Giovanni Vincenti
Alberto Bucciero
Carlos Vaz de Carvalho (Eds.)

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E-Learning, E-Education, and Online Training

Second International Conference, eLEOT 2015
Novedrate, Italy, September 16–18, 2015
Revised Selected Papers

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Preface

Welcome to the proceedings of eLEOT 2015, the Second International Conference on e-Learning, e-Education and Online Training! The 2015 eLEOT conference was held during September 16–18, 2015, at the Università degli Studi eCampus, in Novedrate (Como), Italy. This year's edition was particularly exciting because we joined forces with the fifth edition of SGames, a conference dedicated to Serious Games, Interaction and Simulation. The two conferences had several joint sessions, but retained their individual identities through separate tracks.

The main theme for this year's eLEOT conference was E-Distance Education in Science, Technology, Engineering, and Math. We received 52 submissions, which resulted in 26 papers being presented and the conference. We were also proud to offer three pre-conference workshops, one of which was held jointly with SGames. This year again we debuted a demo session, where our presenters let the attendees experience their works. This year we featured a student track that was completely integrated with the rest of the conference, to ensure that researchers who are just starting their careers get the same exposure as more seasoned ones. Finally, we also had a series of online presentations for all those who were not able to join us in person. Every year we continue building eLEOT in the hope of creating a state-of-the-art conference that merges disciplines and approaches.

Paolo Paolini offered the opening keynote address at eLEOT 2015. His dedication to e-learning has been shown throughout his career. He teaches Web Application Design, Hypermedia Applications, and Human Computer Interaction at the Politecnico di Milano. He is the scientific coordinator of the HOC-LAB (Hypermedia Open Center), located in Milano-Lambrate and Como. In his address, Prof. Paolini introduced us to some of his work regarding educational portals, the rationale driving them, and practical applications that may be derived. We were also honored to have our returning Tech-Talk speaker Stefano Santo Sabato with us once again. He is the CTO of MediaSoft, S.r.l., one of Italy's premier private endeavors in bridging the gap between industry and academia in the area of distance education. The brilliant work that Stefano and his group produce daily was showcased in part during this presentation. Finally, our closing keynote address was given by Aron Keith Barby, Director of the Decision Neuroscience Laboratory at the Beckman Institute for Advanced Science and Technology at the University of Illinois. His contribution to eLEOT reminds us all about the more physiological aspects associated with human learning by introducing a new cognitive neuroscience framework.

All of this would not have been possible without the Technical Program Committee, chaired by Alberto Bucciero. He successfully assisted 31 exceptional members of the committee who powered this conference from four different continents, representing both academia and industry. The Organizing Committee is grateful to each member of the Technical Program Committee, and I am grateful to each member of the Organizing Committee for their tireless support. The professional and tireless work of

Stefano Za, Marco Zappatore, Minjuan Wang, Carlos Vaz de Carvalho, Sabrina Leone, Nicoletta Di Blas, Aldo Torrebruno, and James Braman built the foundations of this year's edition. I would like to also thank the European Alliance for Innovation (EAI) as our primary sponsor. The tireless work of Sinziana, Jana, and Barbara was invaluable and essential in the organization of this year's event. And last but not least, I would like to thank all the presenters, who are the true protagonists of eLEOT 2015.

December 2015 Giovanni Vincenti

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Contents

Does Character's Visual Style Affect Viewer's Perception of Signing Avatars?

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Abstract. The paper reports a study that aimed to determine whether character's visual style has an effect on how signing avatars are perceived by viewers. The stimuli of the study were two polygonal characters that presented two different visual styles: stylized and realistic. Each character signed four sentences. Forty-seven participants with experience in American Sign Language (ASL) viewed the animated signing clips in random order via web survey. They (1) identified the signed sentences (if recognizable), (2) rated their legibility, and (3) rated the appeal of the signing avatar. Findings show that while character's visual style does not have an effect on subjects' perceived legibility of the signs and sign recognition, it has an effect on their interest in the character. The stylized signing avatar was perceived as more appealing than the realistic one.

Keywords: Sign language animation · Signing avatars · Deaf education

1 Introduction

Computer animation of American Sign Language (ASL) has the potential to remove many of the barriers to education for deaf students because it provides a low-cost and effective means for adding sign language translation to any type of digital content.

The benefits of rendering sign language in the form of 3D animations have been investigated by several research groups [2–4] and commercial companies [5,6] during the past decade and the quality of 3D animation of ASL has improved significantly. However, its effectiveness and widespread use is still precluded by two major limitations: low realism of the animated signing (which results in low legibility of the signs) and low avatar appeal. The goal of our research is to advance the state-of-the-art in ASL animation by improving the quality of the signing motions and the appeal of the signing avatars. Our first step toward this objective is to determine whether certain characteristics of a 3D signing character have an effect on the way it is perceived by the viewer. In a previous study we investigated the effects of character's geometric model (i.e. segmented versus seamless) on viewer's perception of the animated signing. Details of the study can be found in [7]. The objective of the research reported in this paper was to determine whether the character's visual style, and specifically its degree of stylization, has an effect on the legibility of the animated signs and on the viewers interest in the character.

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2 Prior Work on American Sign Language Animation

Vcom3D [5] was first to reveal the potential of computer animation of ASL, with two commercial products designed to add ASL to media: SigningAvatar® and Sign Smith Studio®. While Vcom3D animation can approximate sentences by ASL signers, individual hand shapes and signing rhythm are often unnatural, and facial expressions do not convey meanings as clearly as a live signer.

In 2005, TERC [8] collaborated with Vcom3D and the National Technical Institute for the Deaf on the SigningAvatar® accessibility software for web activities and resources for two Kids Network units. TERC has also developed a Signing Science Dictionary with the same software [4]. Although both projects have benefited young deaf learners, they have not advanced the state-of-the-art in animation of ASL - they employed existing Vcom3D animation technology. Purdue University Animated Sign Language Research Group [9] with the Indiana School for the Deaf, focuses on development and evaluation of innovative animation-based interactive tools to improve K-6 math/science education for the Deaf (e.g. Mathsigner and SMILE™). The signing avatars in Mathsigner and SMILE, improve over previous examples of ASL animation.

Several research efforts target automated translation from written to sign language to give signers with low reading proficiency access to written information in contexts such as education and internet usage. In the U.S., English to ASL translation research systems include those developed by Zhao et al. [10], Grieve-Smith [11] and continued by Huenerfauth [12]. To improve the realism and intelligibility of ASL animation, Huenerfauth is using a data-driven approach based on corpora of ASL collected from native signers [13].

Despite the substantial amount of research and recent advancements, existing sign language animation programs still lack natural characteristics of intelligible signing, resulting in stilted, robot-like, low-appeal signing avatars whose signing motions are often difficult to understand.

3 Realistic Versus Stylized Characters

In character design, the level of stylization refers to the degree to which a design is simplified and reduced. Several levels of stylization exist, such as iconic, simple, stylized, realistic [14]. A realistic character is one that closely mimics reality. For instance, the body proportions of a realistic character closely resemble the proportions of a real human, the level of geometric detail is high and the materials and textures are photorealistic [15]. A stylized character often presents exaggerated proportions, such as a large head and large eyes, and simplified painted textures. In general, stylized avatars are easier to model and set up for animation and much less computationally expensive for real time interaction than realistic avatars.

Both realistic and stylized characters (also called agents) have been used in e-learning environments to teach and supervise. A few researchers have conducted studies on realistic versus stylized agents with respect to interest and engagement effects in users. Welch et al. [16] report a study that shows that pictorial realism increases involvement and the sense of immersion in a virtual environment. Nass et al. [17] suggest that embodied conversational agents should accurately mirror humans and resemble the targeted user group as closely as possible.

On the other hand, Cissel's work [15] suggests that stylized characters are more effective at conveying emotions than realistic characters. In her study on the effects of character body style (e.g. realistic versus stylized) on user perception of facial emotions, stylized characters were rated higher for intensity and sincerity. McCloud [18] argues that audience interest and involvement is often increased by stylization. This is due to the fact that when people interact, they sustain a constant awareness of their own face, and this mental image is stylized. Thus, it is easier to identify with a stylized character.

In summary, literature shows no consensus on realistic versus stylized characters with respect to their impact and ability to engage the users. In addition, to our knowledge, no studies on the effects of visual style in regard to signing avatars currently exist. This indicates a need for additional research and systematic studies. The work reported in the paper aims to fill this gap.

4 Description of the Study

The objective of the study was to determine whether the visual style of a character (e.g. stylized versus realistic) has an effect on subjects' perception of the signing avatar. The independent variable for the experiment was the presence of stylization in the signing avatar's visual style. The dependent variables were the ability of the participants to identify the signs, their perception of the legibility of the signed sentences, and their perception of the avatar's appeal.

The hypotheses of the experiment were the following:
H_0 (1) = The presence of stylization in a signing avatar's visual style has no effect on the subjects' ability to recognize the animated signs.
H_0 (2) = The presence of stylization in a signing avatar's visual style has no effect on subjects' perceived legibility of the signing animations.
H_0 (3) = The presence of stylization in a signing avatar's visual style has no effect on perceived avatar's appeal.

H_a (1) = The presence of stylization in a signing avatar's visual style affects the subjects' ability to recognize the animated signs.
H_a (2) = The presence of stylization in a signing avatar's visual style affects subjects' perceived legibility of the signing animations.
H_a (3) = The presence of stylization in a signing avatar's visual style affects perceived avatar's appeal.

4.1 Subjects

Forty-seven (47) subjects age 19-32, twenty-four (24) Deaf, five (5) Hard-of-Hearing, and eighteen (18) Hearing, participated in the study; all subjects were ASL users. Participants were recruited from the Purdue ASL club and through one of the subject's ASL blog (johnlestina.blogspot.com/). The original pool included fifty-three (53) subjects, however six (6) participants were excluded from the study because of their limited ASL experience (less than 2 years). None of the subjects had color blindness, blindness, or other visual impairments.

4.2 Stimuli

Avatars

The two characters were created in MAYA 2014 software. One character, Tom, is a *realistic* character constructed as one seamless polygonal mesh, with a poly-count of 622,802 triangles and a skeletal deformation system comprised of 184 joints. The face is rigged using a combination of blendshapes and joint deformers. To achieve realism, the face/head was set up to convey 64 deformations/movements that correspond to the 64 action units (AU) of the FACS system [19]. The hands have a realistic skin texture with wrinkles, furrows, folds and lines, and are rigged with a skeleton that closely resembles the skeleton of a human hand. The second character, Jason, is a partially segmented *stylized* avatar; comprised of 14 polygonal meshes with a total poly-count of 107,063 triangles. He is rigged with the same skeletal deformation system as the realistic character and uses the same number of blendshapes and joint deformers for the face. Although the skeletal structures of both characters are identical, Jason presents exaggerated body proportions and unrealistic, stylized textures (see Fig. 1).

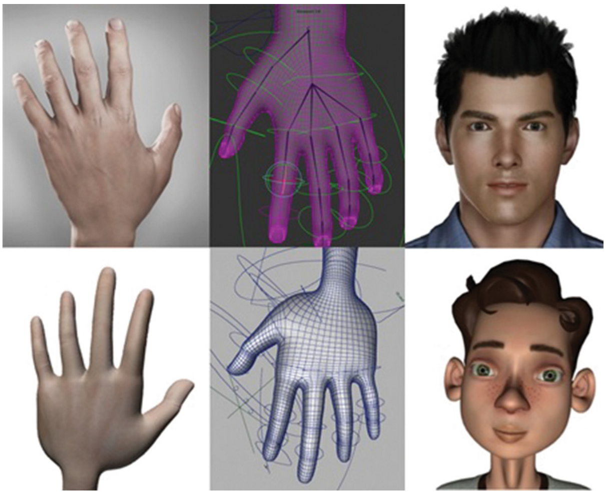

Fig. 1. Rendering of realistic character's hand (top-left); polygonal mesh and skeleton of realistic character's hand (top-middle); rendering of realistic character's face (top-right); rendering of stylized character's hand (bottom-left); polygonal mesh of stylized character's hand (bottom-middle); rendering of stylized character's face (bottom-right).

All signing animations were keyframed on Tom and the animation data was exported and applied to Jason. Videos of a native signer performing the signs were used as reference footage for the creation of the clips. The signer was actively involved in the animation process. Because both characters have the same skeletal structure it was possible to retarget the motion from one character to the other. However, as the characters have different body proportions, there are slight differences in the hand shapes and in the position of the arms/hands in relation to the torso and face.

Animations
Eight animation clips were used in this test. Four animation clips featured the stylized character, while the other four featured the realistic character. Both avatars signed the following sentences:
(1) *Nature can be unbelievably powerful.*
(2) *Everyone knows about hurricanes, snowstorms, forest fires, floods, and even thunderstorms.*
(3) *But wait! Nature also has many different powers that are overlooked and people don't know about them.*
(4) *These can only be described as "FREAKY".*

These four sentences (from National Geographic for kids [23]) were chosen because they represent fairly complex sign language discourse. They include one and two-handed signs, different levels of handshape complexity, a finger-spelled word (FREAKY), and a variety of non-manual markers. Camera angles and lighting conditions were kept identical for all animations. The animations were created and rendered in Maya 2014 using Mental Ray. Figure 2 shows six frames extracted from the animations.

4.3 Web Survey

The web survey consisted of an introductory screen with written and signed instructions and eight other screens (one for each animated clip). The eight screens with the animations included the animated clip, a text box for entering the signed sentence, (if identified), a 5-point Likert scale rating question on perceived legibility (1 = high; 5 = low), and a 5-point Likert scale rating question on perceived avatar appeal (1 = high appeal; 5 = low appeal). The animated sequences were presented in random order and each animation was assigned a random number. Data collection was embedded in the survey; the web survey also included demographics questions on subjects' age, hearing status and experience in ASL.

4.4 Procedure

Subjects were sent an email containing a brief summary of the research, an invitation to participate in the study, and the http address of the web survey. Participants completed the on-line survey using their own computers and the survey remained active for 2 weeks. It was structured in the following way: the animation clips were presented in randomized order and for each clip, subjects

Fig. 2. Three frames from the animation featuring the realistic character (top), and three frames from the animation featuring the stylized character (bottom)

were asked to (1) view the animation; (2) enter the English text corresponding to the signs in the text box, if recognized, or leave the text box blank, if not recognized; (3) rate the legibility of the animation; (4) rate the avatar's appeal; and (5) fill out the demographics questionnaire.

