engaged in flexible, distance or e-learning. The QAA suggest that excessive amounts of summative assessment should be avoided. They state that "it is good practice to provide students with sufficient, constructive and timely feedback on their work"[2, p20].
De Montfort University uses Blackboard as a platform for providing e-learning materials for all students and this was therefore an obvious choice as the main platform for the MSc. Decisions about the best way to use Blackboard and which other resources to employ alongside it were necessary and as both on-site and distance students study the modules concurrently, the experiences need to be as similar as possible. We provide software if necessary for all modules, though some modules use free downloadable software. Lectures and software demonstration can be viewed as streamed video through Blackboard. Other methods include sound over Powerpoint slides using tools such as Articulate Presenter and more recently Microsoft Expression Encoder.

Assignments are made available to students on Blackboard and they are asked to submit them for assessment twice, once to TurnitinUK for plagiarism detection and once to a Blackboard assignment submission link. The assignment submission link enables multiple files and multiple file types to be uploaded which is important for computer courses. This work is then marked using electronic methods, and the annotated scripts with provisional marks are posted in a feedback space on Blackboard that is generated when the students submit their work. This means that the students get feedback as soon as the work is marked and the university requires marking to be completed within a maximum of 4 weeks. The kinds of annotations added to the scripts vary depending on the tutor. Most work with PDF files and these can be annotated easily with the use of pen-tablets (for hand-written notes), or with typed 'post-it' notes, voice clips and so on. The timing of students receiving their feedback has been an issue on our courses but since adopting this approach it is no longer the case. The approach summarised in this paragraph is more fully described fully in [6].

As well as the requirement for timeliness, the feedback needs to be of an appropriate quality so that the students are able to learn from it and make use of it in subsequent work. This is identified by the Joint Information Systems Committee (JISC) [5] which states that "feedback must:

• Be helpful, detailed and appropriate to learners' current understanding
• Provide more detail with each failed attempt
• Identify a means of rectifying errors
• Invite an active response." [5, p1]

Both [5] and [7] identify that feedback that is explanatory is necessary; in particular, [7] shows that explanatory feedback results in improved learning compared with the effects of corrective feedback (simply marked right or wrong); they also state that such explanations should be succinct and positioned so that they are close physically to where the error in the students' work took place. This is why the commented work (regardless of the mechanism used for making the comments) is considered to be valuable for our students.
All tutors have adopted one of the electronic methods made available to them and described previously. The good take-up by staff has been aided by the variety of methods possible. In [6], two modules from the course used electronic methods for assessment and feedback as a pilot study and students' opinions of the change in approach to marking and feedback were gathered by means of a short survey. The results showed that all students, both on-site and DL, preferred this method.

We encourage interaction between students and tutors; students and peers; by having an assessed discussion board on our Virtual Learning Environment (VLE). It is assessed based on the number of contributions over the semester rather than the quality of the content. We have found this to be very successful [11] and it is clear that it helps to create a virtual learning community amongst our students.

Student Case Studies

In order to find out more about the students' perspective on the course, a study was carried out [16] to find out the opinions of the students about the different materials with which they are presented and additionally to find out why they chose to do the course and what they hope to achieve in terms of their employability as a result of completing it.
The results were interesting and therefore prompted a further study presented in this paper. For this, a smaller number of students (volunteers) were asked for more detailed information enabling us to gain a better depth of understanding about their reasons for doing the course and the way in which they have been able to use what they have learned. The aim of the research is to have a better insight into:

1. The typical backgrounds of those who study the course
2. The way they use the knowledge gained from their course (if at all) either in current or future employment
3. What they see as the gains from studying the course.

The questions were sent to students who had finished or who were about to finish. Only a small number of volunteers were needed as the emphasis here was on depth of information rather than breadth. A previous study [13] already collected data from a larger number of students. The students were therefore only asked once (as a group) and those that responded have been used.

The short case studies that resulted included 6 DL and 5 on-site students. The focus of this paper is on the distance students but some discussion about responses from the on-site students is also given.
The questions were as follows:

- Why did you apply for the MSc IS/ISR?
- What did you do before? (previous degree? training? jobs? Where did you live?)
- What were the best things about the course for you, what did you get out of it?
- What do you plan to do next (or what are you doing if you've already finished)?
- Would you recommend the course to future applicants?
- What advice would you give them before they start?

Tables 1 and 2 summarise the responses for DL and on-site students respectively.

Question	Response summary
Why did you apply for the MSc IS/ISR?	To learn about data-driven modelling techniques - increasingly important to programming the finance industry where employed. Structure, content, study mode Add to skills for current & future employment Up to date useful content Interested in robotics Interested in AI
What did you do before?	Web & desktop software development, UK – x3 – London, Cheshire, Italy E-learning creator, UK SW development, business analysis, DBA, USA Finance (MD of asset management company, Germany)
What were the best things, what did you get out of it?	Learning a variety of AI tools. Interesting & useful topics Practical work Robot localization & navigation Convenience of distance learning New algorithms Keeping up to date Relevance & variety of topics Practical component Distance Learning mode (DL)
What next?	One person going on to a PhD Others are using the MSc to enhance current employment in the following ways: Move into research & development Commercialization of ideas Application to finance Application to portfolio construction in asset management

Would you recommend it?	All said yes
Advice to future applicants..	Advice was mainly about preparation (pre-reading), how to keep on top of the work load and how to plan for the final project.

Table 1 : Summary of responses for distance students

Question	Response summary
Why did you apply for the MSc IS/ISR?	Content, part time mode Interest in subject Robotics Met tutors before and enthusiasm & accessibility added to the content made it the first choice. Higher level study for better job prospects
What did you do before?	BSc Computer Science, ran own e-commerce business, wants to expand knowledge into wider areas. Worked in multimedia development for training, then BSc from DMU BSc from DMU followed by year out. BSc from DMU
What were the best things, what did you get out of it?	Confidence, understanding, meeting like-minded people. Good foundation both technically and in research skills Small numbers on-site. Good relationships with peers and staff. Robotics
What next?	Full time PhD. Full time PhD – now completed and modelling customer behavior at Experian. PhD in grey systems. Full time job in Telecoms Full time mother (to 2, soon to be 3)
Would you recommend it?	Yes
Advice to future applicants..	All said pre-reading again Chance to engage with tutors because of smaller group – make the most of that Ask questions. Engage with induction material (programming & maths classes etc.)

Table 2: Summary of responses for on-site students

All of the students, both DL and on-site, said that they would recommend the course and most suggested pre-reading and engagement with the induction programme beforehand. More of the on-site students came straight from a first degree although some had worked before doing that degree. All of the distance students were in full time employment and chose to study for the MSc on order to enhance their employment, either in terms of prospects for the future or to provide alternative problem solving techniques within their current roles. Two of the distance students specifically wanted to apply their new skills within the finance industry.
The open nature of the assignments for most of our modules enables students to try applying the techniques they learn to their areas of interest and we see this frequently in module assessments and in the final projects. To illustrate this point, some previous project titles are given: “The success of a Genetic Algorithm for portfolio and risk management within a momentum trading strategy”; “ Indoor Search & Rescue Simulation using Lego”; “Question Generation on Software Requirement Specification to Support Rich Requirement Tracing”; “Intelligent Radio: An Evolutionary Approach to General Coverage Radio Receiver Control”; “ Development of a Quadcopter with Fuzzy Stability Controller”; “ A Neural Network Model for Exoplanet Detection”. A number of students publish papers in both conferences and journals as a result of either their assignment or project work.

All of the students said they would recommend the course to future applicants. This is a pleasing outcome especially as many of our students are very experienced in their fields of work and are therefore especially discerning about what they want to study and what they hope to achieve from their work.

Conclusion

In this paper we have described the MSc in Intelligent Systems and MSc Intelligent Systems and Robotics. As courses that runs both on-site and by distance learning, they are often used as an example in our own institution.
Delivering courses at a distance is a topical area. With the many available mechanisms for interacting with learners electronically, there are a number of choices to be made regarding the approach to take. In this paper we have summarised some of the approaches to the course delivery and the assessment and feedback strategies. We have also discussed information gathered from students about their backgrounds and reasons for studying the course. This showed an apparent difference between the typical backgrounds of distance learners and on-site students. It also helps to validate the content of the course and the way that it has evolved as technology changes.

The course is successful and sustainable with a total of around 60 students currently enrolled (5 on site, the rest as DL). We continue to gather feedback regularly, using the responses to inform future developments. We hope to continue in this way ensuring that our students benefit from a carefully crafted course that makes appropriate use of current e-learning research and associated technology.

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Open Access Courses in an E-Learning Process: Lessons from a Pilot Case Study

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The European Conference on Technology in the Classroom
Official Conference Proceedings 2015

Abstract
Learning, in terms of academic or scholar education, used to be a privilege for few. Nowadays, with the use of new technologies and under the changing demographics in education, even higher academic knowledge can be acquired from people leaving in the most remote places at their convenience. In this paper we exemplify how Open Courses (OCs) in terms of Open Educational Resourses (OERs) can assist the process of e-learning in university level, especially that of autonomous and asynchronous. We present the lessons learned from the Open Academic Courses of the Agricultural University of Athens (AUA) in Hellas experimental pilot case. We review the project's progress so far, the challenges of converting traditional courses into OCs, the technologies used and the steps that were followed in order to ensure, intellectual property, accessibility and openness of the content. Furthermore we present future work, which includes a survey amongst tutors for the evaluation of such OERs and of the used methods. Open Academic Courses of the AUA is a project part of a major programme for converting the Hellenic University's courses into OCs. Lectures converted to OCs (Type A-, A and A+ according to the percentage and type of multimedia used) are hosted in the project's preliminary platform and are being implemented to both the University's portal, Open *e*Class and Open Delos platforms, and the national repository for OCs. Project's target group includes academia, graduates, and people with special needs, professionals and individuals as well as local authorities.

Keywords: open courses, OER, e-learning

Introduction – the Notion of Openness

Higher Educational Institutions (HEIs) aim to provide expert education, as well as, to contribute to the development of harmonic personality and students training in the sense of democratic values, humanism and tolerance, and equip students for whole life with knowledge and information that are from general level. Today HEIs are challenged by great changes caused by multiple external factors. World demographics and reductions in the traditional 18-to-25-year-old student age group (OECD, 2007) affect institutions and participant rates, while longer living and longer working can lead to more carrier changes and thus people being more flexible and open to acquire new knowledge. Moreover higher education is highlighted as a key policy area where reforms can directly contribute to jobs and economic growth (European Commission/EACEA/Eurydice, 2013). Educational practice is expected to change from a pedagogical approach closed, tightly controlled by the teacher, in an open, transparent, integrated in society, with parents and community involvement that supports student initiative, facilitating collaboration, personal skills and lifelong learning (Chimos, Karvounidis, Basios, & Tsiligiridis, 2013). This swift to lifelong learning is also depicted in the policy of the European Union (EU). One of the EU new strategic framework "Education and Training" (ET 2020) benchmark is that by 2020, an average of at least 15% of adults (age group 25-64) should participate in lifelong learning (European Commission/EACEA/Eurydice, 2013; Eurostat, 2015).

Electronic learning (eLearning), by means of using internet to deliver courses, or web based educational systems are being installed more and more by universities, schools, businesses, and even used by individual instructors in order to add web technology to their courses and to supplement traditional face-to-face courses. E-learning as a concept derives from the use of Information and Communication Technologies (ICTs) in order to deliver teaching and learning and aims to promote distance learning via the use of distance teaching techniques. E-learning has undergone rapid development over its fifty year history, since its beginning in the 1960s, and developed into highly sophisticated online applications (Fryer, Nicholas Bovee, & Nakao, 2014). Nowadays, an eLearning course may be delivered in various ways. According to Kostis, Basios, Chimos, Karvounidis, Douligeris & Katsanakis (2012) these are interactive course content consisting of homework assignments, lessons, quizzes, Sharable Content Object Reference Model/ Aviation Industry Computer-based training Committee (SCORM/AICC), vote banners and workshops; static course content consisting of files and folders, Instructional Management Systems (IMS) content packages, web pages, links of URLs; social course content including chats, forums, glossaries, wikis, databases, surveys, etc. A thorough list of benefits for eLearning, disadvantages, actions to overcome them as well as mistakes in its application are given by Khoury, Eddeen, Saadeh, & Harfoushi (2011).

Digitized content can be used in a synchronous and asynchronous way. Aynchronous eLearning programs are becoming more prevalent and research issues have been progressed from eLearning to mobile learning (mLearning) and form mLearning to ubiquitous learning (uLearning) (Hwang, 2006; Inthachot, Sopeerak, & Rapai, 2013). Additional top eLearning trends include Massive Online Open Courses (MOOCs), personalized learning, augmented learning, Application Programming Interface (API) such as SCORM and Tin Can, cloud Learning Management Systems (LMS), flash

HTML5 conversion, wearable learning (wLearning), video in learning and gamification.
The idea of openness represents approaches that focus on opening access to education and training provision, freeing learners from the constraints of time and place, and offering flexible learning opportunities to individuals and to groups of learners. Content of asynchronous eLearning, when opened, can be used as Open Educational Recourses (OERs), digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research (OECD, 2007). OERs/courses provided by HEIs are typically referred as OpenCourseWare (OCW) and are defined as "free and open digital publication of high quality college and university-level educational materials, organized as courses, often including course planning materials and evaluation tools as well as thematic content, free and openly licensed, accessible to anyone, anytime via the internet (Open Education Consortium, n.d.). Increasing need of lifelong education and geographical barriers, amongst others, led to the massive use of OERs, a specific initiative that is increasing in popularity under MOOCs (Coursera, Futurelearn (Europe)).
Typical examples of OCW are MIT OpenCourseWare and NOVA's OER-based General Education. In Europe there can be found a number of analogous initiatives e.g. Norway's national portal of education, UK's OpenLearn and other initiatives funded mainly by the EU Lifelong Learning Programme. Further information can be found in the Europe's OpenCourseWare page. In Hellenic Republic, the Greek Universities Network (GUnet), funded by the EU Operational Programme "Information Society" and aiming in provisioning academic community in such matters, is currently supporting the programme "Hellenic Academic OpenCourses". This is a major programme for converting the Hellenic University's courses to Open Courses (General aims of GUnet are determined by the broadband network needs and objectives of the Greek academic community in the framework of Information Society aiming at servicing research and education).

The set of rules and best practices defined by the programme and suggested by GUnet provide a common conceptual model of open academic courseware developed at national level that could set the scene for the basis of a unified/ standardized higher education eLlearning policy. The overall budget of this programme is supported by structural European and National funds and (according to Avouris, Komis, & Garofalakis, 2015) around 1/3 of Hellenic HEIs participated though the implementation took place in the midst of a severe economic crisis, where all society and of course Hellenic Universities were particularly affected by. Part of the above mentioned programme is the project of the "Open Academic Courses of the Agricultural University of Athens (AUA)". The project implementation period is January 2013 - September 2015.

The paper structure is as follows: Following the Introduction already presented, we abstractedly describe the Agricultural University of Athens, the project methodology, which is mainly defined by the programme framework and the technologies used in the case of AUA. In sequel the project progress is reported, whereas in the end we discuss the lessons learned, recommendations as well as future work to be done.

Agricultural eLearning

Towards the needs of growing global demand for food, agricultural sustainability, as well as other environmental issues, various eLearning initiatives (targeted mostly in the rural sector and sustainable agriculture) are explored. Perhaps this justifies the limited cases found in the literature. A particular example is the eLearning Center of the Food and Agricultural Organization of the United Nations (FAO) that is targeted in the areas of food and nutrition security, social and economic development, hunger reduction and sustainable management of natural resources. All such courses are of small duration, offered free of charge and designed for self-paced learning, e.g. the International Network of Food Data Systems (INFOODS) eLearning Course on Food Composition Data (Charrondiere et al., 2014).

Knowing the Agricultural University of Athens

The AUA is the third oldest university in Greece. Since 1920, it has been making valuable contribution to the Hellenic and European agricultural and economic development, by conducting basic and applied research in the agricultural sciences, and by producing high quality graduates as well as cutting edge scientific knowledge. The AUA has two Schools, and in total six Departments; specifically the School of Agriculture Engineering and Environmental Sciences (Departments of Crop Science, Animal Science and Aquaculture, and Natural Resources Management & Agricultural Engineering) and the School of Food, Biotechnology and Development (Departments of Biotechnology, Food Science & Human Nutrition, Agricultural Economics & Rural Development). All the Departments aim to promote knowledge and educate scientists specialized in research on agriculture and related sciences, able to tackle problems connected with the rural sector. Hence a wide variety of courses, from different disciplines, are offered to students.

The AUA offers a 5-year Bachelor degree (300 ECTS), as well as postgraduate studies in various fields. There are 10 semesters for the undergraduate studies where the final one is dedicated to a thesis. In every semester the taught courses last for 13 weeks including semi-semester and final exams. In order for undergraduates to obtain their degrees they must also complete a 4 month internship. The University has 184 tutors, 78 tutors' assistants. There are 366 academic courses, and 324 lab courses, that include both compulsory (241 courses) and non-compulsory or elective ones (159 courses). It should be noted that courses are interrelated between different departments of the AUA.

According to AUA records the enrolled students for the year 2013 were 5.057. Table 1 shows the number of students per Department admitted to the University in the academic year 2015-2016.

DEPARTMENT	NUMBER OF STUDENTS
Agricultural Economics and Rural Development	110
Animal Science and Aquaculture	110
Biotechnology	110
Crop Science	160
Food Science and Human Nutrition	110
Natural Resources Management & Agricultural Engineering	120
SUM	**720**

Table 1: Number of students admitted to the AUA in the academic year 2015-2016.

Methodology

Open Academic Courses of the AUA main objective is to convert a number of AUA's courses to OCs. Below follows a list of rules, as well as eligibility criteria set by the programme:

- Traditional courses are formatted into three types of OCs according to the material available and the needs of the tutor(s), namely Type A-, A and A+.
  - Type A- consists of accessible presentations that corresponds/cover 100% of the course's syllabus or equivalently course's teaching hours.
  - Type A consists of audio narrated presentations.
  - Type A+ consists of video lectures that correspond/cover to a percentage of at least 80% of the course's syllabus or equivalently course's teaching hours.

  Interesting to note is that no flexibility in creating mixed types of courses is allowed. For example an OC with 70% accessible presentations and 30% video lectures will be considered as A- OC, meaning that the video lectures will not be compensated.
- For all Type of OCs (A-, A, A+) extra material can be used i.e. small videos, exercises and notes in the form of electronic elements such as slides, audio–annotated slides, photographs and schemas.
- Courses are structured with respect to and following the AUA's curriculum for each semester, leading to the format of courses following 13 weeks duration each, 2 to 5 academic hours/week depending on the courses' nature and scientific topic.
- For all Type of OCs documentation is gathered from the tutors that provide authoring information/description of the open academic course. These information has been found to cover the 18 different elements that (according to Sampson & Zervas, 2012) are used in describing an open academic course.
- For all type of courses images and other content are being handled with respect to intellectual property, i.e. references are mentioned and no copyrighted pictures are used without prior agreement or are replaced by others distributed under Creative Commons. All digital material and resources produced by the project are published with Creative Commons (CC); in our case the CC/BY-SA license.
- Common platforms are used for providing the content to the public and ensure integration with the Hellenic Repository for OCs.
- Participation of tutors and assistants (lecturers) is voluntary.

- An independent board/ committee checks if finalized OCs are according to the resources' specifications, according to each OC Type.