4.5 Findings

For the analysis of the subjects' legibility ratings a paired sample T-test was used. With four pairs of animations for each subject, there were a total of 188 rating pairs. The mean of the ratings for animations featuring the realistic character was 2.19, and the mean of the ratings for animations featuring the stylized character was 2.21. Using the statistical software SPSS, a probability value of .068 was calculated. At an alpha level of .05, our alternative hypothesis H_a (2) (e.g. stylization has an effect on the user's perceived legibility of the animated signs) was therefore rejected. There is no statistically significant difference between perceived legibility of realistic versus stylized signing avatars.

For the analysis of the subjects' perceived avatar's appeal ratings a paired sample T-test was used as well. The mean of the ratings for animations featuring the realistic character was 2.28, and the mean of the ratings for animations featuring the stylized character was 1.36. Using the statistical software SPSS, a probability value of .034 was calculated. At an alpha level of .05, our alternative hypothesis H_a (3) (e.g. stylization has an effect on the subject's interest in the character) was therefore accepted. There is a statistically significant difference between perceived appeal of realistic versus stylized signing avatars. Our study shows that subjects perceived the stylized character as more appealing than the realistic one.

For the analysis of the ability of the subjects to recognize the signed sentences, the McNemar test, a variation of the chi-square analysis, was used. Using SPSS once again, a probability value of .062 was calculated. At an alpha level of .05, a relationship between realistic and stylized characters and the subject's ability to identify the animated signs could not be determined. Our hypothesis H_a (1) (e.g. the presence of stylization in a signing avatars visual style affects the subjects' ability to recognize the animated signs) was therefore rejected. There was not a statistically significant difference in sign recognition between the two avatars.

4.6 Discussion and Future Work

In this paper we have reported a study that aimed to determine whether character's visual style has an effect on subjects' perception of signing avatars. Findings show that whereas sign recognition and perceived legibility of the signs are not affected by the visual style of the character, visual style has a significant effect on perceived avatar's appeal. Subjects found the stylized character more appealing than the realistic one. The lower appeal ratings of the realistic character might be due to the "Uncanny Valley" effect described by T. Mori [20]. Mori hypothesized that when animated characters (or robots) look and move almost, but not exactly, like natural beings, they cause a response of revulsion among some observers. For instance, in computer animation several movies have been described by reviewers as giving a feeling of revulsion or "creepiness" as a result of the animated characters looking too realistic. Realistic signing avatars might evoke the same response of rejection as they approach, but fail to attain completely, lifelike appearance and motions.

One limitation of the study was the relatively small sample size, and therefore the difficulty in generalizing the results. Because of the limited number of participants, we can only claim that stylized characters, which are easier to model and much less computationally expensive for real time interaction, show promise of being effective and engaging signing avatars. To build stronger evidence, additional studies with larger pools of participants of different ages and cultural backgrounds, and in different settings will be conducted in the future.

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Assessing the Usability of Learning Management System: User Experience Study

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Abstract. E-learning is an innovative way of learning that is both symbolic and derivative of 'the information age.' When used as part of the learning process, it provides users with greater flexibility in terms of time and location. For an E-learning application to be considered effective, it should provide its users with a certain standard of usability; otherwise, the learning process is likely to become cumbersome and frustrating for the learner. Focusing on this dilemma, this paper aims to assess the usability of the Jusur Learning Management System (LMS) that is used in higher education in Saudi Arabia. Nine factors have been incorporated into a survey to evaluate the system: content, learning and support, visual design, navigation, accessibility, interactivity, self-assessment, learnability, and motivation. The results show that E-learners who use the Jusur LMS tend to find that Jusur is a usable and desirable application in terms of its users' experiences and perspectives.

Keywords: HCI · Usability · LMS · E-learning · Jusur

1 Introduction

The emergence of computers and their associated technologies is responsible for revolutionising the way the world operates today. Powered by these tools, the technological revolution has resulted in greater ease of communication—and the effect of this on human life cannot be understated. This effect has been further enhanced by the ability of many individuals to acquire powerful computers and gain access to high-speed Internet services. The confluence of these factors is becoming increasingly pronounced and has consequently simplified access to information and knowledge. In education, this revolution has been translated into communication modes that provide opportunities for people to access quality learning without having to "go to school" in the literal sense. E-learning applications give people access to education from their homes and workplaces. Many such applications exist; while some provide users with an enjoyable and informative experience, others inflict stress and boredom while seemingly failing to educate them at all. If the field of E-learning applications is to develop further, it is necessary to achieve a better understanding of what makes an E-learning application positive or negative for the learner. An integral step in gaining this understanding is undertaking a quantitative and qualitative assessment of the effectiveness of E-learning applications. According to [1], Learning Management Systems (LMS) provide tools that can be used to manage teaching and learning

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activities and to integrate learning services in order to facilitate the procedures of both teaching and learning. The tools provided by LMS usually include: course-management tools for handling the provision of course content; tools for the management of online groups; communication aids; tools for collecting assignments; virtual classrooms; and tools that allow for learner assessments and course evaluations. The LMS software used in the Kingdom of Saudi Arabia is known as Jusur [10]. It was developed and is operated by the National Centre of E-learning and Distance Learning for use by universities within the Kingdom. The Jusur system is the subject of the assessment performed in this study, which seeks to determine Jusur's usability. For that evaluation, a certain set of factors has been selected to investigate users' experiences with the system and to assess the level of its usability. Motivation to learn has been selected as one of the factors in order to determine the extent to which users are motivated to learn through the use of the Jusur system.

This study is organised as follows. In the following section, we will review studies and methods that are relevant to the assessment of the usability of E-learning systems. Next, the methodology utilised in this research will be presented, followed by findings and results. Finally, this paper will end with a summary of the research.

2 Related Research

2.1 Usability

Usability is an easy-to-understand concept, but its practical, high-level application to a website can be more difficult to gauge. The definition of usability in [11] encapsulates five components: learnability, efficiency, memorability, general accuracy, and user satisfaction. The relevant literature makes it clear that usability reflects, and always connects with, 'ease of use.' Ease of use is one of the main goals of Human–Computer Interaction (HCI), which in turn involves the study of the interactions between users and technology [3]. Nevertheless, usability is a measure of more than simple ease of use; it refers to consumers' subjective experiences upon using an application. Usability also captures more measurable aspects, such as whether users, in using the application, are actually able to accomplish that which they set out to achieve. In E-learning applications, this second aspect is especially relevant. It is possible to assess how much an individual has learned through the use of an E-learning application, and this assessment reveals information regarding the effectiveness and efficiency of the application.

2.2 E-Learning

E-learning is the process of learning through the use of software and via electronic media, such as the Internet, satellite broadcasts, and traditional computer-supported learning [6]. When using an E-learning application, the end user can have a positive experience; this can, in turn, be good for the business of the company that is presenting that application. However, certain flaws in E-learning applications have been identified in [4], and such flaws can result in a negative end-user experience. For instance, when an E-learning application is used for training purposes, it often tends to ignore objectives and to focus instead on technological aspects; as a result, it does not always provide the user with the learning that the training had promised. Research conducted vis-à-vis the usability of E-learning applications for disabled learners has found that many applications lack appropriate accessibility tools for those who require assistive technologies [7]. In [12], the authors evaluated the effect of individual preferences and differences; they found that an individual's E-learning experience can be dominated by his or her disability, prior E-learning experience, and preconceived notions regarding the use of computers as learning tools. Therefore, learners with disabilities might have experiences with E-learning that differ completely from those of individuals without disabilities, even within similar environments.

2.3 Assessing the Usability of E-Learning Applications

With specific reference to E-learning applications, the meaning of the term usability can vary. For example, the aesthetics of an application must be considered; a poorly laid-out application can lead to confusion on the part of the user. The authors in [16] performed a multi-method usability assessment using questionnaires, guided interviews, eye-tracking, and the annotation of multimodal behaviour. This complex approach revealed interesting information that other methodologies had failed to identify, such as software problems. The authors in [8] derived an evaluation methodology called e-Learning Systematic Evaluation (eLSE), which combines inspection tools with user-testing. Their technique, called Abstract Tasks (ATs), has been validated by their results, which show the benefits of using AT inspection techniques and illustrate why they are effective tools.

2.4 The Use of Questionnaires in Usability Assessment

Questionnaires and other survey instruments (e.g., interviews) are tools that are commonly used to obtain data regarding people's perceptions. Questionnaires have a proven track record in the assessment of interactive applications. They have been applied to the assessment of E-learning applications [5] and are considered highly appropriate for this purpose because they are inexpensive and easy to use [17]. Existing questionnaire methods relating to the usability of E-learning applications cover several areas. For example, the researchers in [15] divided their questioning into three categories: general interface usability criteria, website-specific criteria for educational websites, and learner-centred instructional design that is grounded in learning theory and aims to provide effective learning. Additionally, the author in [2] used a questionnaire approach to assess ten areas: general system performance, software installation, manuals and online help, online tutorials, multimedia quality, information presentation, navigation, terminology and error messages, learnability, and overall system evaluation. The authors in [17] developed a questionnaire that covered several areas and included 'motivation to learn' as a new attribute by which one could assess the usability of an E-learning application.

2.5 Motivation to Learn in Usability Assessment

The study in [17] is not the only work to make use of the 'motivation to learn' attribute in undertaking a usability assessment. The researchers in [13] also did so while defining the usability of E-learning applications in the following terms: "usability = usable + learnable + useful + motivating." The author in [14] lists "Web feature and motivation," along with six other categories of motivation-study issues, with regard to web-based learning. In [9], the author assesses usability while using the usability testing method and focusing on user motivation.

2.6 The Target E-Learning System

The target E-learning system assessed in this study is the Jusur LMS. The Ministry of Higher Education of Saudi Arabia owns the system, and the National Centre of E-Learning and Distance Learning manages it. The Jusur LMS allows its users (i.e., university students enrolled and studying in Saudi Arabia) to register, record, and manage their personal data; to schedule their courses and course structures; and to view the corresponding content as selected and uploaded by the faculty [10].

3 Methodology

As stated above, the broad aim of this study is to evaluate the usability of the Jusur LMS from a user perspective using the measures that have been suggested by [17], which integrate the attribute of 'motivation to learn' with the existing criteria of web usability and design instructiveness. Therefore, a web-based survey consisting of 11 sections was created. The aim of the first section was to collect demographic information about the respondents, such as gender, length of computer utilisation, and length of Jusur LMS utilisation. The next nine sections covered the usability of the Jusur LMS, including content, learning and support, visual design, navigation, accessibility, interactivity, self-assessment, learnability, and motivation; the questions in these sections were phrased as positive statements, and the respondents were required to indicate the extent to which they agreed with each statement using a five-point Likert scale from one (strongly agree) to five (strongly disagree). The last section in the survey included two open-ended questions asking respondents what they liked and disliked about the system.

4 Results Analysis and Discussion

4.1 Respondents' Profile

This section presents the results and analysis of the collected responses to the questionnaire. The response rate to the questionnaire was high in terms of the researchers' expectations, with 808 learners who use the Jusur system completing the questionnaire. According to the collected data, 299 respondents (37 %) were male, while 509 (63 %)

were female. Most learners had used computers for more than three years (84 %), while 9 % had used computers for one to three years and 7 % had used computers for less than a year. From this, it can be assumed that respondents had a relatively high level of IT literacy and computer ability. Most participants (66 %) had not used any other E-learning system, while 34 % of learners had used other E-learning systems. Therefore, most participants in the sample were not able to make comparisons between the E-learning system in question and other systems; this means that they analysed the system impartially.

4.2 Overall Assessment for the Jusur LMS

Figure 1 shows the learners' overall response to the system. When asked about the usability of the system, over half of the learners (58 %) responded positively. In contrast, only 21 % of the sample responded negatively. This result shows the strength of the system, given the extent of overall user satisfaction. For additional clarification, Fig. 2 shows the learners' ratings for each usability factor. It appears that most of the students tended to agree with each statement regarding the usability factors. Interestingly, most learners provided positive ratings for the first four factors (i.e., content, learning and support, visual design, and navigation), thus indicating the strong usability of the system in terms of these attributes. The overall rating of the system will be discussed further in the following sections.

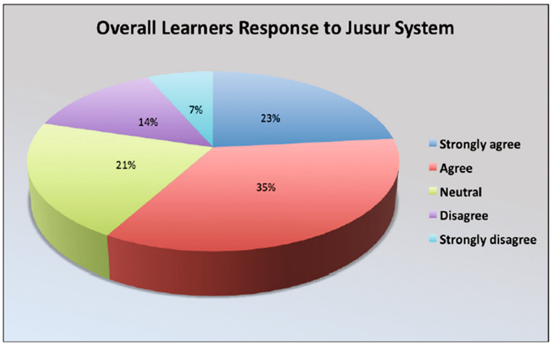

Fig. 1. Overall response

4.3 Overall Impression, Likes, Dislikes

In the last section of the survey, the questions were designed to elicit more subjective information. There were two questions: the first asked what learners disliked about the system, while the second asked what they liked about it. The learners provided often detailed answers to these questions, thereby offering insight into the usability issues and the weaknesses and strengths of the system. The following two sub-sections will present the different issues and positive points regarding the Jusur system, as collected via the responses to these questions.

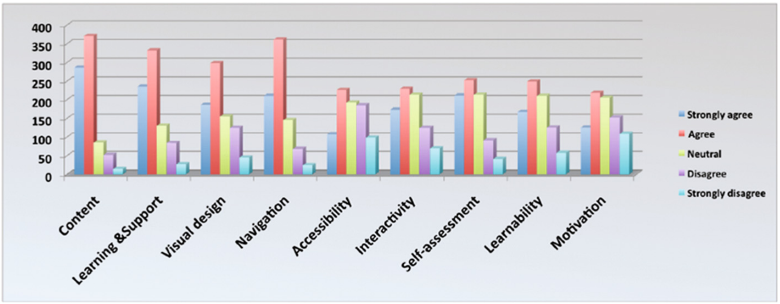

Fig. 2. Overall response with factors

4.3.1 Number and Nature of Problems Identified

In terms of analysing the qualitative data, a code-based analysis was designed to classify the answers. Regarding the first question, which asked learners what they disliked about the system, there were 502 statements submitted by 479 learners. Table 1 shows the different classifications of answers regarding the first question.