Additional rules concerning budgetary issues include:

- Only 10 % of the initial budget is eligible for all equipment purchases.
- A 70% of the budget should be allocated directly to the development of Open Academic Courses of which only 15% could be allocated for Type A+; however this limitation of 15% was recently removed.
- The remaining 20% can be allocated for supporting, promotional and other actions.

Technologies used in the AUA Pilot Case

Type A- OCs

Lecture notes are formatted, according to specifications, to PowerPoint presentations and then converted to accessible portable document format (pdf) files. The equipment used for this type of OCs is the MS Office PowerPoint (2013) and an Accessibility add-on.

For this type of OCs six PowerPoint (2013) templates, one for each department of the University, were prepared at the beginning of the project with standards of making the presentation courses readable with ease, and with respect to the needs of visually impaired and colorblind learners. These standards include that all texts have certain font size, each slide is titled to facilitate frame identification and navigation, no random use of images, charts etc. is done, a text equivalent for every non- text element (alternative text) is provided, foreground and background color combinations provide sufficient contrast when viewed by someone having color deficits or in black and white screen.

For each day of lesson or for each academic hour a PowerPoint presentation, in the majority of the cases, is provided by the tutor, however traditional lecture material is often redesigned to meet the project's standards. Course material should correspond to 13 sections, and contain 15-20 slides for each academic hour. As said, additional slides or notes can be included in the lecture as assisted material. To better guide the learner, presentations also contain information given by the academic staff, a brief description of the course, and educational goals of each specific section, references, and keywords. In order for the learner to follow the logical flow of the course in each file is indicated with the number of the specific section and the number of academic hour it corresponds to.

Type A, A+ OCs

Type A OCs refers to audio narrated presentations of the course's material. Though practical and very informative for some types of courses, no Type A OCs were prepared due to low desirability amongst the tutors and due to the nature and teaching environment of many AUA courses, i.e. lab courses, open field lectures. To our knowledge the same has occurred in several other Hellenic HEIs.

For Type A+ OCs, lectures are captured into high quality videos (minimum 720p resolution and maximum 1080p). In this Type of OCs the equipment can be divided into fixed and portable. Lab courses or courses held on the field, in orchards or other places in the University are captured using portable cameras.

Three (3) amphitheaters/lecture rooms of the AUA have been equipped with Internet Protocol (IP) (AXIS P1347-E) cameras, microphones and all other electronic equipment needed. Specifically the fixed equipment has been placed in the main library room (5 Mpixel IP camera), in one large and one small amphitheater in the AUA (3Mpixel IP Camera), and finally in an IT laboratory (3Mpixel IP Camera). The selected amphitheaters/lecture rooms are easy to monitor for security reasons. It should be noted that the IP camera is a tool for the live streaming broadcast of the courses. This occurs either by directly connecting with an IP address (requires a maximum bandwidth) or through the AUA server. In the current project such a live streaming connection was possible; however up to now it has not being implemented as it affects learning methods (in class courses) as well as institutional policy.

The fixed equipment in each classroom implies the use of IP cameras as mentioned above. A shotgun microphone is placed above the lecturer's desk to capture the sound. An alternative process of recording is also available via microphone lice. When the sound is received, it is then sent to the IP line-in via a sound mixer. The IP camera recording can be downloaded or sent directly to Wowza media server of the AUA. The portable equipment includes two cameras (a Sony Digital HD Camcorder HXR-NX5E NXCAM Camcorder and a Sony HXR-NX30U NXCAM Palm-Sized camcorder) with all the appropriate related equipment. The purpose is to record and create video-lectures and indoor and outdoor workshops. This is of outmost importance to the AUA because of the nature of its courses. In case of lectures in which the use of smartboards is necessary or in the case where the lecturer desires it, there possibility of screen recording is also provided. The software that is used for editing are MSOffice 2013, eLearning Suite 6.0 and Camtasia Studio. After video editing (montage) OCs comes out in MPEG-4 format for better Quality of Service (QoS) (Chimos et al., 2013).

Software Platforms

The final digital content of each OC is:

- Uploaded to the project's preliminary portal (opencourses.aua.gr), this is mainly done for Type A- OCs.
- Implemented to the AUA Digital Repository - DSpace (SCORM standards).
- Uploaded to specific platforms (in the AUA webserver) that provide integration with the Hellenic Repository for OCs.

The specific platforms used are the Open eClass and OpenDelos management systems. The Open eClass e-learning platform version 3.1.2 provides an integrated course management system whereas the OpenDelos version 0.91 video platform for asynchronous eLearning, provides multimedia management system functionalities i.e. lecture player, video editor and slide synchronization. Both platforms are supported and distributed by GUnet and, as said, provide integration with the Hellenic Repository for OCs.

Current State of the Project

According to the initial plan of the project all departments of the university would be covered equally (Table 2). It should be noted that the active participation of department members was characterized as key determinant for the success of the project (Mpasiou, Mpasios, Chimos, Karvounidis, & Tsiligkiridis, 2013). Table 3 presents the allocation of courses (resources) between Departments of the AUA, according to the last year modification of the project's framework.

DEPARTMENT	A- COURSES	A COURSES	A+ COURSES
Agricultural Economics and Rural Development	10	2	1
Animal Science and Aquaculture	20	1	2
Biotechnology	20	1	2
Crop Science	20	1	2
Food Science and Human Nutrition	20	2	2
Natural Resources Management & Agricultural Engineering	10	1	1
General	10	2	2
SUM	**116**	**10**	**20**

Table 2: Allocation of courses (resources) between Departments of the AUA, according to the initial framework

DEPARTMENT	A- COURSES	A+ COURSES
Agricultural Economics and Rural Development	14	6
Animal Science and Aquaculture	8	1
Biotechnology	8	1
Crop Science	10	4
Food Science and Human Nutrition	14	2
Natural Resources Management & Agricultural Engineering	5	1
SUM	**59**	**15**

Table 3: Allocation of courses (resources) between Departments of the AUA, according to last year modification of the project's framework.

Below is given a brief summary of the number of AUA's courses opened so far per Department (Tables 4, 5) as well as a comparison of Type A- OCs and Type A+ OCs between the current state of the project and the project's framework (Tables 6,7). The numbers provided in the tables refer to courses already opened, from the beginning of the project, as well as those that are currently being finalized. Currently eight (8) Type A- and three (3) Type A+ OCs are being finalized. As the AUA's curriculum has been undergoing changes for the past two years, the information provided in the bellow tables are according to the curricula that was active at the time each lesson was opened.

DEPARTMENT	A- COURSES	A+ COURSES
Agricultural Economics and Rural Development	9	5
Animal Science and Aquaculture	5	0
Biotechnology	4	0
Crop Science	3	3
Food Science and Human Nutrition	13	0
Natural Resources Management & Agricultural Engineering	1	0
SUM	35	8

Table 4: Courses of the AUA opened from the beginning of the project.

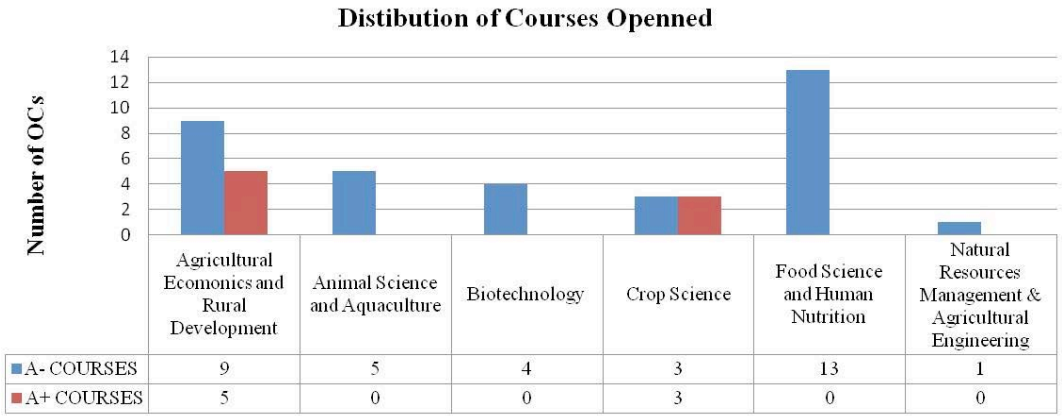
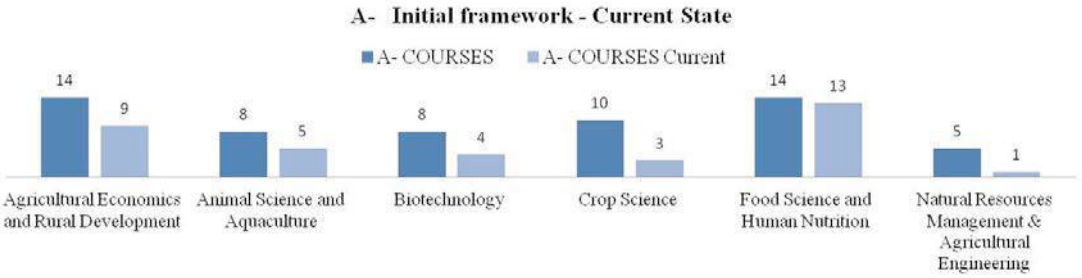


Table 5: Distribution of courses opened between Departments of the AUA.



Tables 6: Comparison of A- OCs according to project framework and current state.