Some of the statements (8 %) were classified as general statements of opinion, such as "complicated system" and "boring system." The majority of the statements (92 %), however, reflected a mixture of different issues that were classified into five categories,

Table 1. Classification of issues

Statements	Frequency	Percentage
General statements of opinion	39	8 %
Specific Issues	463	92 %
Nature of Specific Issues	**Frequency**	**Percentage**
Technical issues	127	28%
Technical limitation issues	29	6%
Management issues	96	21%
Instructor issues	71	15%
Usability issues	140	30%
Usability Issues	**Frequency**	**Percentage**
Help and support	9	6%
Visual design	64	46%
Navigation	27	20%
Accessibility	5	4%
Interactivity	6	4%
Self-assessment	10	7%
Learnability	6	4%
Motivation to learn	2	1%
Availability	11	8%

Table 2. Classification of positive points

Statements	Frequency	Percentage
General statements of opinion	70	8 %
Specific positive points	761	92 %
Nature of Specific Positive Points	Frequency	Percentage
Technical	13	2%
Management	3	0%
Usability	745	98%
Usability Positive points	Frequency	Percentage
Content	25	3 %
Visual design	18	2 %
Navigation	12	2 %
Interactivity	228	31 %
Learnability	66	9%
Motivation to learn	23	3 %
Availability	373	50 %

as illustrated in Table 1. The taxonomy for these categories was based upon the researchers' understanding of the statements' core meanings and the type of the issues. While other researchers may have different taxonomies, this will not affect the totality and nature of the problems. As can be seen, 28 % of the problems identified were technical issues, including connection interruptions and difficulty with logging onto the system. The most significant problem cited in this category was that the E-learning application was considered slow. This is obviously a serious potential problem for an E-learning application system. Past research concurs that this is a major barrier to the relevance and success of any E-learning application. Technical limitation issues accounted for 6 % (n = 29) of the total issues cited. To illustrate, 13 users noted that notifications and synchronisation between the E-learning application and their mobile devices/e-mail were issues. This observation is notable because it shows that social media is expected to overlap with IT and E-learning today, especially among student users. The most frequently cited issue (n = 39) was that the registration procedure for the system was considered complicated. The students could not register automatically and receive benefits from all the features of the system directly. Rather, the learners were required to get permission from their instructors or support staff members in order to be added to view the content for a specific course. The instructor issues that were cited were related to the learners' instructors and their utilisation of the system. Specifically, some students (n = 22) mentioned that most of their instructors did not use the system, while others argued that their instructors were lacking the appropriate technical background. Instructor issues were raised by 15 % of the sample, and thus were quite commonly raised issues. The usability issues identified in the open-ended questions were further analysed. They were divided into nine categories, as shown in

Table 1. There were 140 statements submitted by the learners. It appears that the greatest number of problems cited was with the visual design. In summary, the findings suggest that the system has some usability problems, the most significant of which are related to the file upload and the forums features, which can be considered to be visual design problems.

4.3.2 Number and Nature of Positive Points Identified

When asked what they liked about the Jusur LMS, users expressed their satisfaction with the system, which indicates that the system has a wealth of positive points. The total number of statements submitted was 831 by 588 learners. A few of these (8 %) were general statements of opinion, such as "successful system" and "it is the system that can help users,"while 92 % of the statements referred to other aspects (see Table 2). Table 2 shows that the most significant positive aspect of the system was its usability, with 745 statements reflecting the users' positive impressions of the system.

This usability aspect is further classified into seven categories, as shown in Table 2. It appears that half of respondents (n = 373) liked the availability of the features in this particular E-learning system. These features include submitting coursework, viewing marks, voting, participating in surveys, completing online exams and online mock exams, accessing announcements, and participating in discussion forums and virtual classrooms. In addition, a significant number of students (n = 228) indicated that the system has features that encourage interactivity with their classmates and instructors (e.g., through group discussions and projects). The findings also show that learners (n = 23) believe that the system motivates their learning. These findings reinforce the importance of motivation and learnability as attributes to measure the usability of an E-learning application. These findings, along with the others, suggest one main conclusion: that most students (n = 588) like the system, as reflected by their opinions regarding the features they most liked about the system.

5 Conclusion

This paper has presented an evaluation for the usability of the Jusur LMS used in Saudi Arabia. The findings were based on a questionnaire that was designed to evaluate specific factors, including 'motivation to learn,' in order to discover the strengths and weaknesses related to the usability of this LMS, as well as to investigate the importance of any learning management system to motivate its users to learn. We presented detailed findings based on data collected from 808 learners who responded to the survey. From a statistical standpoint, the data gathered found that the Jusur LMS is viewed as a usable system from a user perspective. In this study, the research process concentrated on eliciting phenomenological data to assess what is problematic and what is good about the system from the reflexive view of its users. From the findings obtained, the system can be seen to be a usable and desirable example of an E-learning application from a student user perspective. However, some problems in the system were also identified, and these need to be considered by the system's providers. Finally, the results from this study affirmed that the questionnaire suggested by [17] was able to successfully determine the extent to which users are ‘motivated to learn’ by this particular E-learning system.

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A Service-Oriented Distributed Learning Environment for Manufacturing Workplaces

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Abstract. Small and Medium Enterprises (SME) are key assets to Europe's economic future, providing millions of workers with access to technology, skills, and knowledge – often, however, missing a managed approach and appropriate tools for continuous learning and development.

This paper introduces a service-oriented platform – and associated building blocks – developed to implement an operational reference framework ("eMeMO"), tailored to learning and training needs of Blue Collar Workers in manufacturing environments, and built to increase their training and work performance directly at the workplace.

The experiences and results illustrated have been collected during the activities of the research project TELL ME [1], a EU-co-funded initiative held by industry, universities, research labs, technology firms and innovation companies from all over Europe.

Keywords: Service oriented architecture (SOA) · Technology enhanced learning (TEL) · Small medium enterprises · Manufacturing · Workplace · Augmented reality (AR) · Internet of things (IoT) · Mobile learning · Multimodal user interfaces (UI) · User experience

1 The Learning Process

The TELL ME project [1] was conceived to improve learning and training in small manufacturing environments by introducing advanced learning technologies and innovative training methods to SMEs.

To address this challenge, a new pedagogical framework was defined to be supported by state-of-the-art technologies and be tested during two piloting cycles in different application scenarios. This framework – a learning process meta-methodology – takes its name (eMeMO) from the steps it encompasses: enquire, mix, experience, match,

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and optimise [2–4]. It is tailored to the Blue Collar Workers' (BCW) needs in manufacturing environments, increasing their work performance rapidly, with training taking place directly at the workplace. eMeMO defines a process by which the correct learning/training method for each specific worker/activity/context is selected, applied and monitored: hence it is more correctly referenced to as a "meta-methodology" (Fig. 1).

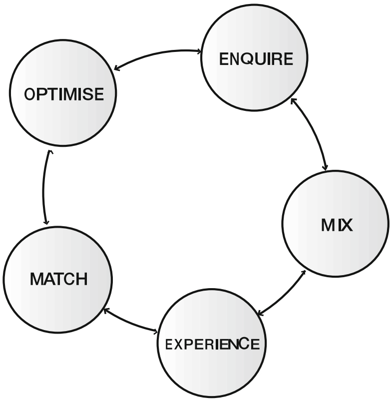

Fig. 1. The eMeMO meta-methodology cycle.

Step 1 (*Enquire*) provides tools to express a learning need, to retrieve training resources that could help BCWs in filling gaps on e.g. new manufacturing processes and associated skills. Enquiries can be generated by BCWs, Process Managers, or semi-automatically (e.g. IoT-based wrong behaviour detection).

Step 2 (*Mix*) helps in choosing an appropriate sub-set of the available training resources and blending those resources into learning mixes that suit specific training needs. Learning mixes conveyed to the worker can contain any type of contents so that existing material can be reused, minimizing costs. The learning mix is composed applying personalisation axes (eMeMo rule engine) modelled at configuration time.

Step 3 (*Experience*) provides the BCW with the actual training experience. Training resources are delivered on different complementary devices and can be contextualised on the fly according to the detected device, profile, environment, etc.

Step 4 (*Match*) uses engagement data from the training experiences to make predictions about trainee's state of competence, comparing learner behaviour with the reference models specified at design time.

Step 5 (*Optimise*) allows for experimentation with new parameters for steps 2-4, seeking an increase in engagement and driving up performance, while reducing time-to-competence.

eMeMO is particularly appropriate for BCWs accomplishing activities that require manual dexterity: their work typically involves a mix of physical and cognitive activity, with a blend of fast and slow steps, repeated in cycles within a time period ranging from seconds to hours. This scenario requires a mix of different types of learning methods for training-on-the-job according to the specific contexts. To support this approach, the eMeMO methodology provides suggestions at design time on how to organize the learning process and the associated contents, leading to a personalisation of the training solution.

2 The Service-Oriented Architecture

To support the five steps of the eMeMO methodology, the TELL ME project has implemented a distributed architecture (see Fig. 2), spanning three distinct layers: a presentation layer holding multimodal user interfaces, a middleware layer including the core business logic components (implementing the eMeMO-powered functionalities), and a repository layer including distributed repositories and legacy systems, including repositories for Open Educational Resources (OER).

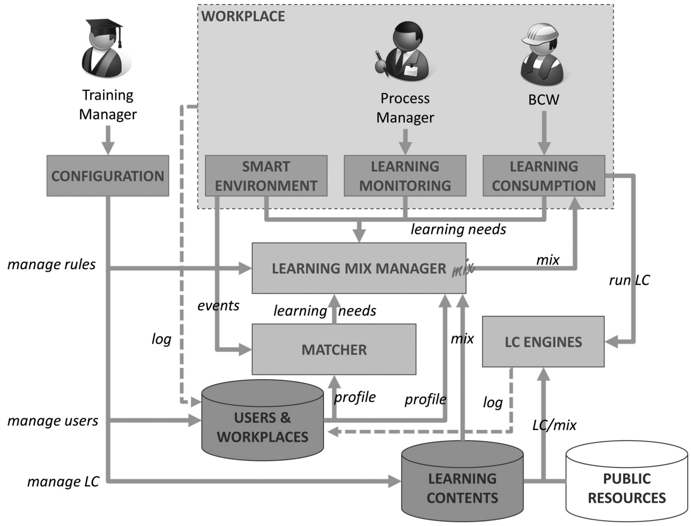

Fig. 2. Logical view of the architecture.

The approach allowed to develop a modular platform that can be customised easily and that scales out according to the needs of the applicable scenario, including customized components and tools in compliance with the technical and operational requirements defined by the working environment context.

2.1 Presentation Layer

The presentation layer includes tools for the Training Manager (in charge of the preparation of learning resources and of the planning of learning processes), the Process Manager (in charge of the scheduling and monitoring of working activities, for which specific training may be required), and the BCW, to support configuration and content preparation (upload, tagging, editing etc.), job/activity scheduling and monitoring, and learning content consumption while training-on-the-job.

Several tools allow the Training Manager to include available training resources in the assets managed by the TELL ME system, by uploading or referencing contents and tagging them with proper domain taxonomy tags for later indexing and retrieval.

A dedicated UI allows the Process Manager to assign jobs to BCWs: the system acts as a Decision Support System (DSS) suggesting the personalized training needed by the selected BCWs to accomplish the assigned task, according to the worker's previous experiences (in same or similar tasks) and on a set of personalisation criteria (e.g. the expertise in the specific sector). The system allows the manager to monitor the execution of learning and annotate the execution and the results of the work in order to align the user experience and optimise the learning ex-post.

The BCW accesses the system via the learning consumption user interface, where notifications on jobs to be done and associated learning mixes are available, thereby blending learning contents and manual activities to be executed in order to correctly accomplish the operations assigned. The UI includes a set of players to run the learning contents (which include e.g. video tutorials, interactive Computer Based Training contents, Precision Teaching lessons, extracts of manuals, electronic jobcards, etc.) plus tools to monitor the consumption and test results where applicable (e.g. in Precision Teaching modules).

2.2 Middleware Layer

The middleware layer provides two categories of functionalities to the TELL ME distributed architecture. Firstly, there are communication/integration functionalities, whose services are supported by components such as the Enterprise Service Bus (ESB), where services register in order to interact, or, to make another example, the Messaging Server that allows the communication between the TELL ME system and the IoT infrastructure. The second type of functionalities are those dealing with the business core, i.e., services that implement the eMeMO core functionality in order to provide the personalised and optimised learning mixes to the BCW, adapted according to context, previous expertise, identified existing knowledge and/or skills gaps (using, e.g., IoT-related Complex Event Processing, the eMeMO Rule Engine, and the Learning Content Indexing and Retrieval Engine).

2.3 Repository Layer

The repository layer includes repositories for data used by the platform components (e.g. Learning Contents and Learning Mixes, the associated meta-data, Domain Taxonomies, User Profiles) as well as the Repository Data Access functionality, providing a unified API for accessing the TELL ME data by means of services for retrieving local and distributed media and learning contents.

All training material is homogeneously described by using descriptive tags extracted from dedicated domain taxonomies modelling the workplace in terms of relationships associating categories such as Subject, Object, Mediator, Activities, plus technical information such as Format and contextual information such Rule (i.e. motivation for a specific learning need) and Target (i.e. objective of training). In addition to such tag-based meta-description of learning contents, URLs can be added to directly retrieve contents from external public sources that are freely available on the web as well as from private, protected sources, typically given where storage resides in company databases and legacy repositories.

3 Technologies and Tools

3.1 Adaptive BCW User Interface

The adaptive web UI for BCWs includes a complete set of tools to allow trainees to consume learning contents on a web desktop environment, e.g. for briefing sessions before training-on-the-job activities.

The web UI is based on the Dojo Toolkit [5], improving modularity and reusability of modules and UI responsiveness. Tools and functionalities are 'widgetized', adhering to the principle of Progressive Enhancement (separation of concerns among presentation, structure and behaviour) and the graphical layout has been adapted from a fully adaptive dashboard template [6] based on Bootstrap [7].

Learning mixes can be inspected in a timeline view and experienced in a dedicated player, which allows rating and commenting the learning experience content by content. The information is later reused to optimise the proposed learning mixes.

Events (e.g. learning content consumption, search, browsing, rating) are logged to an instance of the Learning Locker [7], a Learning Record Store (LRS) implementing the Experience API (xAPI) [8], for tracking and analysing trainees' learning activity (ADL xAPI Vocabulary) and work behaviour (proprietary activity vocabulary).

3.2 Augmented Reality

Augmented Reality (AR) provides new possibilities to improve proficiency and safety on the workplace, while at the same time reducing training costs in particular in manufacturing industries. Among the applications developed to support workers on the shop floor, the possibility to perform training-on-the-job using an AR app for showing contextualised information is considered an innovative approach to experience learning contents, while carrying out manual tasks.