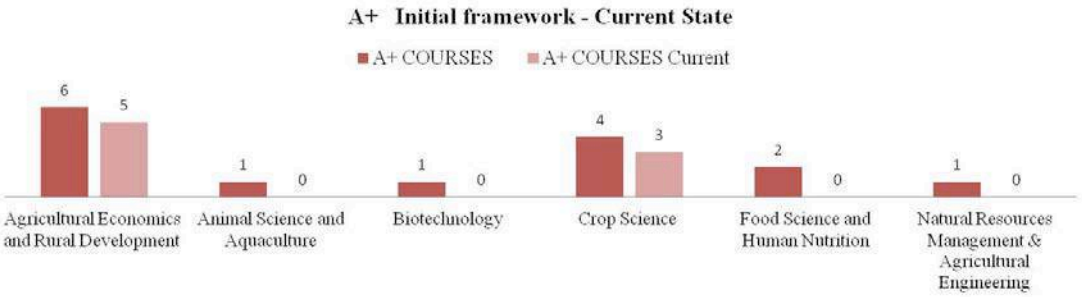


Table 7: Comparison of A+ OCs according to project framework and current state.

Discussion and Recommendations

During our experience we conclude that there are two types of factors that play a significant role in the project implementation itself as well as the programme's framework. The first type of factors relates to the participants' motivation in the AUA as follows:

- The programme sets the scene for future implementation/recommendations of eLearning activities. The openness of the project promotes knowledge dissemination as well as flexible learning opportunities available to all free of geographical boundaries. It also gives access to knowledge to persons with disabilities.
- The project offers educational opportunities and quality improvement of the courses and the taught material. In particular, it offers repetition and backup of the course material for the students, as well as it enhances the lecturers' capabilities in using new technologies and educational tools. It also allows collection and compilation of the course material, as well as clarification and safeguarding of copyright issues. Finally, it promotes the teaching activities and learning methodological tools used.
- The use of fixed and portable equipment is proven to be beneficial for the project since it allows flexibility for indoors and outdoors recording.

The second types are suspending factors for the project implementation. These are the following:

- As already mentioned, methodology imposed by programme's framework concerns the course's material coverage. In cases these rules create certain difficulties in opening a course. For example in the co-taught courses, not all lecturers who are co-teaching agree to participate in the program despite their initial high interest; note that the lecturers' participation is voluntary. Moreover, sometimes the standard teaching schedule is changing suddenly for many different but well justified reasons. For the Type A+ OCs there are additional course specificities which make the lecture recordings difficult, e.g. in microbiology we should use microscope with camera. In addition in courses where the entire lecture takes place in front of a screen, as is the case, for example, of programming languages courses, the use of IP camera is not appropriate. An alternative idea would be the use of video tutorials instead of courseware in this form.
- Lecturers see with skepticism the idea and practical use of open licenses, particularly in cases they are not familiarized with the use of Creative Commons. Best practices concerning open licenses and CC, on both third parties' material and open resources produced by the project are subject to constant change.
- During the project implementation period the AUA underwent several changes in its curriculum.
- For the production of an appropriate courseware, the lecturers were asked to use technological tools such as screen video recorder, smart board, microphones, etc. Some lecturers need technical assistance to operate part of the above mentioned equipment.

The project team has to overcome challenges concerning video, lighting and sound conditions. IP camera with higher resolution can render better video quality of the lecturer's physical presence as well as of the use of whiteboard or blackboard. It goes without saying that amphitheaters and lecture rooms were not initially planned to be

used as studio, hence lighting conditions are not ideal in some cases. Concerning sound issues, we have to deal with two major problems. First, there are no personal microphones to facilitate the students' participation in the recordings. Second, isolating the main sounds from external noise, especially in the outdoor recordings is needed.

Based on the present project experience we may provide the following main recommendations. First, more flexibility in allocating courses of different Types is needed. Mixed Type(s) of OCs (mostly OCs consisting of accessible pdf files and video lectures) should be an option as they were highly demanded by lecturers. Towards this, we propose that the material coverage limitations for Type A- and A+ OCs could be applied to each thematic subject and not to the entire course material. This will be also beneficial in cases of co-tough courses.

Another aspect that should be considered is copyright issues. Already established open licenses do not seem to facilitate the openness of eLearning as they follow common practice. Experts should provide a flexible solution, possibly by using IT to combine open licenses i.e. Creative Commons (CC), standard copyright licenses and openness.

Finally Universities should develop and establish a specific policy relating to all eLearning issues including matters such as the openness and funding opportunities of similar projects. On the same line, there should be opportunities for the training of both tutors and students on using ICT tools in order to disseminate/ receive and apply higher academic knowledge and ensure high teaching quality.

Conclusions and Future Work

In this paper we provided a brief introduction concerning eLearning and openness in HEIs. We presented in brief the programme "Hellenic Academic OpenCourses" and especially its project pilot case "Open Academic Courses of the AUA", the project's framework, methodology and technologies used. In this respect a brief description of the structure and curriculum of the AUA was given. Furthermore we presented the current state of the project and the basic factors that, according to our so far experience, play significant role for the project implementation. In addition we gave basic recommendations that could be taken into account for a University policy to combine both eLearning and openness.

During the project implementation period we came across few cases of opposition to the idea of openness. We are under the impression that mostly this along with the already mentioned suspending factors, have led to small deviation in the participation rates between current status of the project and the project's initial plan.

Future work includes a survey (ongoing) to reveal the exact reasons behind lecturers' skepticism, and specific aspects of their attitude towards the idea of openness. Concrete conclusions are expected to derive from this research.

Acknowledgements

The project is co-financed by the European Union (European Social Fund ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) 2007-2013.

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A Proposed Framework to Support Adaptivity in Virtual Learning Environments

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
The revolution of the Internet and technology has dramatically changed the educational system in many countries. Learning Management Systems (LMSs) are becoming crucial and widely used in many educational institutions for the adoption of blended and distance learning. However, the "one-size-fit-all" approach is the basis of most of these systems where the differences and preferences such as knowledge level and learning styles of learners are not taken into consideration in their design. In this paper, a generic framework is proposed reflecting a novel approach in order to support adaptivity in LMSs. The framework is composed of two major modules: the Event-Condition-Action (ECA) module and the Multi-agent module. The ECA module is used as the sensing component and source for the Multi-agent module. It provides necessary and real-time data based on predefined pedagogical rules to the multi-agent module which reacts accordingly to provide adaptive experiences in LMSs.

This paper has been divided into three parts. The first part provides a background of e-learning systems and adaptivity outlining the technologies used in our proposed framework. The second part discusses our proposed framework with its components. The last part concludes our paper and states our future work.

Keywords: virtual learning environments, adaptive e-learning systems, Learning management systems, agent-based systems, ECA

Background

E-learning can be defined as the method of delivering knowledge and training using any electronic media (Hayakawa, Higashino, Takahashi, Kawamura, & Sugahara, 2012; Zimmermann, 2011). Recently, Virtual Learning Environments (VLEs) have become a paramount part of eLearning in many institutions such as universities, schools and training centres. VLEs can be seen as a generic umbrella that includes various educational platforms such as Learning Management Systems (LMSs) and Course Management Systems (CMSs). Other terms can be used to designate this type of system. VLEs such as Moodle, Blackboard and Prometheus are examples of modern VLEs (Mallon, 2010). Most current LMSs are web-based platforms that facilitate the learning process for both teachers and students by providing various tools and facilities such as Discussion Forums, Online Assignments, etc. However, the "one-size-fit-all" approach is the basis of most of these systems where the differences and preferences such as knowledge level and learning styles of learners are not taken into consideration in their design.

The idea of providing adaptive content in LMSs has emerged from Adaptive Hyper Media Systems (AHMSs) and Intelligent Tutoring Systems (ITSs) in which adaptive presentation and navigation are provided. These systems are normally used in computer-based instruction (Phobun & Vicheanpanya, 2010). Recently, LMSs are becoming increasingly popular in many educational institutions (Pitigala Liyanage, Gunawardena, & Hirakawa, 2013). Furthermore, Massive Online Open Courses (MOOCs) have been becoming popular worldwide. We believe that one of the significant keys to make the adoption of these courses successful is the use of reliable LMSs that can meet learners' needs. Supporting adaptivity in these systems is one of the challenging issues in e-learning that must be taken into consideration.

Adaptive E-learning Systems

Adaptive learning can dynamically adjust the type of instruction based on each learner's abilities and knowledge, and can personalise instruction in order to foster learner's performance. Therefore, prevalent challenges such as the limitation of resources, student motivation and diversity of students' knowledge and preferred learning styles can be addressed during the learning process. Targeting instruction to the learner's abilities and needs can diminish course drop-out rates, improve learning outcomes and achieve learning goals (Pappas, 2015). The current trends in education and training should focus on identifying tools and methods for delivering on-demand knowledge tailored to learners, taking into consideration their differences in skills and knowledge level (Musumba, Oboko, & Nyongesa, 2013). Since LMSs are widely used by many educational institutions for the adoption of distance learning or blended learning, learners' differences such as preferred learning styles and knowledge level should be taken into account when designing and implementing these systems.

Recently, with the revolution of technology, supporting adaptivity in LMSs has become the interest of many researchers in the field incorporating different technologies. Agents can play a major role in extending the features of current LMSs and provide adaptive experiences to meet learners` needs.

Agent Technology

Agent-based systems have been applied in many systems – ranging from comparatively small systems such as personalized assistants to large complex systems such as air traffic control (Wooldridge, 2009). In the literature of the field, agent technology has also been used in the context of e-learning systems to support adaptivity and enhance the learning process. Agents are autonomous and can act intelligently in their environment (Wooldridge & Jennings, 1995). It is possible to achieve a powerful system adapted to the needs of each learner by using intelligent agents in the design of e-learning systems (Tveit, 2001). Hammami, Mathkour, and Al-Mosallam (2009) have proposed a multi-agent architecture for an adaptive e-learning system. The architecture is composed of several multi-agent levels and an intelligent blackboard as an agent in order to support adaptivity in e-learning systems. Chang and Chen (2012) have built an adaptive learning system using agents to provide learners with adaptive content based on their learning styles using Felder-Silverman Learning Style Model (FSLSM) (Felder & Silverman, 1988). In addition, a Mashup search engine has been developed to search supplementary teaching material to enhance the learning process. Agent technology can be seen as a promising approach to enhance e-learning effectiveness. Xu, Huang, Wang, and Heales (2014) have used intelligent agents in order to personalise the internal learning mechanism in VLEs. They argue that VLEs can be used for achieving e-learning effectiveness when personalisation is integrated in these systems in which learners' needs are satisfied.