The TELL ME project developed an Augmented Reality system, called ARgh!, which utilises an activity model (managed as a special learning content to be consumed on tablets or smart glasses) to prompt contextual information such as safety signs and simple instructions, depending on environment recognised and actual objects detected. The tablet UI enables the presentation of both informative HTML5 contents and simple/contextualised AR contents (see Fig. 3).

The tablets are technically very suitable for AR: since the user looks at the environment through the live video produced by the tablet camera, the overlays can be placed accurately without the need of any offset correction. Being the AR layer added using this hand-held window, the user can simply put the AR layer aside, whenever it is not needed. Usability problems with tablets arise in cases where it is necessary to use

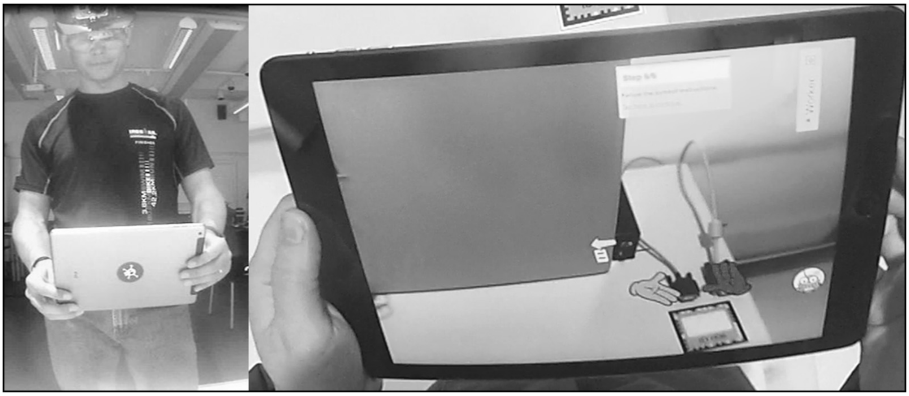

Fig. 3. ARgh! AR-systems tablet version: user performing a task (left), view of the graphical information overlay (right).

both hands for manual activities and get information through the AR layer as well. Since many on-the-job learning cases require hands-free operation, ARgh! running on tablets cannot be the only available option for training delivery, although the tablet might offer the most reliable AR experience: TELL ME provides such an alternative in terms of hands-free smartphone apps and smart glasses apps.

3.3 Multimodal JobCard App

An Android app was developed to allow multimodal consumption of training-on-the-job learning activities, modelled in form of electronic job cards. The app allows BCWs to download a particular training job card onto the mobile device and provides online and offline learning support for every included step. Multimodal interaction is powered by a hands-free interface with Speech Recognition and Text-to-Speech functionalities supported by a low-cost Bluetooth media headset: single clicks on the headset media button trigger the recognition of spoken commands, so that the trainee can follow instructions, immediately perform the illustrated manual activity and proceed further or, alternatively, ask for specific support, for example, on how to do a specific process, how to use a specific tool, or how to find specific parts. In the latter case, the app retrieves specific learning contents such as photos, instructions and tutorials (videos) enriching the on-the-job training experience.

3.4 Experience API (XAPI) and Learning Locker LRS

An instance of the Learning Locker [8] Learning Recording Store (LRS) has been included in the TELL ME SOA to support collecting, querying and reporting learning activities. Learning Locker is a LAMP-based [10] project using MongoDB, PHP, and AngularJS, designed to collect learning activity statements generated by xAPI-compliant components and generate reports from such data. A REST WS API interface to the LRS is available to any TELL ME component to submit and retrieve xAPI statements. Use cases thus include the tracking of learning activity (e.g. expertise diary), constraint/check validation (e.g. for AR application, to enable triggering specific information according to the detected expertise and proficiency), optimisation for creating learning mixes (e.g. on the basis of training contents previously consumed, on average ratings/comments), and the logging of combinations of learning and work activities by means of dedicated vocabulary extensions (additional activities and verbs).

3.5 Video Segmentation and Adaptive Bitrate Streaming

The content delivery system in the TELL ME SOA includes also HTTP Adaptive Bitrate Streaming (ABS) capabilities, providing both server-side (transcoding, packaging and deployment) and client-side (delivery) tools for video management. This technology delivers videos at the highest-possible quality playback, independently of the workplace characteristics, by automatically detecting in real-time network and playback conditions. In this way, the videos (e.g. on-demand tutorials) are available without lags, allowing the workers to consume video tutorials and successfully conclude the assigned tasks in the expected time.

ABS works by dynamically monitoring CPU and memory capacity and then making corresponding adjustments to video quality. To accomplish this, the original learning video is encoded according to multiple qualities (bitrates). Then each of the different bitrate streams is segmented into small parts and uploaded to appropriate web server folders. The list of segments and bitrates is written into a manifest file, called Media Presentation Description (MPD). By parsing the MPD, the client learns about the video characteristics (media-content resolutions, minimum and maximum bandwidths, locations on the network, etc.). When the user plays the video, the user's device fetches the segments from the lowest bitrate stream (given in the manifest file), by using HTTP GET requests. After appropriate buffering to allow for network throughput variations, the player continues fetching the subsequent segments and also monitors the network bandwidth changes. If the video player detects that the download speed exceeds the bitrate of the initial segment, it will request the next higher bitrate segment. This process will continue until a close match is found between the current bitrate segment and the user's available bandwidth. The video will then play at that bitrate. Later, if user bandwidth changes, a different bitrate segment will be requested. The implemented components utilise the unified common standard MPEG-DASH [11] and open-source technologies, precisely x264 transcoder [12], the MP4BOX content packager [13], and video.js library for the player heuristics [14].

4 Conclusions

At the time of writing, the TELL ME project Consortium is carrying out a public campaign for the demonstration of results in several EU countries, involving dozens of companies (mainly SMEs) from the manufacturing sector and a large number of BCWs and Process Managers. Live demos will allow hands-on experience for all participants, to show facts and best practices of TEL solutions adopted by the project and gather precious feedback on how to guide the industrialization process of the released prototypes, eventually supporting the exploitation phase.

During the final piloting, validation and evaluation phase, the proposed solutions will be further tested by end users in three different application scenarios: supplies and maintenance for the helicopter industry; fitting out luxury yachts (furniture making); and in the textile industry (quality inspection). The results of these activities will allow to fine tune the proposed tools and finally reduce the time-to-market for SME-tailored learning systems based on the proposed framework.

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Personalization of Foreign Language Education in the LMS Moodle Environment

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Abstract. The paper deals with new processes in e-learning to achieve the most effective path through a course for each student. In order to achieve such an ideal path through an e-learning course (here a course of the English language), a new methodology has been developed and special components have been introduced, which enabled to create an individual study plan for each student individually. New components consist of two blocks. A block consisting in finding out student's language knowledge and a block of sensory preferences. These blocks provided input values and information for creating a verification e-course. A great benefit is that the proposed methodology used existing possibilities of a conditional progress through a course while introducing the new components enabled to create individual study plans in an *automated* way. This comprehensive system has been verified on a sample set of students of the bachelor study program Applied Informatics at the Department of Informatics and Computers, Faculty of Science, University of Ostrava, in winter term 2014.

Keywords: e-learning · Language learning · LMS · Personalized education

1 Introduction

Computer-based learning is very favoured among the users of e-learning, mainly if it concerns languages [1], and as described in paper [2], languages can be taught learnt through e-learning although with limited possibilities and results. Thus, the results often show that e-learning of a foreign language falls behind in areas of flexible feedback and individualized approach [3]. Thus, various systems have been developed in order to overcome this insufficiency. Achieving an individual approach to students, primarily those of distance studies, represents a complicated task and requires a change in the conception of the whole e-learning system. One of the possibilities is to use systems that enable to work with inaccurate information.

Inaccuracy, insufficient definition of these processes respectively, also has its own structure, which enables to use appropriate tools for work with a given type of incompleteness. When analyzing inaccuracies occurring when solving a given decision-making process, it is frequently found out that the given inaccuracy is also insufficient information, thus its cause can lie in student's "inability" to define their knowledge, i.e. what they know or not. Insufficiency is basically represented by describing knowledge

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in all areas of the language in one test – e.g. if a student can use the present continuous tense in two out of its several possible ways of using, does it mean that the student knows the tense or not, or only partially? This blurriness then becomes the ultimate cause why classical mathematics and exact sciences were not able to adequately cope with linguistically-defined situations. The situation has changed in the last decade when a so-called fuzzy mathematics was established, which enables to effectively work with such verbally described situations. Our approach is therefore based on the possibilities of working with a fuzzy logic expert system.

2 Adaptivity

Adaptivity of a system mean system's ability to adapt to changing input information, which the system reacts to with an appropriate change. Current LMS systems generally do not offer possibilities of adaptation to the needs of individual users to such an extent which would qualify them to be called adaptive systems. All activities are permanently supervised by a tutor, who guides the student through the course to achieve better results. It is fully up to the tutor to advise a student the most suitable study materials, which might be often difficult as the tutor does not have much personal contact and time to analyze the students. This might result in a very time-consuming or even impossible process.

Research in adaptive systems branches into several, more specific areas. There have been attempts for adaptation in the area of learning styles [4], or testing respecting learning styles [5]. However, they do not lead to adaptive systems as we have defined the term *adaptivity*.

An example of a more advanced adaptive system can be found in work [6] dealing with an adaptive system for proposing a so-called *re-usable adaptive educational e-content* and their prototype system KOD (*Knowledge on Demand*).

Our approach focuses on adaptivity in the area of adapting the learning content of the course according to student's needs not only based on initial information about the student, but based on his later study results as well.

3 Proposed Model

A general objective of the research of the authors of this paper is to propose an adaptive model applicable in an e-learning system used for language learning. Its verification has been carried out in LMS Moodle. The model proposal is based on two levels which provide a basis for next processes. The first level represents a pedagogical area aiming at focusing on the student, i.e. gathering information about his learning and absorbing information (i.e. learning preferences) and (http://vark-learn.com/home/) information about his language knowledge. Results of a more detailed research on this area were published in [7]. The second level focuses on using a fuzzy logic expert system LFLC 2000 [8] to assess student's language didactic test. Benefits of using such a system were published in [9].

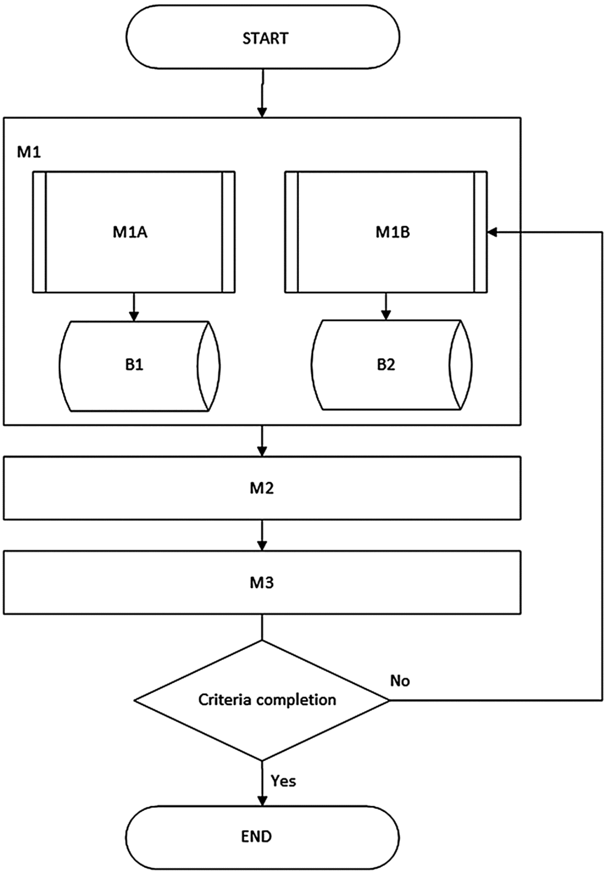

Fig. 1. The proposed model of adapting a student's study plan

This paper is closely related to the phase when all student's data has been gathered and stored in a database, or portfolio, consisting of two sub-databases, see Fig. 1. We do not try to design a universal student's model because each student is unique. Thus we do not want to assign a real student a predefined student's model, which would a priori predefine his study plan. Our conception is that each student has his own portfolio.

The proposed model is based on three modules M1 to M3. Module M1 deals with acquiring student's portfolio and consists of two sub-processes M1A and M1B. M1A deals with the issue of mapping student's learning preferences from the point of view absorbing information. The results are stored in Base 1 marked as B1. M1B gathers and evaluates current student's knowledge, which results in assessing his input knowledge of the language. This is stored in Base 2 marked as B2. Module M2 represents a process of managing the educational process itself. It primarily focuses on adapting the content of the e-learning course to student's needs defined in B1 and B2. In this view, the study materials are adapted both in their content and form. A more detailed study of M2 might result in dividing it into parts corresponding to its thematic areas. From the pedagogical point of view, it is highly important that basic thematic areas form basis for more advanced levels. Thus, managing the educational process does not only focus on adapting the content, but on conditional access to higher thematic levels based on the results from preceding thematic areas. Once processes in module M2 are completed, module M3 takes its turn. M3 focuses on the final diagnostics.

3.1 Target Group of the Experiment

The target group for verification of the proposed model, including designing and structuring the didactic test and the e-course, were students of distance and combined form of studies, bachelor study programs Applied Informatics and Informatics at the Department of Informatics and Computers, Faculty of Science, University of Ostrava. The students enrolled for course *English for Specialisation Degree 3* (marked as XANG3) in winter term 2014. The time length of the course was 13 weeks, period September 22 – December 19. The course XANG3 has two preceding optional courses XANG1 and XANG2.

3.2 Implementation of Module M1A

Implementation of an adaptive e-learning model has been verified in the LMS Moodle environment using its existing components. The model focuses on student's individuality. This idea was reflected in the implementation, which concentrated on student's profile, primarily on optional fields in user's profile. This profile was extended with 25 new fields. The extension consisted of two groups.

The first group of user's fields served to define learning preferences for study materials. A set of such fields is marked as VARK. This group corresponds to base B1. The fields hold values either yes or *no*, which was obtained from the student by a questionnaire.

VARK methodology of learning preferences was developed by Neil Fleming [10] and extended by Leite in [11]. VARK reveals how people how they ideally acquire information, and how they process and remember the information best. The preferences are divided as follows:

Visual – images, diagrams, charts, maps;
Aural – lectures, recordings, discussions, repetition of spoken words;
Read/write – texts of all forms;
Kinaesthetic – movement, learning by doing, touching, active experience.

VARK methodology is very simple, but practical and effective. It is obvious that a student is not clearly defined and assigned to one dimension, but the categories do not exclude each other. They are not opposite poles which one must select from; one always has a certain combination of these preferences.