Databases are the main repository of most of the current LMSs. Data about learners including their online activities and personal information is stored in these databases. However, some of this data can be automatically integrated in LMSs from the main university's Student Information System (SIS). This huge amount of data about learners can be used to understand the learners and enhance the learning process. From this point of view, the online activities (e.g. accessing the system, submitting assignments and accessing courses' content) can be seen as events stored in the database of LMSs. Therefore, the Event-Condition-Action model can be used in this kind of environment. The ECA model is widely used in Active Database Management Systems and Workflow Management Systems (Zhi-xue, Xin, Qing-chao, Hong-yue, & Qing-long, 2012).

The Event- Condition- Action (ECA) Model

The ECA model has been used in event-driven systems (Denecke, 2012). This model is a reactive model that responds in a real-time manner to any changes in its environment based on pre-defined rules and conditions. It is being used in different critical systems such as autopilot systems and anti-virus systems. It takes the form on *event* if *condition* do *actions* (Poulovassilis, Papamarkos, & Wood, 2006). It can sense the environment and react accordingly in a timely manner based on pre-defined rules and conditions. Most of the LMSs are designed with a database where all logs and data about learners and their activities are stored and archived. From this point of view, we believe that the ECA model can play a significant role in sensing the e-learning environment using database triggers. These triggers are based on pre-defined pedagogical rules which can be updated by teachers for any new requirements without re-structuring the system. In the next section we propose our framework to support

adaptivity in any LMSs reflecting a hybrid architecture using agent technology and the ECA model.

The Proposed Framework

Our proposed framework is composed of three components: the ECA module, the multi-agent module and the e-learning environment as shown in Figure 1. Our approach is designed as an independent automated system which can be integrated with any e-learning system.

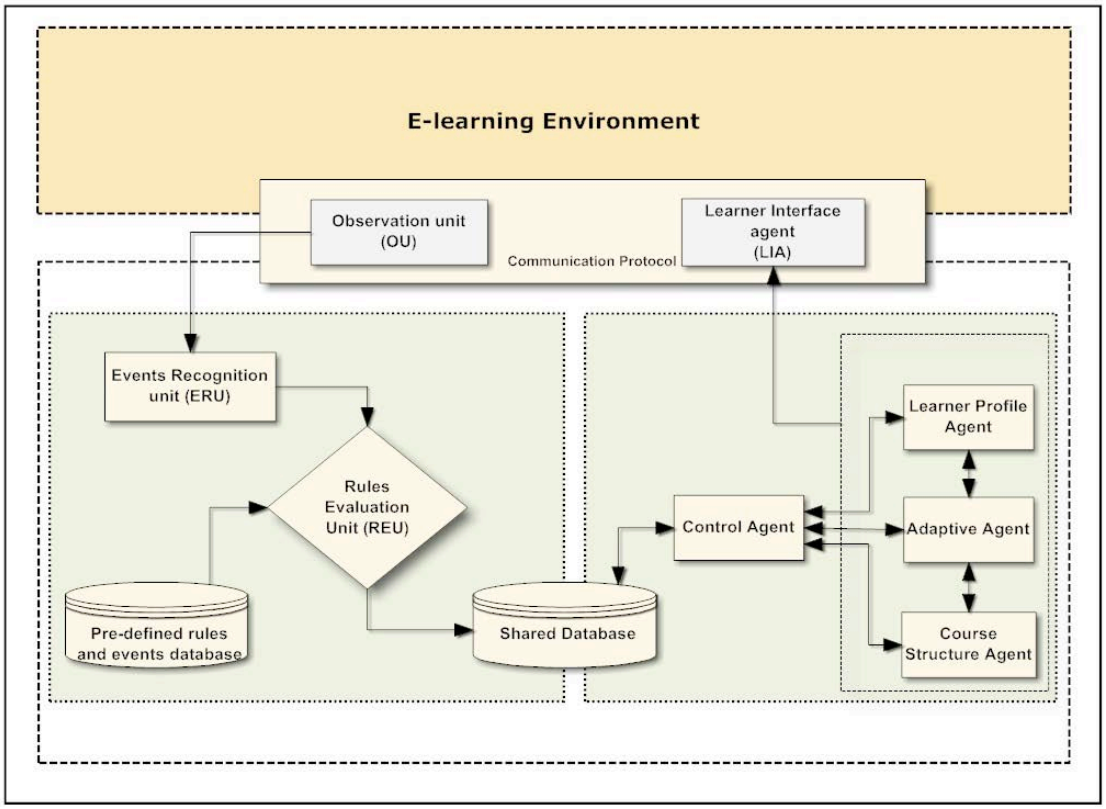

Figure 1: The proposed framework.

The proposed framework above aims to support adaptivity in E-learning systems. It is designed using a hybrid architecture reflecting a novel approach that can be used to support adaptivity in any given e-learning system as shown in Figure 1. The framework is composed of three main components:

The E-learning Environment

This component can be any LMS where learners interact, collaborate and learn. This environment is an essential part for the adoption of distance and blended learning. Moreover, it provides learners and teachers with the required tools and facilities to enhance the learning process. Moodle, Blackboard and Saba are some of the leading e-learning platforms (Pitigala Liyanage et al., 2013). However, Moodle is probably the most popular and used platform, with over 53,346 sites providing for over 70 million users across 222 countries (Moodle, 2015).

The ECA Module

The ECA module is designed and used as the sensing component in our framework. It is based on events that may occur in the e-learning environment and react accordingly. However, this process is a rule-based mechanism based on database triggers so that the events (learning activities) such as registering and accessing a course are observed by the Observation Unit (OU) which is interfaced with the e-learning environment using a communication protocol. Then, the event is received by the Events Recognition Unit (ERU) so that it is recognised and categorised before the evaluation process takes place. The Rules Evaluation Unit (REU) is responsible for determining whether or not the current event satisfies the pre-defined pedagogical rules in order to provide the multi-agent module with the necessary and required data via a shared database to provide adaptive experiences to learners.

The Multi-Agent Module

Our multi-agent module consists of several agents. Each agent is responsible for specific tasks managed by the Control Agent. Moreover, an agent can communicate with other agents in order to achieve the overall objective which is to provide learners with adaptive experiences such as adaptive content based on their learning styles. The Learner Profile Agent deals with learners' personal information such as name, age, program and preferred learning styles. It provides the Adaptive and Course Structure Agents with the required data in order to provide adaptive experiences to learners via the Learner Interface Agent. For example, each learner is provided with adaptive content based on his/her learning styles through the Learner Interface Agent. In order to design our multi-agent module, JADE is used as the platform for developing multi-agent systems (Bellifemine, Caire, & Greenwood, 2007). JADE is one of the most common platforms that researchers use for building multi-agent systems. A study by Kravari and Bassiliades (2015) shows that JADE is currently the most popular FIPA-compliant agent platform in academic and industrial community.

We believe that our proposed framework can support adaptivity in e-learning systems to overcome the limitations of these systems. This framework may open further research paths on the field. It may be used for Educational Data Mining (EDM) and Recommendation Systems (i.e. recommendation for online courses).

Conclusion

Supporting adaptivity in e-learning systems has become crucial for the adoption of distance and blended learning in educational institutions. We believe that by supporting adaptivity in these systems taking into consideration the differences between learners can enhance the learning process. Therefore, a framework has been proposed reflecting a novel approach using ECA and Agent technology to support adaptivity in any given e-learning system. We have only identified our approach using different technologies in our framework. As future work we intend to implement and evaluate our approach in Moodle as a case study to provide adaptive content based on learner's learning styles using Felder-Silverman Learning Style Model (FSLSM).

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Canonical Explorations of 'Tel' Environments for Computer Programming

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract
This paper applies a novel technique of canonical gradient analysis, pioneered in ecological sciences, with the aim of exploring student performance and behaviours (such as communication and collaboration) while undertaking formative and summative tasks in technology enhanced learning (TEL) environments for computer programming. The research emphasis is, therefore, on revealing complex patterns, trends, tacit communications and technology interactions associated with a particular type of learning environment, rather than the testing of discrete hypotheses. The study is based on observations of first year programming modules in BSc Computing and closely related joint-honours with software engineering, web and game development courses. This research extends earlier work, and evaluates the suitability of canonical approaches for exploring complex dimensional gradients represented by multivariate and technology-enhanced learning environments. The advancements represented here are: (1) an extended context, beyond the use of the 'Ceebot' learning platform, to include learning-achievement following advanced instruction using an industry-standard integrated development environment, or IDE, for engineering software; and (2) longitudinal comparison of consistency of findings across cohort years. Direct findings (from analyses based on code tests, module assessment and questionnaire surveys) reveal overall engagement with and high acceptance of collaborative working and of the TEL environments used, but an inconsistent relationship between deeply learned programming skills and module performance. The paper also discusses research findings in the contexts of established and emerging teaching practices for computer programming, as well as government policies and commercial requirements for improved capacity in computer-science related industries.

Keywords**:** Technology-Enhanced Learning; Computer Programming; Collaborative Learning.

Introduction

Ever since the introduction of FORTRAN to Higher Education in the 1960s (Davey & Parker, 2010), computer programming has been considered a challenging subject to learn. Although much progress has been made with teaching techniques, 50 years on, students still struggle to learn the underlying concepts and to apply principles to solve programming problems.