Suitability of using VARK methodology to analyze student's learning preferences was proved in [7].

The VARK questionnaire was processed in a way to acquire percentage ratio for each student. Generally, it can be 25-25-25-25. However no student achieved such balanced preferences. If any of the preferences fell below 20 %, corresponding materials were not offered, see Table 1.

Table 1. Students‘learning preferences in XANG3, winter term 2014

First name	Last name	Profile field V	Profile field A	Profile field R	Profile field K
Student*1*	Student*1*	YES (29.7)	YES (21.6)	YES (21.6)	YES (27.1)
Student*2*	Student*2*	YES (20.3)	YES (33.3)	NO (11.1)	YES (30.3)
Student*3*	Student*3*	NO (15.2)	YES (30.4)	YES (27.2)	YES (27.2)
Student*x*	Student*x*	YES (33.3)	NO (16.6)	YES (30.1)	YES (20)

3.3 Implementation of Module M1B

The second group of fields, corresponding to base B2, focused on particular thematic areas, therefore let's call it a group of thematic fields. Such fields describe individual grammatical phenomena and specific areas related to English for IT:

– Present tenses, past tenses, present perfect tenses, past perfect tenses, passive voice, adjectives, numerals, modal verbs, verb patterns, future and conditionals, countable nouns, phrasal verbs, databases, networking, network topologies, giving talks.

These fields acquired linguistic values corresponding with individual fuzzy sets characterizing present students' competences in individual thematic areas (categories). Such a linguistic value is acquired as a result of the initial didactic test, which is processed in software LFLC 2000, which enables to work with indefinite information. Individual categories are analyzed to assess the need of further studies of the given category in an e-learning course.

The analysis process considers the following input variables for each category separately:

1. Number of correct answers (V1) – *small, medium, big*
2. Weight of correctly answered questions (V2) – *small, medium, big*
3. Importance of the category for further study (V3) – *very small, small, medium, big, very big*
4. Time spent on questions of the given category (V4) – *small, medium, big*

Number of Correct Answers (V1). It means how many correct answer a student has achieved in a given category.

Weight of Correctly Answered Questions (V2). It means that some questions are more difficult than others. More difficult questions hold a higher weight.

Importance of the Category for Further Study (V3). It means that categories hold weights according to their importance at the point of starting the course. For example, knowledge of Present simple for an advanced user is highly important (strongly required) because the student already learnt it in previous courses. On the other hand, knowledge of Past perfect continuous is not as important (not required) because the student will learn it.

Time Spent on Questions of the Given Category (V4). Time allows us to assess student's knowledge in a way that if the student answers quickly (and correctly), it positively influences the output variable, and vice versa.

Output Variable (V5):

5. Need of further studies of the given category – *extremely small, very small, small, more or less medium, medium, big, very big, extremely big*.

3.4 Implementation of Module M2

The LMS Moodle environment has been extended with a set of rules which open the student the most suitable form of study materials, based on the VARK fields and V5. Altogether, this extension included 25 user fields.

Implementation of this extended version required a new instance of LMS Moodle, which was installed in Linux Debian hosted on the VMWare technology. The Moodle version was 2.7.2+ and is available at http://bradac.osu.cz. The experiment could not be implemented in current Moodle of the University of Ostrava because the extension of user field would affect all existing courses.

When preparing the XANG3 e-learning course, we had to consider the possibility that a student should be able or will have to study the categories from previous courses (XANG1 and XANG2), which regular Moodle at the UO does not allow. Thus, it was necessary to import materials from the preceding courses, but only materials related to grammar, not topics. Having completed the import and extension of user fields, settings how to progress though an e-course had to take place.

3.5 Methodology of the Progress Through an e-course

The progress through an e-course had to ensure that it corresponded with the results from M1A and M1B, but there was a need of reflecting student's results during the studies – ideally without any tutor's interference (Table 2).

A general structure of the course was as follows:

Table 2. Structure of XANG

Unit 1	Present simple
Unit 2	Present continuous
Revision 1	Cumulative test (Present simple + Present continuous)
Unit 3	Past simple
Unit 4	Past continuous
Revision 2	Cumulative test (Past simple + Past continuous)
…	…

In a standard e-learning course, all students would have accessible all study materials and units. However, the fact that we possess a student's portfolio, we can work the possibilities of adapting it to his needs by, for example, using conditional access.

Limiting access to a whole unit is based on the result from the didactic test (V5). However, we might face a situation when the student can skip a closed unit (based on V5), but fails a compulsory revision Cumulative test, which checks if the student really knows the given area. Now, if the student fails a Cumulative test, a corresponding closed unit opens. The student then has the possibility to study the unit again and come back later to the failed Cumulative test. Let's describe such a conditional access to Unit 1, Unit 2, and Revision 1:

1. V5 is *extremely big, very big,* or *big* neither for Unit 1 nor Unit 2. Both units are closed and the student immediately proceeds to Revision 1.
2. V5 is *extremely big, very big,* or *big* either for Unit 1 or Unit 2. The student has to pass a test from the open unit before proceeding to Revision 1.
3. V5 is *extremely big, very big,* or *big* both for Unit 1 and Unit 2. The student has to pass a test from both open units before proceeding to Revision 1.
4. If Unit 1 or Unit 2 are closed, the closed unit automatically opens based on the result from Revision 1, i.e. if the result fall below a specified threshold.

Once the student passes Revision x, he can proceed to next step in the studies, i.e. next available Unit or Revision. The student proceeds the course in this way until he reaches the end. Personalized study plan is achieved by using the information from the initial portfolio, but from the results during his studies as well.

3.6 Implementation of Module M3

Diagnostics in module M3 is, once again, adapted to student's need from the form point of view. Diagnostics can be considered normative. The diagnostic phase can be performed repeatedly, although there is a limit in a number of trials for achieving this diagnostics. For our purposes, the number was set to three. It means that the student had tree possibilities to pass Unit x and Revision x. If the anticipated normative of knowledge has been achieved, the studies came to its successful end. If not, base B1 has to be redefined in order to find a better form of suitable study materials.

4 Conclusions

The paper dealt with new processes in e-learning to achieve the most effective path through a course for each student. A new model has been designed to meet the requirement of e-learning. A methodology related to language learning has been developed and special components have been introduced, which enabled to create an individual study plan for each student individually. New components consist of two blocks. A block consisting in finding out student's language knowledge and a block of sensory preferences. These blocks provided input values and information for creating a verification e-course. A great benefit is that the proposed methodology used existing possibilities of a conditional progress through a course while introducing the new components enabled to create individual study plans in an *automated* way.

The verification on a sample set of students of the bachelor study program Applied Informatics at the Department of Informatics and Computers, Faculty of Science, University of Ostrava, in winter term 2014, proved that it is possible to successfully implement this model into real education using current LMS systems and to make them more adaptive than they are today.

Our research has not reached its end, but in future we want to focus on structuring students' study plan taking into consideration time exigency of individual study materials and the e-course as a whole.

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Automation of Variant Preparation and Solving Estimation of Algorithmic Tasks for Virtual Laboratories Based on Automata Model

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Abstract. In the work a description of an automata model of standard algorithm for constructing a correct solution of algorithmic tests is given. The described model allows a formal determination of the variant complexity of algorithmic test and serves as a basis for determining the complexity functions, including the collision concept – the situation of uncertainty, when a choice must be made upon fulfilling the task between the alternatives with various priorities. The influence of collisions on the automata model and its inner structure is described. The model and complexity functions are applied for virtual laboratories upon designing the algorithms of the variant constructing with a predetermined complexity in real time and algorithms of the procedures of students' solution estimation with respect to collisions. The results of the work are applied to the development of virtual laboratories, which are used in the practical part of massive online course on graph theory.

Keywords: E-learning · Virtual laboratories · Remote laboratory control protocol

1 Introduction

The development of information technologies in education resulted in a wide distribution of electronic teaching instruments, virtual laboratories (VL) being one of them. VL are electron media making possible the creation and study of visual models of the real phenomena. This is rather an extended determination taking into account the fact the both real laboratory installations (the laboratory is called distant in this case) and various mathematic and imitation models may form the basis of the models. A large number of information systems differing by aims, application methods, and program structure comply with it. A special feature of all VL may be their orientation to the formation and checking of practical skills and experiences. To determine the application field of the models and methods given in this work we shall give a short classification of VL.

One of the features of VL may be the type of tests embedded in them: there are both algorithmic tests requiring the fulfillment of a rigid sequence of actions and logical methods of solving and the tests associated with creative activity requiring the accomplishment of intuitive jumps, recognizing the objects, and the use of heuristic solving methods [1].

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Another feature may be the program architecture of VL. Autonomic VL are a united supplement [2, 3], and the functions of distributed VL are divided between several individual modules interacting between each other with the help of special Remote Laboratory Control Protocol (RLCP) [4] or other network technologies [5].

An important marker is the presence and the method of automatic checking student's solution, since this property directly influences the applicability of VL during independent work with electronic practical courses of electronic information and education media. The automatic checking is especially important for massive open online courses. Automatic estimation is often carried out with the help of a method of testing the black box: student's solution is represented as a system, which can be acted upon and its reaction can be compared with what was expected [1, 6, 7]. One more example of commonly used practice in the systems of massive online courses may be the instrument of peer assessment: after completing his own test the student must check several solutions of other course participants selected randomly [8]. The method of checking depends on the character of the test: the black box test is convenient and therefore widely used method of automatic checking of the tests concerning the description of a designated algorithm in some program or modeling language and a peer assessment is used when a student must present a work badly amenable to automatic analysis – an essay, figure, or abstract.

One more property of VL is its wide application. Multi-purpose VL [1, 3], which can be used to carry out the studies on various topics, are usually substantially more scaled and complex than specialized VL developed for solving the problems concerning one topic [2].

In [4] a model of a distributed VL of a standardized structure with automatic checking students' solutions, which represents VL as a connected up modulus of electronic information-education system, is given. This model allows creation of a unified medium of fulfillment for multiple VL on the basis of AcademicNT system. Such a method appeared to be appropriate for control over the software of small specialized VL intended mainly for the work with algorithmic tests. We emphasize that the student is not required to describe the very algorithm, but he must reproduce its actions correctly for a given variant. Preparation of the test variants in the automatic way appeared to be an important problem – it was decided to reject the traditional bank of variants owing to its inherent drawbacks. In this case, variants of tests must have a predetermined complexity to ensure equal conditions for all students in the estimation of achieved education results. The complexity of the test variant in this context is a quantitative characteristic reflecting the number of operations needed to be fulfilled for obtaining a correct solution. It is necessary to distinguish the complexity of the test variant from the difficulty of the test. The difficulty is associated with mastering the algorithm of the test solving and is expressed by a percent from the number of students being tested from a representative selection, who fulfilled this test correctly. Nevertheless, under condition of a limited time the complexity of the test influences its difficulty. Even knowing the algorithm of solving the test you can fail to meet the schedule of its fulfillment, if a given variant has an excessive complexity.

2 Automata Model of Reference Algorithm

In this work a method is proposed for formal determination of the complexity of variants for algorithmic tests based on automation model of *reference algorithm*. Let us assume that there is a certain algorithmic test t, which must be solved with the help of reference algorithm a, and there is a great number of variants *V*, for it:

$$V = \{v_1, v_2, v_3, \cdots, v_n\}. \quad (1)$$

Each element v_i is a particular variant of the test with specific data.

As an example let us concern ourselves with an algorithm for Turing machine, which increases an integer by a unit. The starting number is in the tape in the binary digits written from left to right, in other cells this is an empty symbol, and the head points to the eldest order of the number. Then with the aim of increasing the number by a unit we must fulfill the following sequence of actions: (1) Move to the right till you meet the empty symbol; (2) Shift to the left; (3) If symbol in the current cell equals '1', change it for '0' and move to the left; (4) If the value of the current cell equals '0' or an empty symbol, write down '1' into the cell and complete the work. In this case the test *t* requires the actions of the reference algorithm *a* to be reproduced, and the starting state of Turing tape is a variant of test v_i. Here we should emphasize once more that the student must not write the program for Turing machine but must reproduce the above described algorithm correctly. He gains access to Turing tape, the possibility to accomplish the requests for reading a symbol from a current cell and the commands for shifting the head and writing the symbol into a cell.

To develop VL with automated processes of constructing the test variants and estimation of the student solutions for a model test *t* with the help of algorithm *a* we suggest to advance a special automation model *M*. As such model we propose to use a combination of determined final automate with an output (controlling automate) and a data depositary, which it interacts (the control object) with. This model is the development of a model of automated object (AO).

The AO model consists of three main components: controlling automate, object of control and external medium. At every step of the work the controlling automate forms a new state of the control object (calculating state) on the basis of external medium action, of current state of the control object and of the state of controlling automate (controlling state). Applying this model to algorithmic tests we find that at every step the controlling automate forms a record of a correct solution *s*, on the basis of the data of the test variant *v*, of the intermediate results of previous steps fixed in the record of the solution. The test variant is the object of the external medium, and the state of the control object must be considered as the record of the test solution including intermediate results. This means that after completion of the work of the controlling automate the object of control must contain all the information about the transfers carried out by the controlling automate and about the sequence of control states attended by it. Then with the help of the advanced model *M* we can obtain a correct solution for each variant of the test *v*. In other words, there is a reflection ρ_M of a great number of the test variants *V* to a multitude of solutions *S* (ρ_M: $V \rightarrow S$).

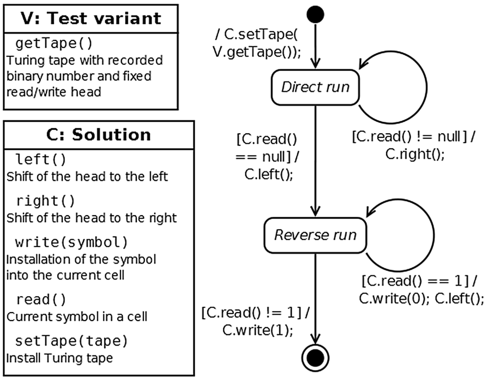

Fig. 1. Automation model of the algorithm of increasing an integer by a unit for Turing machine

Figure 1 represents the AO for the algorithm of increasing an integer by a unit described above. The solution being formed is contained in the control object *C*. The variant of the test *V* contains the starting state of Turing tape, which can be obtained with the help of the getTape inquiry.

A special attention must be paid to the structure of the object of control, since it must be designed in such a manner that in the resulting calculating state all the intermediate results were given. Hence, the object contains Turing tape, which starting state can be found with the help of the setTape command. The control over the tape is performed with the help of the head shift commands (left and right), the record of symbols (write) and an inquiry for reading the symbol in a current cell (read). Moreover, in order to save the intermediate results a journal of accomplished commands is added into the control object. Each time a shift of the head of the symbol record is performed, a corresponding record is added to the journal. Such a journal may be presented as one more Turing tape, let us call it the tape of command journal, with the aim of distinguishing it from the data tape. As the automate fulfills the command to shift the head of the data tape or to record a symbol, a symbol is written into the current cell of the command journal, which designate this command, then the head of the tape of the command journal is shifted to the right. The structure of the control object is given in Fig. 2. Table 1 contains description of commands and inquiries of both test

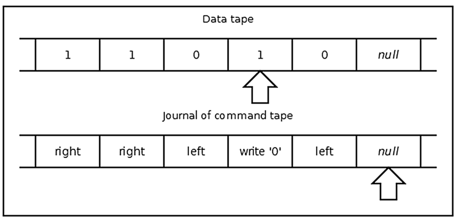

Fig. 2. Structure of the control object of automation model of the algorithm of increasing an integer by a unit for Turing machine Data tape, journal of command tape

Table 1. Commands of the test variant and the solution being formed

Object	Command	Description
V: Test variant	getTape()	Turing tape with recorded binary number and fixed head
C: Solution	left()	Shift of the head to the left
	right()	Shift of the head to the right
	write (symbol)	Installation of the symbol into the current cell
	read()	Current symbol in a cell
	setTape (tape)	To install Turing tape

variant and solution being formed in control object. The model is loaded into the controlling automate, the operation of copying the state of Turing tape from the test variant into the solution being formed is included into the initiating stage in this case.

Assuming that a student must adhere to reference algorithm *a* and its representing with the control object initiated according to the data of a variant and also an interface for interacting with it. We can reason that in the case, when the student reproduced the actions of the algorithm correctly, his solution as a resulting calculating state of the given control object must coincide with the correct solution. Thus, after adding a unit to "11011" the data tape must contain "11100" and the tape of the journal of commands – the sequence "right, right, right, right, right, left, write '0', left, write '0', left, write '1'".

The aforesaid interface must be designed in such a manner that the student could interact with the control object with the help of the same commands as the controlling automate. The student has an access to the same commands, which are used in the automation model in Fig. 1 – the head shift and symbol recording. Moreover, the student only sees the content of the current cell, as well as the controlling automate, hence the solution of the variant is not evident for him, and he must follow the given algorithm.

3 Consideration of Collisions

The special feature of automation models under consideration is the following: external actions on AO are known to be determined first of all by the data of the test variant. Moreover, some algorithms as known allow a selection from several equivalent alternatives (collision) during fulfillment, and then great number of correct solutions may exist for one variant of the test. In this case student's solution may be correct, but not coinciding with the solution constructed with the help of automation model. To avoid such situation it is necessary that the automation model take into account student's choice made in the situation of collision. A correct solution is constructed with the help of the controlling automate as long as the situation of collision emerges. Then the information about the made choice is selected from student's solution and is added to the input action on the automate at the next step of the work. Then the record of the solution is constructed by the usual manner up to the emergence of the next collision. Therefore, we can state that each component of the input action x_E on the controlling automate really consists of the component x_{EV} resulting from the test variant and the component x_{EU} resulting from the student's choice fixed in the solution suggested by him: $X_E \subseteq X_{EV} \times X_{EU}$. Therefore in the general case the reflection ρ_M of great number of test variants to a multitude of the solutions given as M must take into account student's choice in the situations of collision and is determined as function $\rho_M : V \times U \rightarrow S$, where U is the multitude of the choices made by the student in the situations of collision.

In the example considered above the collisions are not encountered, however they can appear, if the test were a little changed and, for example, let the student from the beginning set the head into any number order but the eldest. This means that the model of the control object given in Fig. 2 must be updated by adding one more element – a number variables into which the information must be written about the very number order the student set the head into. In this case a modification of the automate model of the algorithm given in Fig. 1 must be made: one more element appears in the model – student's solution U. The model U and the model of the solution C coincide, however they have various sets of commands. It is possible to find out into which number order the student set the head with the help of getInitPosition() inquiry of the student solution U. A command for setting the head getInitPosition() is added to the solution C, it is excited at the stage of initiation. The modified automate model is given in Fig. 3.

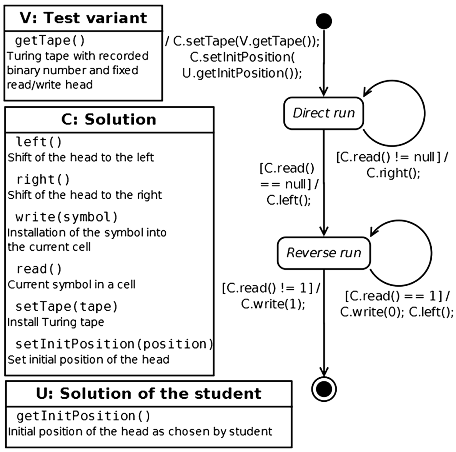

Fig. 3. Automation model of the algorithm of increasing an integer by a unit for Turing machine taking account of collisions

4 Formal Determining of Complexity of Algorithmic Tests

The complexity of the test variant c_v can be determined as the number of transfers completed by the controlling automate if the complexity of completing the transfers is the same. This value can be obtained as the number of terms q of the sequence Y_v of controlling states visited by the controlling automate in the process of constructing the correct solution for the test variant v:

$$
\begin{aligned}
Y_v &= (y_{r_i})_{i=1}^{q}, \\
y_{r_i} &= \delta\left(y_{r_{(i-1)}}, x_i\right), \\
c_v &= q,
\end{aligned} \tag{2}
$$

where δ*: X* × *Y* → *Y* is the transfers function of controlling automate of model *M;* x_i – an input action on the controlling automate formed under the influence of variant *v* in the *i* – cycle; r_i – the index of the visited controlling state.

In the case when the complexity of completing the transfers cannot be considered the same, it is necessary to determine the function *f* of complexity of completing the transfer c_i to the state y_{r_i} from the state $y_{r_{i-1}}$ under the action x_i. Then the resulting complexity of the test variant will be equal to the sum of the complexities of the transfers made by the controlling automate:

$$
\begin{aligned}
Y_v &= (y_{r_i})_{i=1}^{q}, \\
y_{r_i} &= \delta(y_{r_{i-1}}, x_i), \\
c_i &= f(y_{r_{i-1}}, y_{r_i}, x_i), \\
c_v &= \sum_{i=1}^{q} c_i.
\end{aligned} \tag{3}
$$

Using such a procedure we can determine the complexity of any existing variant of the test, but this cannot solve the problem of automatic construction of the test variants of a designated complexity. It is necessary to examine the automation model of algorithm for each test *t* in order to answer the question, which properties of the test variants do influence the complexity of the solution and how they influence. The result of such examination must be the function of the kind *c* = *c*(*v*), making possible the calculation of the complexity as a function of the properties of the test variant. Let us call it *complexity function*.

In the example described above (without admission of the collisions) the number of transfers completed by the controlling automate depends on two factors: *l* – the total number of the number orders and *z* – the ordinal number of the last number order equal to ‘0’. Automation model at the stage of direct run passes all the number orders and at the stage of reverse run completes one more transfer in order to return to the last order and passes to the first order not equal to ‘1’, hence the resulting complexity is: *c* = *l* + 1 + (*l* – *z*) = 2*l* + 1 – *z*. For example, if a number «1000000000» is written in Turing tape, the complexity of adding a unit to it will be *c* = 2 × 10 + 1 – 10 = 11. Really, the stage of reverse run includes only one transfer. For the variant with number «101111» the complexity is also equal to 11: *c* = 2 × 6 + 1–2 = 11, since in the stage of reverse run there will be five transfers.

5 Automatic Variant Constructing and Estimation of the Student Solution

Having the complexity function, we can compose the algorithm of constructing the variants of algorithmic test with a designated complexity. Thus, if it is necessary to create the variant of the test for reproducing the above described algorithm of the increment of binary number with a designated complexity *C*, we can use the algorithm given in Fig. 4.

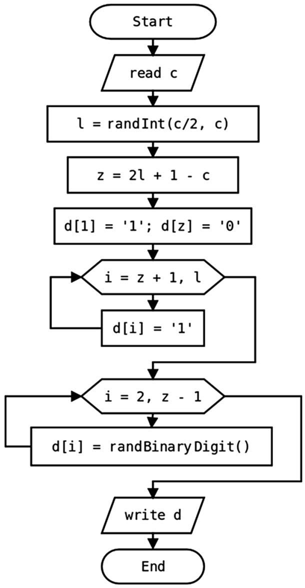

Fig. 4. Algorithm of constructing the test variants

6 Conclusion

To summarize we can point out that the automation model of reference algorithm allows the complexity of the variants of algorithmic tests to be determined formally. Nevertheless, to solve the problem of automatic construction of the test variants with designated complexity it is necessary to determine the complexity function, which characterizes the dependence of the variant complexity on its properties. Automation of composing the variants with equal complexity an of estimating on the basis of verification procedure allows VL to be created for algorithmic tests functioning in the completely automatic regime, which makes possible their use in the preparation of massive online courses.

Automation model of reference algorithm allows us to correlate the student's solutions with a fortiori correct solution making possible the checking of all the intermediate results and a precise answer to the question whether the student presented a correct solution and also an indication the place of an error. This model gives us the method of formal determination of the variant complexity of the algorithmic test. The significance of this method consists in the fact that on its basis the algorithms of constructing the test variants with designated complexity are created. However, the field of application of this model is limited by algorithmic tests only.

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Assessing Students and Teachers Experience on Simulation and Remote Biotechnology Virtual Labs: A Case Study with a Light Microscopy Experiment

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Abstract. With recent trends of using Information and Communication Technologies in education, virtual labs have become more prevalent in classrooms of most schools and universities, especially in South India. The purpose of this paper was to perform a comparative analysis of virtual learning components such as animations, simulations and real-time remotely controlled experiments. As a part of this study, we conducted a series of biotechnology virtual lab workshops for University-level users within India and collected feedback related to the usage of virtual labs via direct approach. The survey amongst the students and teachers suggested simulation-based labs were more preferred in enhancing teaching and learning strategy compared to graphics-mediated animations and remotely controlled experiments. This paper also reports some of the issues faced by virtual lab users. Studies indicated that even though the web-based technologies are a new venture in education, it still poses adaptability issues.

Keywords: Virtual labs · Biotechnology · Simulation · Remote labs · Feedback

1 Introduction

In the recent years, web-based educational platforms have become popular in schools and universities and have became an integral part of modern educational system [1]. Research indicated that integration of ICT enabled e-learning technologies in conventional classroom education dramatically changed real laboratory education scenario [2–4]. Virtual laboratories provided learning materials in an easily deliverable manner to users all over the world at anytime –anywhere [5, 6] and students perceive virtual labs as an educational tool. From a teacher perspective, implementing web-based tools in classroom education have shown to reduce their work load and helped them to monitor student participation in a better way [7].

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In remote areas, students have been facing issues such as well-established laboratory with sufficient lab equipment, costly reagents, trained teachers and adequate technical support [8]. In virtual labs, animation-based labs are mainly based on multimedia representation of laboratory protocols and real-lab setup for providing a feel of real laboratory [9]. Blended approach of using animations in classroom teaching has shown to be more reliable for both students and teachers [10]. Previous studies reported that simulation-type experiments lack ability to generate real data since it does not provide access to real laboratory equipment. For that, remotely controlled experiments were developed as a complementary educational resource to hands-on labs [11]. Remote labs such as light microscopy have been popular among students in which they can effectively use the equipment and conduct experiments without being onsite. Studies also reported user adaptability in controlling remote lab set-up over the internet thus adding a new venture to distant education [11]. Various issues like multiplexed usage, noise and stability issues need to be solved to make remote lab easily accessible to users all over the world [12]. Previous studies have shown a comparative analysis of traditional labs versus virtual lab experiments [13] (see Table 1). In this paper, we highlight a comparative study on the usage of virtual lab components such as animation, simulation and remote triggered experiments amongst students and teachers for enhancing laboratory education and highlight some of the issues.

Table 1. Comparative analysis of traditional labs versus virtual lab experiments

Types of labs	Advantages	Disadvantages
Traditional labs	1. Access to real equipment	1. Scheduled lab hours
	2. Access real data	2. Need trained persons
	3. Face to face interaction with teachers	3. Cost of equipment
		4. Maintenance issues
Animation based labs	1. Visual demonstration of experiments and detailed step-by-step explanation of protocols	1. Only virtual presentation is provided to users
	2. Close proximity to real lab scenario	2. Idealistic results
	3. Easy access to labs	3. Need basic knowledge for operating computers
	4. No ethical issues	
Simulation based labs	1. High degree of interactivity	1. Understand the instructions before practicing experiment
	2. User can change the variables, which emulated real data	2. Need basic knowledge for operating computers
	3.Helps to analyze critical mistakes one could perform in a real lab set-up	
	4. Repeatability	
Remote triggered labs	1. Access to real and costly equipment	1. Network related issues
	2. Anytime access and repeatability	2. Single user at a time (Slot booking)
	3. Instrument damages comparatively low	

2 Methods

As a part of evaluating and comparing key virtualization techniques such as animation, simulation and remote triggered experiments in enhancing biotechnology education (in 2014), we conducted 6 hands-on workshops for students and 4 for teachers. A total of 250 students and 100 teachers participated in this study. The influence of virtualization techniques in learning and teaching process was analyzed via feedback.

2.1 Biotechnology Virtual and Remote Lab Workshops in India

We chose a light microscopy animation experiment, an undergraduate experiment wherein participants were allowed to learn from an animation, various parts of a microscope and its functioning. Participants were then allowed to perform a "simulation"-based light microscope experiment. They were trained to operate microscope by adjusting the fine and coarse knobs, observing various stained cells such as onion cells, cheek cells, onion root tips and different bacterial cells by changing objective lenses (10X, 40X and 100X). In remote-triggered light microscope, specimens such as plant cell and animal cell were fixed in the stage of microscope. User could operate remote microscope using an internet-enabled computer and control microscope's fine and coarse adjustments by moving a slider in GUI. Participants were trained to observe the cell and cellular components through remotely controlled microscope, adding to feel of controlling real equipment (see Fig. 1).