Programming modules are central to the four computing courses taught here at Buckinghamshire New University (hereafter referred to as 'Bucks'). Due to the considerable revenues that digital and technological industries attract to the UK economy (Sparrow, 2006) the newly elected government has reaffirmed a commitment to policy to promote "high levels of skills in science, technology, engineering and maths (STEM), and citizens that value them" (UK Government Department for Business Innovation & Skills, 2015). The number of programming and software engineering related jobs are growing at a rate that is faster than most other sectors. In the USA, some forecasts estimate growth between 20-30% by 2020 (Bureau of Labor Statistics, 2014; Zhao, 2013), thus indicating a continued global demand for skilled programmers. Livingstone and Hope (2011), co-author of "The Next Gen" report, however found that there had been a reduction in the numbers of qualified graduates entering the video games industry. The authors attributed this to university curricula that "neglected" the computer science and programming skills needed by this sector (Gove, 2012; Livingstone & Hope, 2011).

In Higher Education, although the dropout rate amongst other subjects has decreased recently (HEFCE, 2013), this is not the case with computing and computer science courses. Programming modules are often cited as an obstacle to progression. It is estimated that between "30% (in the 1960s) and 50% (some institutions in 2010s)" of students taking programming will fail or dropout (Bornat, 2011). This is consistent with the experiences at Bucks where many students are required to retake introductory programming modules in order that they may progress to second year studies.

This research continues the work of Mather (2015), presented at the IAFOR ECTC conference in 2014. Research reported here endeavours to determine whether the patterns of engagement and learning progress reported this year are consistent with those reported for 2014, and thereby indicate whether earlier observations are likely to be representative of future cohorts. Since Mather's earlier study, assessment criteria of the modules involved were altered in an attempt to encourage the development of a deeper understanding of programming skills required by industry. In the 2013-2014 academic year students were required to complete and document all tasks (numbering 100 or so problems) issued in 'study packs'. These comprise some 5-7 in-class practical exercises and 1-3 independent studies each week. In a further week exercises are replaced with a single in-depth and extended project. This academic year (2014-2015) students were requested to only submit independent studies and projects, significantly reducing the volume of work required for assessment. It was hoped that this would allow greater time to concentrate on completing tasks to a higher standard. The course team also introduced voluntary formative testing measures to help students consolidate subjects covered in theory and practical sessions.

Aim and Objectives

This paper applies a novel technique of canonical gradient analysis, pioneered in ecological sciences, with the aim of exploring student performance and behaviours (such as communication and collaboration) while undertaking formative and summative tasks in technology-enhanced learning (TEL) environments for computer programming.

Research emphasis is, therefore, on revealing complex patterns, trends, tacit communications and technology interactions associated with a particular type of learning environment, rather than the testing of discrete hypotheses. The study is based on observations of first year programming modules in BSc Computing and closely related joint-honours computing with software engineering, web and game development courses. This research extends earlier work, and evaluates the suitability of canonical approaches for exploring complex dimensional gradients represented by multivariate and technology-enhanced learning environments. The advancements represented here are: (1) an expanded context, beyond the use of the 'Ceebot' learning platform, to include learning-achievement following advanced instruction using an industry standard integrated development environment, or IDE, for engineering software; and (2) longitudinal comparison of consistency of findings across cohort years.

The overall aim was to continue applying the technique of 'canonical' analysis to explore student progress and patterns of engagement behaviours (including communication and collaboration) while using in-house TEL environments for learning programming.

The supporting objectives were as follow:

- To suggest behaviours associated with learning success;
- By validating studies reported in 2014, to indicate whether behaviours may reliably predict learning success (thereby, have potential value as early signals for remedial intervention);
- To determine whether the modified assessment regime has improved the alignment of assignments to workplace skills;
- To compare the findings of 2015 with those reported in 2014 with respect to the persistence (thereby predictability) of engagement patterns (regardless of the use of an additional learning platform and modified regime);
- To comment on the usefulness of canonical approaches in the light of extended findings.

Literature Review

Many educational researchers have attempted to discover predictors for success in learning programming, with varying results. The following review suggests that learning success cannot be attributed to simple educational factors or solutions. This perhaps reflects the multifaceted nature of learning and its dependence on complex interactions between diverse influences such as teaching methods, learning styles, supporting materials, modes of assessment and the learning environment. The review, however, attempts to identify prominent student behaviours and/or attributes that may either contribute to success or obstruct progress when learning programming. These factors may influence the delivery of programming courses and guide teacher intervention.

Dehnadi and Bornat (2006) claimed to have designed an aptitude test able to predict "with high accuracy" the students most likely to succeed when learning programming at an introductory level. Their aptitude test contained 20 questions on the assignment of variables (entities used to store information/values in programs), and was administered to 61 students in both the first and third weeks of module delivery. According to the answers submitted, students were placed in one of three 'mental model' categories that represented the conceptual approaches that non-programming students used to solve problems. The categories were 'consistent' (those using the same conceptual model), 'inconsistent' (those drawing from a variety approaches) and 'blank' (those not answering most or all questions).

In their analyses of two sets of exam results, Dehnadi and Bornat (*ibid.*) demonstrated that the 'consistent' group significantly outperformed their 'inconsistent' peers. Although the test was replicated by other researchers (Caspersen *et al.*, 2007; Ford & Venema, 2010), these did not demonstrate similar associations between performance and 'mental model', thus placing the prediction value of Dehnadi's and Bornat's (*op cit.*) in some doubt. Richard Bornat (2014) has since modified claims concerning the reliability of their test as a result of findings from subsequent administrations of the test. Nevertheless, he continues to advocate the need for students to develop consistent mental models in order to succeed as programmers. Other authors have identified specific topics that cause confusion when learning programming. These include problems relating to determining the values assigned to variables (e.g. du Boulay, 1986; Bayman & Mayer, 1983; Perkins & Simmons, 1988), and related problems working with iteration constructs that programmers use to repeat code (Bornat, 2011; Kessler & Anderson, 1986).

The late Steve Jobs (1995) remarked on the importance of programming as a 'mirror for thought processes' explaining that "everyone should learn how to program a computer, because it teaches you how to think". This is consistent with Ben-Ari (1998) who associates the educational philosophy of constructivism with learning how to program. Students create their own mental models of a concept, based on their previous knowledge and experiences, rather than 'copying' someone else's idea of what the concept is, from a book or from the lecturer. Biggs and Tang (2011) stress the importance of constructively aligning the course materials, teaching, and assessment so that students have opportunities to coherently relate ideas and concepts from these individual elements of the course. Hagan and Markham (2000) found that students who had prior experience in a programming language performed

"significantly better" in assessment. They surveyed students at four stages during an introductory programming module at Monash University in Australia. Data collection was by questionnaire survey and included biographical information, educational expectations and programming experience. The authors were therefore also able to observe that greater grade performance was associated with prior programming experience and to exposure to more than one programming language. It is of further interest that other researchers have found that prior experience can be a hindrance if this based on misconceptions or incorrect models of programming concepts (Bonar & Soloway, 1985; Taylor & Du Boulay, 1987; Lui *et al.*, 2004). Conversely, Longo (2010) regards that the competitive advantage of prior experience is unaffected if students already possess some 'pre-existing matrix', or schema, or correct mental model of programming principles.

Following a study that questioned students on their understanding of passages of prose, Marton and Saljo (1976) famously reported that individuals either adopted "surface-level or deep-level processing" strategies. Surface learning behaviour is generally associated with a focus on knowing what needs to be known in order to complete a task. In contrast, deep learners consider the underlying reasons behind concepts and explore these in greater detail. Bornat (2011) suggests that the decision to learn lies with the student; in other words teaching does not necessarily result in learning.

Simon and co-authors (2006), reporting on a "multi-national and multi-institutional" study in 2004, found that grade results were positively correlated with a deep approach to learning and negatively correlated with adopting a surface approach. The study compiled the data of 177 participants from 11 institutions based in Australia, New Zealand and Scotland. The study comprised four tests: a spatial visualisation task (a standard paper folding test); two behavioural tasks - drawing a simple map, and articulating a search strategy; and an attitudinal task based on a questionnaire that requested students to provide details of their approaches to learning and studying.

It is also commonly suggested that there is an association between mathematical and programming ability. Wilson and Shrock (2001) conducted a study that recorded twelve 'predictors' for 105 students. They found that a background in mathematics was the second strongest predictor of success in a programming module. Van der Veer and various colleagues (1983; 1986) also report that students who are strong in maths do not require as much teaching as other students. Simon and co-workers *(op. cit.*), similarly observe a correlation between maths ability and programming ability, and suggest that the two disciplines require similar logic to step through problems. Here at Bucks, there is anecdotal evidence that students who are strong in maths can solve problems faster than those who are not. Mather (*op. cit.*) also found that students were able to solve problems within the environment that they were being taught in, but many struggled to answer questions outside that environment: suggesting the underlying concepts were not learnt to a level whereby they could be confidently transferred to other environments.

Programming modules are typically structured so that students build on knowledge each week, whereby concepts introduced later in the module often require that foundation principles are properly understood. This is sometimes referred to as 'scaffolded' learning (Sawyer, 2006) and is also consistent with Meyer & Land's

(2013) notion that many subject disciplines have 'threshold concepts'. Such thresholds are critical transformations in understanding that are necessary for a learner to progress to more advanced topics.

Robins (2010) noticed that students built momentum as they succeeded in learning the first topic, and then found it easier to learn the second, and then the third and so on. However, students who failed to learn foundation topics often found it difficult to progress further. The loss of momentum at early stages may also signal reduced motivation and a weakening in engagement and attendance.

Given the difficulties that students experience when learning programming, it seems probable that such reduced levels of motivation may, in some part, be attributable to low 'self-efficacy'. This is described as "the personal perception of one's ability to successfully execute an activity" (Ponton & Rhea, 2006 after Bandura, 1997). Ponton and Rhea (2006), who contextualise autonomous learning in the Social Cognitive Theory of Bandura (1986), consider how three key agents (environment, the learner and behaviour) reciprocally influence the development of self-efficacy through 'mastery experiences'. These are experiences where the learner genuinely attributes 'successes' to personal ability. Conversely, successes borne of 'environmental factors', such as assistance from others or "information supplied by the environment", do not enhance self-efficacy (Ponton & Rhea, *op. cit*. after Bandura, 1997).

Whilst academic skills are usually the subject of research, academic ability is also significantly affected by wellbeing and personal circumstances. Wilson & Shrock (*op. cit.*), observed that 'comfort level' was the most significant predictor of student success in a programming course. Outside of programming, many authors have commented on the negative impact that anxiety has on students (Medlicott, 2009, Richardson *et al.*, 2012). The pressure to do well has always existed in academic contexts, but in many countries this anxiety is now exacerbated by increased tuition fees against a background of global recession and reduced opportunities for employment. De Raadt and colleagues (2005) note a change in research focus from 'presage factors' (IQ, previous programming experience) to more holistic views surrounding issues of welfare, experience and emotional circumstances that may influence capacity for learning.

Students respond differently when faced with programming problems. Perkins and co-workers (1989) noticed that some students were easily frustrated with problems and quickly abandoned attempts at solutions. These students were categorised by the authors as 'stoppers'. Conversely, other students (categorised as 'movers') recognised when they were unable to solve problems, and would progress by working on other tasks to make more effective use of time. As well as being effective in time management, 'movers' were less prone to lose motivation than 'stoppers'.

Motivation is frequently cited as a key factor in determining student success across many disciplines. Geoff Petty (2009) recognises this to be one of the most significant challenges faced by teachers and students alike, and of particular consequence for the "digital native" generation (Prensky, 2001; Ritchel, 2010). This generation is often characterised, even stereotyped, by behavioural attributes that include: low attention span; prone to distractions and continually switching between tasks; having

insufficient ‘downtime’ to connect ideas; lack of sleep due to time spent with social media etc.

Many authors have found that the best predictor of success revolves around student expectations, especially of grades (Richardson *et al*., 2012; Rountree *et al*., 2002), but that attitude, keenness and general academic motivation are also important (Simon *et al*., 2006).

Methods

The approach adopted was similar to that described by Mather (*op. cit.*), thereby ensuring that findings could form part of a longitudinal study. This adopted an ecological perspective that, similar to the positioning of organisms along natural environmental gradients, the position that students may occupy along achievement gradients is partly determined by their learning behaviours and their engagement with learning environments.

Mather’s 2014 questionnaire was slightly amended. The overall structure remained unchanged as follows:

- an initial question asking students to evaluate the ‘perceived difficulty’ of modules;
- five test coding questions, four requiring coding concept definitions and one to identify output from a ‘broken’ code;
- 22 Likert scale questions (20 in 2014) concerning learning behaviours and module acceptance attitudes.

Likert scale questions were modified in 2015. This was because in the earlier study (Mather, *ibid*.) the combined test and questionnaire was issued after students had completed only one of two programming modules, this based on the ‘Ceebot’ learning environment. In 2015, the test and survey was conducted at the end of the academic year when students had almost completed both programming modules. Questions were therefore amended to capture impressions of both Ceebot (Semester 1 module) and the C# language using Microsoft’s Visual Studio™ platform (Semester 2 module). A further question was included to determine student preferences for learning programming with either Ceebot or the Visual Studio™ integrated development environment (IDE).
This research forms part of the teaching team’s ongoing evaluation of module delivery. Full student consent was obtained and findings have been anonymised.

Results and Discussion

5.1 The application and interpretation of Redundancy Analysis

Questionnaire data was transferred to a spreadsheet. Programming test data was scored for correctness and 21 opinion questions captured using five Likert categories. For the purposes of canonical analysis (see Mather 2015 for details of this procedure), independent variables (corresponding to 'environmental gradients'), were represented by programming skill and knowledge and module grade. The dependent variables were represented by the Likert opinion responses and a percentage record of student attendance. The analysis was conducted using the canonical analysis software Canoco 5™. This is widely used by ecologists to conduct multivariate analyses and reveal patterns and trends in data. Here redundancy analysis (RDA) is applied to the data set. Among key advantages of RDA over more commonly used ordination techniques (such as Principal Components Analysis) are:

- that ordination axes are constrained in iterative steps to describe variation in the explanatory variables of interest;
- the technique does not require assumptions of unimodality (ter Braak, 1987);
- the resulting correlation biplots provide an easily interpretable and graphical summary of the most important relationships in the ordination model.

The reader is again referred to Mather (*op. cit.*) and the original and updated works of Canoco specialists (e.g. Corsten & Gabriel, 1976; ter Braak, *op. cit.* and 1992; Šmilauer & Lepš, 2014) for more detailed description of the mathematical interpretation of vectors represented by RDA biplots.

For the purposes of visual interpretation of the biplot figures below it is sufficient to understand that vectors or 'arrows' point in the direction of maximum variation. Variables with longer arrows have greater effect on the overall model and are generally most closely correlated with the independent variables of interest (ter Braak, 1987; ter Braak &Prentice, 1988). Variables and axes pointing in the same direction are positively correlated, perpendicular vectors are uncorrelated and opposing ones are negatively correlated.

With respect to negative correlations, these may only be artefacts caused by 'negative' assertions in expressing questionnaire items. In the biplots below independent variables are indicated by red arrows and dependent ones by blue arrows.

The summary statistics for analyses of both 2014 and 2015 data are presented in Table 1. Eigenvalues and other expressions for the proportion of variation explained by the first two (most important) axes, as well as for overall models, are slightly greater in 2014 than in 2015. This is perhaps due to the inclusion of further variables that were later shown to be rather weakly related to explanatory variation (notably two questions to capture preferences for the two environments used for teaching). Monte Carlo permutation tests indicate that model axes significantly describe variation in dependent variables.

Table 1 Summary statistics for RDAs presented in Figures 1 and 2.

Statistic	*Axis 1*	*Axis 2*
2015 Analysis		
Eigenvalues	0.0770	0.0258
Explained all variation (cumulative %)	7.70	10.27
Pseudo-canonical correlation	0.5968	0.6222
Explained fitted variation (cumulative %)	66.98	89.40
Permutation Test Results (on all axes)	pseudo-*F*=1.5; *p*=0.05	
2014 Analysis		
Eigenvalues	0.0915	0.0516
Explained all variation (cumulative %)	9.15	14.31
Pseudo-canonical correlation	0.8523	0.6975
Explained fitted variation (cumulative %)	54.04	84.52
Permutation Test Results (on all axes)	pseudo-*F*=1.4; *p*=0.04	

5.2 Results for 2015 and their comparison with 2014

Despite changes made to delivery, as well as differences in student cohorts and assessment regime in 2015, the overall patterns of biplot ordination for 2015 (Figure 1) were similar to those in 2014 (Figure 2).

The most notable feature is that in 2015 (similar to 2014) the alignment between module assessment and 'real' programming skills ("Module %" and "Test …" vectors in Figures 1 and 2), is not as strong as the programing team would wish. In fact, the increased angle (towards the perpendicular) between module assessment and test variables suggests that the modified assessment may not have had the desired effect of cultivating a deeper understanding of principles.

With regard to other relationships, all assessment indices (red) appear to remain (as in 2014) relatively strongly correlated with the 'commitment' indicators of independent study and homework (16, 19), but less so (in 2015) with the inclination to maintain a logbook of practical work (as indicated by the shorter vector for item 12 in 2015 compared to 2014). This latter observation is of some pedagogic significance because the modified assessment regime for 2015 also omitted the need to submit in-class solutions, and required students to present a smaller portfolio of independent-study tasks.