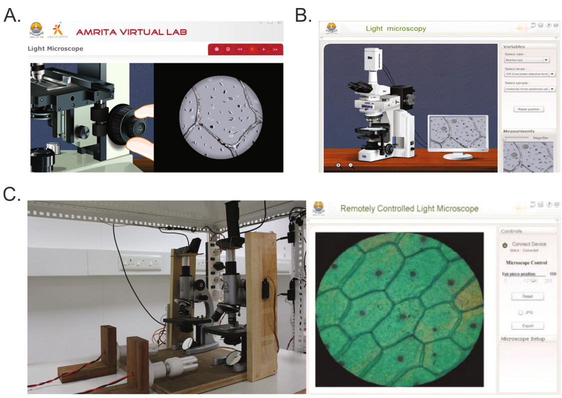

Fig. 1. **A.** Animation of Light microscope experiment, **B.** Simulation of Light microscope experiment, **C.** Remotely controlled Light microscope experiment (freely available via http://vlab.amrita.edu/)

The demonstration and hands on session were followed with a set of questionnaires for a comparative analysis of virtual lab components. A similar study was conducted amongst teachers to know and compare their interest in including virtual and remote lab

Table 2. Comparative analysis of virtual learning components amongst students

Sl. No.	Questions for analysis	Choices given for response
Q1	___helped to apply my theoretical knowledge into practice	Animation
Q2	__motivated me to use ICT tools in my education	
Q3	__provided a student-centered learning approach	Simulation
Q4	__are more consistent in view of easy access and realistic data	Remote trigger
Q5	___provides a close proximity to real lab experiences	

Table 3. Questionnaire based feedback to analyze the role of virtual learning techniques amongst teachers

Sl. No.	Questions for analysis	Choices given for response
Q1	__provides instructions that are able to deal with students in more interactive manner and make them to practice an experiment?	Animation
Q2	___ is helpful for you in teaching basic lab techniques easily with standardized protocols and enhance, intensify and motivate students in learning?	
Q3	___ is very helpful to teach step-by-step procedure of an experiment and prepare students to operate equipment correctly before entering to real lab	Simulation
Q4	_______________ is an alternative supplementary tool that can easily access to train students at any time?	Remote trigger
Q5	_______________ imitates an experiment exactly like doing in realistic lab with respect to materials and results?	

techniques in teaching process. Feedback survey collected user's preference from students (see Table 2) and teachers (see Table 3). We also included questions to analyze various limitations that create problems for students and teachers while doing experiments.

3 Results

3.1 Interactive Simulations - a Novel Platform for Current Education Scenario

Feedback analysis indicated student's preference on simulation labs compared to animation and remote triggered experiments in their learning. 48 % of students supported interactive simulations indicating that it helped them to apply their theoretical knowledge into practice. 44 % students suggested that repeated use of simulations in their learning motivated them to use ICT enabled tools in their education. 56 % of them indicated simulation-based experiments supported student centered approach of learning since instructions provided were easy to understand. 46 % of students reported that when comparing with animation and remote triggering, simulations were more consistent in view of easy access and realistic data. 34 % of students indicated simulation labs as substitution to real lab experiences, but 56 % of students suggested they got a real feel of experiments and equipment as in a conventional laboratory education (see Fig. 2).

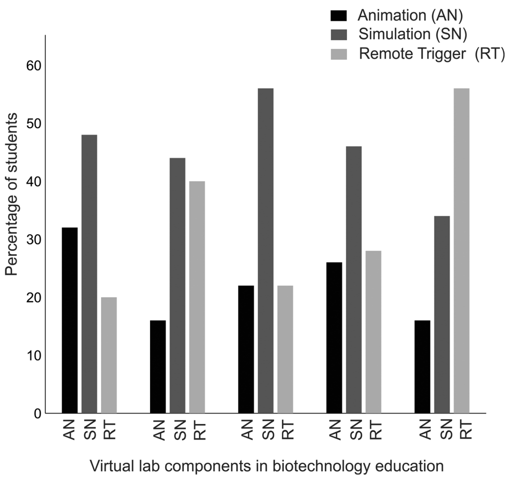

Fig. 2. Student Feedback. Questions for analysis on X-axis and percentage of users on Y-axis.

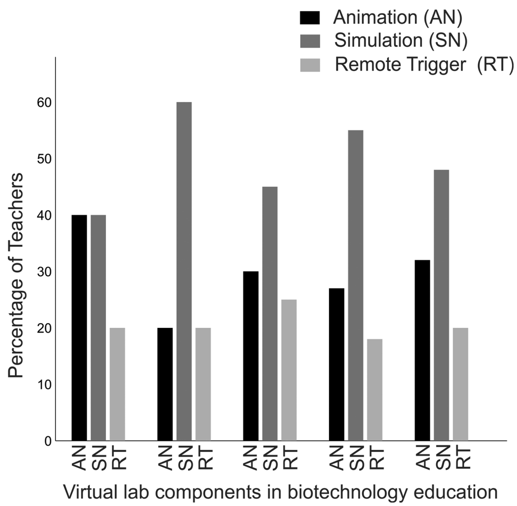

Fig. 3. Feedback of teachers. Questions for analysis on X-axis and percentage of users on Y-axis.

There was a high degree of interactivity between users and computers while performing simulations. Few users complained that they experienced network connectivity issues while doing remotely triggered experiments.

3.2 Comparative Analysis of Animation, Simulation and Remote Triggered Experiments in Teaching Biology Course

Analysis of feedback from teacher groups showed that 40 % of them suggested including both animation and simulation in the curriculum so that they could deal with students in more interactive manner and make them to practice an experiment more precisely. 60 % of teachers showed their interest on using simulations to teach basic lab techniques since they found it as an effective tool to teach the standardized protocols. 45 % of teachers would like to use simulation based experiments as a substitute for class room teaching for its step-by-step procedure of experimental protocol. 48 % of teachers suggested that simulation-based experiments as a supplementary material that can be accessed at anytime (see Fig. 3).

3.3 Analysis of Problems Faced in Virtual Lab Versus Remote Triggered Experiments

To analyze problems faced while performing animation, simulation and remote triggered experiments a questionnaire based feedback data was collected from both teachers and students (350 participants) after practicing the light microscope experiment. Feedback indicated that 80 % were able to follow animation without any difficulties while 20 % reported difficulties in performing experiment. Similarly, 85 % of participants suggested that could easily interact with simulations while 15 % faced

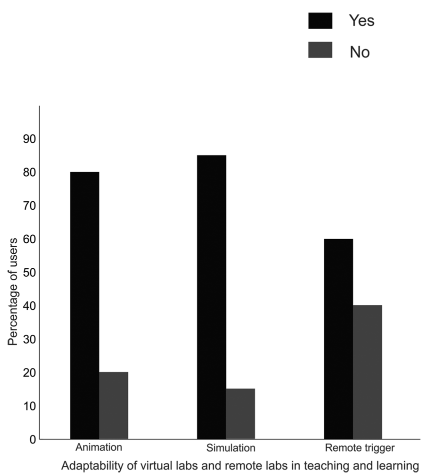

Fig. 4. Participants response on adaptability towards animation, simulation and remote triggered experiments

Table 4. Problems faced in performing virtual and remote labs in a classroom

Types of labs	Problems	User percentage
Animation	Lack of interaction	50
	No realistic output	20
	Lack of audio	21.43
	Time consuming experiments	8.57
Simulation	Difficulty in following instructions	18.87
	Need to add more variables	37.74
	Lacks touch and feel of equipment	18.87
	Computer illiteracy	24.52
Remote labs	Internet issues	50
	Lack of training	21.42
	Slot booking system	14.29
	Lacks deliverability efficiency	14.29

problems in doing experiment. 60 % of participants were able to operate remote equipment easily without the help of an instructor and 40 % of them indicated issues in using remote equipment (see Fig. 4). Most frequent issues faced by participants were identified (see Table 4).

4 Discussion

In this study, a comparative analysis on effective role of ICT enabled techniques such as animation, simulation and remote triggered experiments in learning biotechnology experiments were analyzed. We used a direct approach via organized workshops for students and teachers across various places in India. Data analyzed from overall studies indicated virtual and remote labs as a supplementary education platform for both university students and teachers to understand concepts of the experiments. Overall feedback results showed that most students preferred simulation-based experiments than animation and remotely controlled labs in their learning. Survey suggested that the usage of interactive simulators rather than animations and remote labs enhanced usage motivation in classroom education. User interaction and learner satisfaction were primary challenges while constructing ICT enabled laboratories. Our studies also revealed several problems related to usage of such labs in education. These initial results, although, suggest virtual and remote labs to be effective. We are now extending the study to understand the interaction of social, cognitive and teaching presences in a virtual scene and within traditional blended learning environments.

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Students' Acceptance of Peer Review

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Abstract. Peer review technique used in educational context could be beneficial for students from several points of view. Besides of developing students' writing skills, critical thinking, practising articulation of own knowledge to the others and giving them feedback, it can encourage collaborative learning and boost the students' interest in the course. In our web design course we successfully introduced peer review activities more than 2 years ago. In this paper we discuss the students' acceptance of peer review applied on evaluation of other students' projects.

Keywords: Peer review · Projects · Students opinions

1 Introduction

Peer review is widespread in many professional fields, e.g. science, engineering, health care, etc. In this process a paper, a software, or any other work outcome is assessed by a specialist who is of equivalent expertise level to the author. The goal of peer review is not only to evaluate the work but also to suggest how to improve its quality by adjusting and supplementing the content and the form.

According to the experience reported by several publications [11,13,14], the peer review approach can also be useful also in the educational context. The outcomes of published studies confirm that thanks to the reciprocal evaluation of the colleagues' work the students could better develop their communication skills, critical and analytical thinking, constructive criticism, social learning etc. Additionally, this activity could also boost the students' interest in the course.

Therefore, more than two years ago we started to employ this activity into our course aiming to bolster up students' motivation for learning, course activities and for the course subject itself. At first, peer reviews were integrated with blogging which was also part of the course activities [1] – students evaluated the blog articles of their peers. Based on our previous research results we can confirm that students engagement in blog-based activities as well as their study results significantly improved after peer review was introduced. Despite the extensive involvement and better grading several students expressed their dislike for these activities, especially for blogging. Since we rated peer reviewing to be particularly beneficial for students, we adjusted the course activities next academic year and let students to peer-review their projects. As presented in this paper, after this change the preliminary results for students' acceptance of peer reviews are satisfactory.

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2 Related Work

The most common way of employing peer review into course activities is the mutual students evaluation of essays [8] or blog articles [10,15]. As stated in several studies [2,8], students tend to give better rating to their peers than the teacher gives. In spite of this fact, it is possible to identify weaker works based on the students' peer reviews [2].

MacAlpine [12] and Gehringer [6], who deal with the format of peer review, point out the importance of prescribed peer review structure and good specification of all criteria and aspects to be assessed.

Gehringer [5] successfully used peer review also in other educational activities such as annotating lecture notes, collecting sources related to the course topic, creating test questions, making up a problem on some topic, etc. In some assignments, after initial feedback phase students are enabled to correct the errors pointed out by reviewers. Besides the reviewing others work students also evaluate the usefulness of the reviews they got from colleagues to their own work.

The peer review technique was also used to determine the relative contribution of each group member working on a group project assignment [9].

3 Course Description

Our research was conducted on a web design course that is obligatory part of master study program in Applied Informatics. Besides of masters students many bachelor students voluntarily enroll in this course every year.

The course focuses on front-end web design issues including both desktop and mobile websites and concentrates predominantly on web design methodology (such as prototyping, usability testing, and user centered design) and web quality standards (accessibility and usability, content quality standards, etc.).

Lectures and practicals comprised in the course are not mandatory. The main course activity is a project – a full semester assignment that constitutes one of the essential parts of course evaluation. Apart from the project the course evaluation includes written exams (midterm and final) and extra points for activity during practicals. The best grading students can get for the points earned for all these activities is C (on the scale A, B, C, D, E, Fx, where Fx stands for a failure). The best students are allowed to improve their grading at an oral exam.

The main objective of the project is to practise the knowledge and skills the students are supposed to master during the course. Therefore the project assignment for every particular student is to develop her personal blog with typical blog features, both in desktop and mobile version, including sufficient amount of meaningful content. In the past runs of the course, the assignment was only evaluated as one final submission. As we observed that the students only started to work on the project a few days before the deadline, several years ago, we split the project into three phases, each of them evaluated independently. Thus the students had to spend more time working on the assignment what brought about better learning outcomes. For further improvement, in the last semester each of the phases was supplemented with a peer review round.

4 Peer Review

In the course of each project phase students had to meet three deadlines. Firstly they developed their web application according to the current phase requirements. Consecutively they submitted the project for the peer review in a predetermined deadline. Each student, who successfully submitted her assignment in the given phase, was assigned three randomly chosen submissions to review. The reviewing period took approximately 3–4 days (second deadline). After reviews were delivered, the authors were given few days for correcting their projects according to the peers' comments (hereafter, the *project improvement phase*). Only after this phase projects were submitted for teacher's evaluation (third deadline).

Since the students were not skilled in evaluating others work, a structured review form with several questions was prepared to facilitate the reviewing process. The questions in the form were different in each of the three phases and were directed towards the goals of each phase. They more or less covered the evaluation criteria used by the instructors. The reviewer had to answer each question with a rating ranging from 1 (very poor) to 5 (excellent), and in addition had to provide a verbal justification for the given rating. The reviews were blind i.e., the reviewers knew the identity of the authors but not vice versa. More detailed information about this peer review methodology and project phases can be found in [3,7].

5 Research of Students' Acceptance

To find out the level of students' acceptance of peer review strategies used in the course, we prepared an anonymous questionnaire. Although participation was optional, the questionnaire was completed by 54 students (93.10 %).

5.1 Questionnaire Description

Questionnaire consisted of 16 (semi)-closed questions with possibility to choose more than one option in most cases. Questions were divided into two sections: the first one was focused on students' opinions about peer review in their learning and the second one was oriented to the overall course evaluation. In fact, the latter section comprised the same questions as those in the official Student Questionnaire provided by faculty every semester. We used this strategy with the aim to reveal the differences between results in our and official Student Questionnaire, as discussed in our other paper [4].