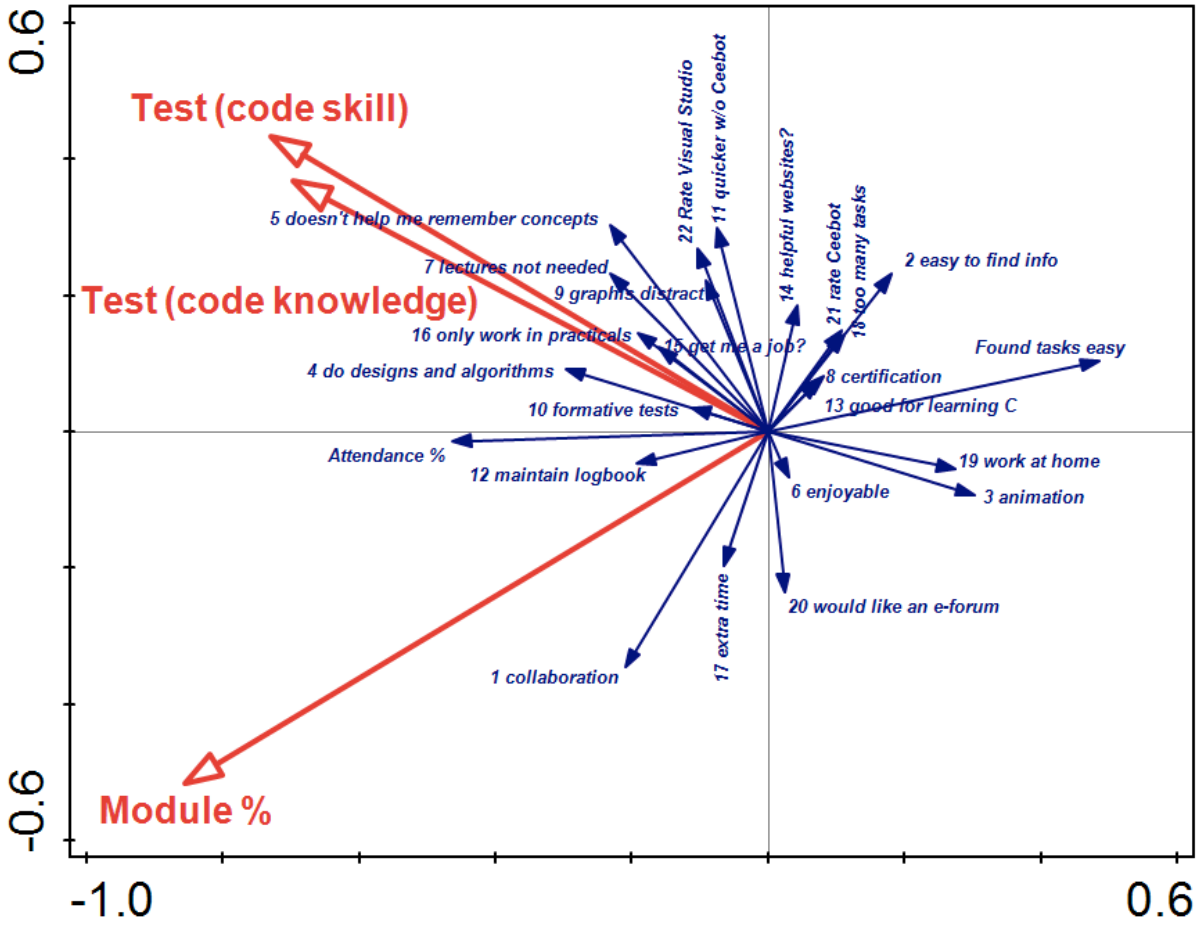

Figure 1: Biplot for RDA of 2015 data. Note: response variables (student behaviour and acceptance items captured by questionnaire and attendance logs) are represented by blue arrows and with three key 'explanatory' learning performance gradients (red arrows) for Module % and tested programming knowledge and coding skill.

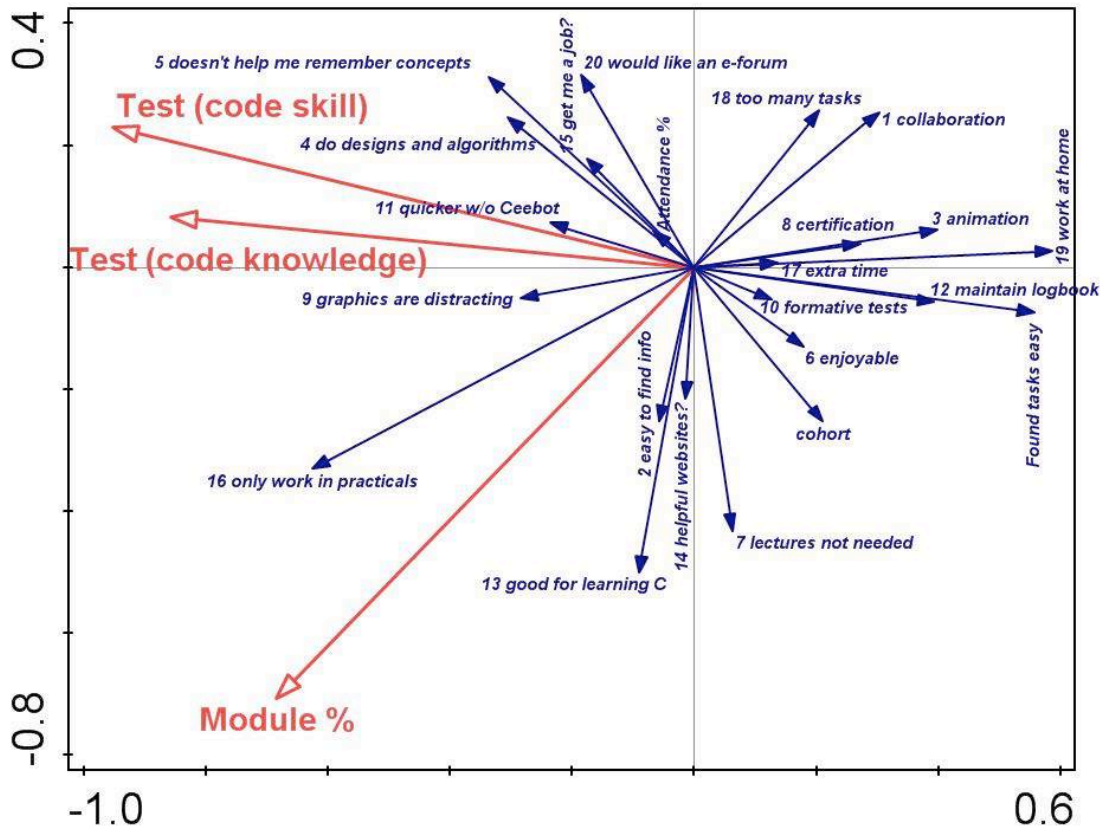

Figure 2. Ordination biplot from RDA of 2014 for comparison with 2015 (reproduced from Mather, 2015). Note: see caption for Figure 1 for interpretation.

Other noticeable between-year pattern similarities included both the orientation and strength (length) of key variables. These included expressions: “found tasks easy” (easy=scored 1 and very difficult scored 4); item 3, Ceebot animation was helpful (1=strongly agree to 5 strongly disagree); and item 19 preference to “work at home” (1=strongly agree to 5 strongly disagree). In both years these three variables are relatively strong and closely aligned with the first axis (indicating their overall importance in the model). Their opposing orientation to assessment and test variables is only an artefact of the direction of Likert category. Thus those who found tasks easier (probably through greater practice), appreciated the animation used in the Ceebot learning environment and were inclined to work outside lessons, predictably, achieving greater module and test scores. It was also unsurprising to discover that in both years, successful students had a tendency to “do designs and algorithms” (4) for their solutions; a behaviour which also directly contributes to module grades.

Of remaining similar and influential variables, the relationships between test score vectors and the item 5 assertion that Ceebot “doesn’t help me remember concepts” (and to lesser extents disagreements that it is “quicker to learn without Ceebot” and “only work in practicals”, items 11 and 16), are reassuringly consistent across both years.

Over interpretation of weaker relationships is perhaps best avoided on the grounds that any model influences are unlikely to be significant. These include expressions for enjoyableness (item 6), the desirability of certification (8), a need to have extra time

(17), the desirability of including formative tests (10), relevance for employment (15), and ease in discovering help (items 2 and 14). Similarly, analysis of questionnaire items introduced in 2015 suggests a slight preference for using Microsoft Visual Studio™ over Ceebot. It may also be inferred from the direction of relationships, that Visual Studio™ is associated with higher code skill scores, and preference for Ceebot is more strongly associated with assessment success. However, although the patterns may be consistent with such views, neither relationship is confidently demonstrated by the analysis.

Regarding differences between years, in 2015 ‘attendance’ is clearly more important than 2014 and is also more closely aligned with the three learning indicators. This may be attributed to a small but significant cohort of unusually capable game development students who, in 2014, were able to complete programming work on a self-directed basis while only attending classes infrequently.

5.3 A changed ‘polarity’ for student collaboration – is this an unintended consequence of the reduced assessment of in-class work?

Although clearly visible in both models, the changed polarity for collaboration (item 1) is less easy to explain. In both 2014 and 2015 collaboration (the full questionnaire expression for this item was in fact “While working on exercises it is very helpful to discuss problems with friends”) is closely aligned with overall assessment success (Module %). In 2014 the opposition of collaboration and assessment vectors are consistent with a rationale that a high desire to discuss problems with colleagues (agreement with item 1 therefore low score) is associated with module success. In 2015, this relationship is such that low desire to collaborate is associated with success. It may be suggested that the 2015 group was less ‘cohesive’ than in 2014 (attendance and overall module success indicators are in fact consistent with this view), but such a complete reversal in direction of relationship indicates a need to more fully investigate the role of collaboration in learning programming.

One interesting (and pedagogically important) scenario is that by completely removing classwork from assessed elements in 2015, rather than having a desired impact of encouraging students to more deeply explore a smaller number of solutions, this has substantially reduced the need for collaborative and discursive interaction towards discovering programming solutions.

6. Conclusion and recommendations

This extension to the work of Mather (2015) demonstrates the overall usefulness of canonical RDA as means for exploring student progress in the educational contexts addressed by this study. Findings also were found to be useful for revealing patterns of engagement with learning materials and the class environment, as well as associating these with measures of learning achievement.

In 2015, as was the case in 2014, certain 'commitment' behaviours (such as the willingness to undertake homework and other independent study) are consistently associated with 'success'. The consistent relationship of these and other 'behaviours' across both years suggests their reliability as 'indicators' of success as well as of acceptance and engagement with learning environments.

The continuing orthogonality of the relationship between module grade and skill test data code (despite changes made to assessments) is a matter of ongoing concern to the teaching team. Additionally, the teaching team will wish to further investigate the possibility that the reduced in-class component of assessment (intended to allow greater time to develop deeper subject understanding) may have inadvertently encouraged 'surface' strategies to complete independent studies at the expense of equally important (but now unassessed) collaborative classwork. It may also be concluded that analyses did not demonstrate any improvement in the alignment of assignments to workplace skills as a result of modifications to the assessment regime.

Many aspects of the observations reported here are consistent with findings reported in literature by the wider research community. Although no causality is demonstrated by analyses here, variation in module achievement, nevertheless reflects the widely ranging circumstances of the student body (such as prior knowledge, 'comfort' in the academic environment, expectations and motivation) that are known to influence success (e.g. Richardson *et al.*, 2012; Rountree *et al.*, 2002; Simon *et al.*, 2006; Wilson & Shrock, 2001).

Overall many of the indicators used in our findings signal the importance of fully engaging with studies at all levels (attendance, collaboration, self-directed study, participation with formative class work as well as summative independent study). This is consistent with wide acceptance that deep-level processes are required to embed learning (Marton & Saljo, 1976) and that computer programming is no exception to this principle (Simon *et al*., 2006),

Acknowledgements

The authors acknowledge the contribution made by first year students attending BSc Computing, Computing and the Web, Games Development and Software Engineering courses, who consented and participated in this research. We also acknowledge Bucks New University's support in funding research.

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