5.2 Outcomes

Initial question explored various benefits of reviews given to a student by her peers. As shown in Fig. 1, nearly all students chose the option: *to correct omitted deficiencies*. However, more than a third of respondents admitted that the

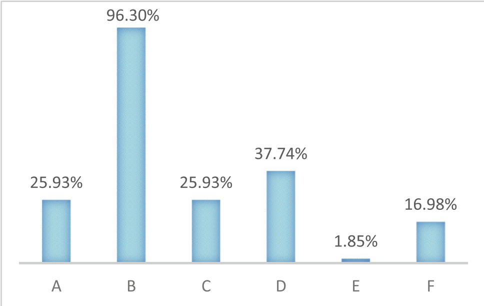


Fig. 1. What were benefits of received peer reviews for you? A: to better understand project assignment; B: to correct omitted deficiencies; C: to correct deficiencies I was not able to solve; D: to improve in my reviewing; E: nothing; F: other

reviews received from their peers helped them to improve their own reviewing skills, and a quarter of them could now solve some issues that they were not able to solve before reviewing. Also, one quarter of students averred that their understanding of project assignment improved after they received reviews.

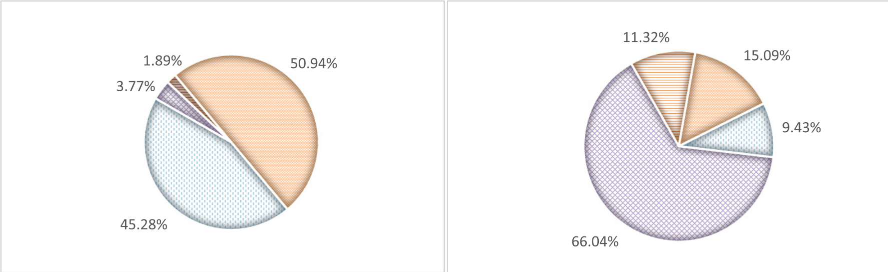
If student chose the option *other*, she should explain it. In some of these cases students appreciated the possibility to gain another opinion to their work: *I got alternative view on my project*; or *viewing other projects inspired me in my work.* However, there were also a comments like: *I "corrected" stuffs that were correct, according to bad advices of my reviewers.* Since we expected such situations, students were asked to specify their experience with incorrect advices.

At first we asked whether they corrected their projects before final submission according to reviewers' advices. Although there were five options, students chose only 3 of them or did not answer (Fig. 2(a)). Skipped options were as follows: *despite the criticism I did not correct my project* and *I had no criticism.*

50.94 % of respondents claimed that they fixed all shortcomings found by their reviewers and 45.28 % of respondents fixed approximately a half of all deficiencies.

Since we assumed that students would not correct all admonished shortcomings, we also explored their reasons to do so (Fig. 2 (b)). The most often selected option (*I ignored bad advices from my peers* – 66.04 %) indicates that the students are able to distinguish right advices from wrong ones. 15.09 % of students claimed that they did not have enough time to make corrections and almost 10 % of them admitted their laziness to work on projects.

Peer review process could also be beneficial to the reviewer. Therefore we asked students whether they gain some benefits while reviewing others' work. We expected the most popular option would be *I could gain more points.* However, although 61.11 % of respondents chose it, there were even more students (68.52 %) who stated that they realized shortcomings in their own projects thanks to the reviewing projects of their peers (Fig. 3). Also the fact that only 3.70 % of students claimed that peer review was not beneficial to them can be taken for a good result.



(a) (b)

Fig. 2. (a) Did you correct your project according to reviews before final submission? yes, everything yes, a half yes, but only a few things no answer; (b) In case you did not change your project according to reviews, why did you do so? I did not have enough time I was lazy to do so I ignored bad advices from my peers no answer

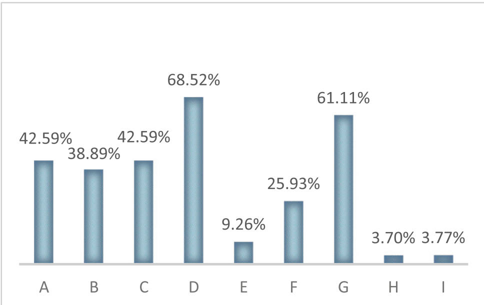
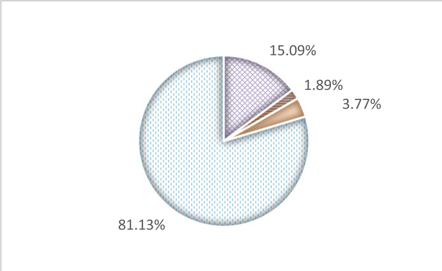


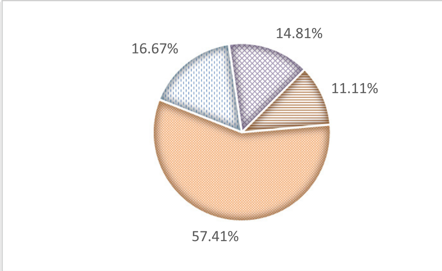
Fig. 3. Do you think that you gain some benefits while reviewing others' work? A: I learned how to test web projects; B: I learned how the project assignment was perceived by my peers; C: I realized how many different types of mistakes can appear on websites; D: I realized shortcomings in my project during peer reviewing; E: I trained my verbal skills; F: I learned how to give constructive criticism; G: I could gain more points; H: nothing; I: other

While many students welcomed the project improvement phase, there were also some who tended to abuse this new option. Reviews they got from their peers did not influence their final grade and therefore some of them had submitted an incomplete project intending to finish it during the reviewing phase. Accordingly to this, we asked students whether projects they reviewed were appropriately finished considering the respective project phase. As depicted in Fig. 4 (a), 3.77 % of students stated that *all* of projects and 81.13 % of students stated that *most* of projects they had reviewed were finished.

In the next question, we explored how students perceived the unfinished projects. 57.41 % of respondents declared that they reviewed unfinished projects that were assembled during reviewing process and it was not a problem for



(a)



(b)

Fig. 4. (a) Were all projects you reviewed finished and prepared for reviewing? all finished almost all finished almost all unfinished all unfinished; (b) What was your experience with unfinished projects? some peers worked on their projects during reviewing, but it was OK for me some peers worked on their projects during reviewing that caused an obstacle to reviewing it motivated me to submit my project in next phase more finished I did not review unfinished projects

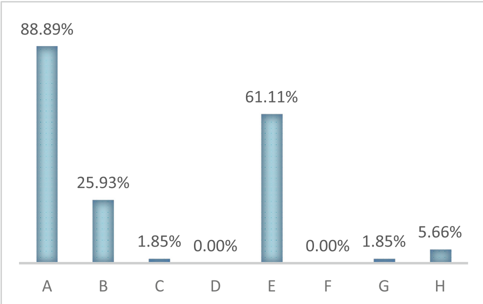


Fig. 5. Do you think that the chance to correct your project before final submission was beneficial to you? How? A: I had a chance to get more points for the project; B: peers gave me advices how to remove mistakes I was not able to solve; C: it helped me, but they gave me also bad advices and I lost points because of it; D: most of peers' advices were bad, it did not help me; E: I got extra time; F: it was not beneficial to me; G: I do not consider submitting projects this way as a fair option; H: other

them (Fig. 4 (b)). On the other hand, 16.67 % of students considered reviewing unfinished projects as a difficult task.

The last question focused on the perceived benefits of the project improvement phase. Definitely the most popular option was the first one: *I had a chance to get more points for the project*, since 88.89 % of respondents chose it (Fig. 5). Students also appreciated extra time they got for final submission (61.11 %) and a quarter of participants welcomed the project improvement phase since their reviewers helped them in eliminating mistakes. The fact, that options *It was not beneficial to me* and *most of peers' advices were bad, so it did not help me* were not chosen by any student, is very satisfying.

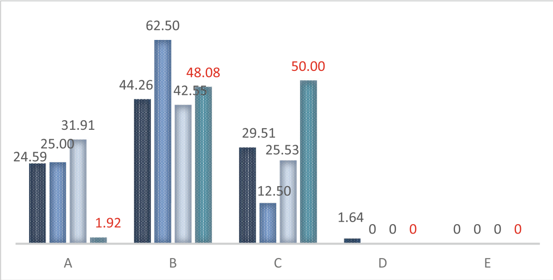


Fig. 6. Was the amount of work appropriate considering the number of credits? A: Absolute killer; B: Too much; C: Just right; D: Too little; E: What work? 2011 2012 2013 2014 (our questionnaire)

In the end we focused to the amount of work required from students in our course. As the official Student Questionnaire provided by faculty regularly deals with this question we were able to compare results from previous years with the answers from our questionnaire. To answer this question, respondents could choose one of five options (see Fig. 6), where the middle one is the most positive: *Just right*. As it is shown in the same figure this year's results are more positive than those from previous years. While students tended to evaluate amount of work mostly as *absolute killer* (31.91 % in 2013) or *too much* (42.55 % in 2013) and only about a quarter of them considered it as *just right* in previous years, the result from our questionnaire in 2014 is completely different. 50 % of students considered the amount of work as *just right* and 48.08 % of students marked it as *too much*. An option *absolute killer* was selected only by 1.92 % of respondents.

6 Conclusion and Future Work

Peer review is an activity which, combined with an appropriate methodology and suitable educational context, can become a powerful tool bringing numerous benefits to students as well as to teachers.

In this paper we focused on peer review activities integrated into a web design university course. Despite the fact that our previous attempt to combine peer review with blogging activities was attended by higher engagement of students and significantly improved study outcomes as well, students were not satisfied with this activity. Therefore we used peer review in combination with project assignment in the last course run. The aim of this study was to find out the attitude of our students to this educational activity in the changed conditions.

According to the results from the questionnaire conducted in the end of semester, the redesigned activity was positively accepted by students. They considered it not as a task created for its own sake, but as an activity that brought added value in their learning.

In our future teaching activities, peer review will be used in combination with group projects where group members will review each others' work. This approach can bring benefits not only to students but it can also help teachers in more fair evaluation of individuals.

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Investigating the Digital Literacy Needs of Healthcare Students: Using Mobile Tablet Devices for the Assessment of Student-Nurse Competency in Clinical Practice

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Abstract. This case study investigates the digital attitudes, skills and development needs of nursing students when using mobile tablet devices to assess student-nurse competencies in clinical practice. Participants have been asked to complete a bespoke skills-based digital competence self-assessment questionnaire based on the EU DIGCOMP framework; this enabled a baseline for both individual and group. The individual characteristics of students were further explored through comments and their reflective diaries results show a complex, highly-individual profile for each student while the group exhibits common characteristics. Further work is proposed to investigate intricacies on how students perceive and use technologies in education and daily lives.

Keywords: Digital competence · Digital literacy · EU DIGCOMP framework · Mobile devices · Competency assessment

1 Introduction

This research was framed within the boundaries of a learning, teaching and assessment project which piloted the use of tablet devices and an application-based mobile electronic assessment portfolio used to assess the practice competence of student-nurses. The project allowed for the rapid identification of students at risk of failure and facilitated early intervention. Academic practice was further enhanced by preventing potential falsification of competence sign-off from mentors, facilitated improved engagement practice and offered ecological and economic benefits in the form of saving paper and printing costs. Students were issued with a tablet device to own and use in their academic, personal and professional lives.

The digital literacy work as part of a wider action research project has identified and validated the suitability of an appropriate digital competence framework through a qualitative analysis of the views of students and staff [1], developed self-assessment tools for quantitative assessing and mapping of their digital competences [2], and documented the views of students about the delivery of digital-literacy skills embedded within the curriculum delivery by utilisation of technology-enhanced activities designed along Dalziel's [3] Learning Design principles.

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2 Methodology

Participants completed a bespoke skills-based online digital competence self-assessment questionnaire that allowed base-lining of the digital-literacy competence level of the group. This questionnaire toolkit development was based on the EU DIGCOMP framework [4] and included 21 questions organised into 5 themes (Table 1).

Table 1. DIGCOMP framework competence areas

DIGCOMP Framework Digital Competence Areas	
1. Information	4. Safety
1.1 - Browsing, searching and filtering information	4.1 - Protecting devices
1.2 - Evaluating information	4.2 - Protecting personal data
1.3 - Storing and retrieving information	4.3 - Protecting health
2. Communication	4.4 - Protecting the environment
2.1 - Interacting through technologies	5. Problem solving
2.2 - Sharing information and content	5.1 - Solving technical problems
2.3 - Engaging in online citizenship	5.2 - Identifying needs and technological responses
2.4 - Collaborating through digital channels	5.3 - Innovating and creatively using technology
2.5 – Netiquette	5.4 - Identification of digital competence gaps
2.6 - Managing digital identity	
3. Content creation	
3.1 - Developing content	
3.2 - Integrating and re-elaborating	
3.3 - Copyright and licences	
3.4 - Programming	

The questionnaire toolkit requires the participants to self-assess their digital competences by selecting the most appropriate scenario to their perceived skill set. Evangelinos and Holley [1] found that the student population has diverse digital skills, attitudes towards technology, and prior experiences. Students were asked to think whether they possessed the required skills and attitudes to complete the proposed activities regardless of having actually completed similar activities in the past. The questionnaire presented the participants with 5 competence areas expressed as groups of questions. Each question presented the participants with 4 examples of possible hypothetical role-play technology-use scenarios and asked them to select the answer that best matched their skills. The scenarios were progressively becoming more complex and were designed to represent different digital literacy profiles ranging from lack of skills to elementary, intermediate and advanced. The scenarios were customised to present the students with authentic situations relevant to their academic experiences. An example of the scenario-based questions can be seen in Fig. 1 - Question 2.4 of the DIGCOMP Self-assessment Toolkit below.

* 8. 2.4 Communication - Collaborating through digital channels

- ◯ I need to collaborate with others on a project for a course, and I know that it is possible and effective to use technology to help with this.
- ◯ I have started to work on our project, and I have created a file that I have shared with others, so that they can offer comments and add material to it.
- ◯ I have put a document into an online collaboration tool, so that others can amend it and add to it, and the system will notify me about the changes that have been made.
- ◯ I don't have the skills to complete any of the above.

Fig. 1. Question 2.4 of the DIGCOMP self-assessment toolkit

24 out of 30 students completed the questionnaire (80 % return rate). The results were exported and analysed by using the Microsoft Excel 2010 spreadsheet software and produced a wealth of data that can be analysed in various ways. For the purposes of this paper the group characteristics of the students will be examined. A wealth of quantitative indicators of student digital-behaviour was revealed. The questions for each competence group were averaged together to give a more reliable single number index (here defined as #eudc_competencearea). For this group the '#eudc_' indices are as per Fig. 2 - #eudc_ Group Indices below. The group digital-literacy map presents the average group digital literacy index as a composite index that is sampled (averaged) across a number of competence-specific scenarios. Please note the existence of different numbers of scenarios in each area (3-6-4-4-4). For example, the #eudc_information index is a composed average of three information-literacy sub-questions; the communication area

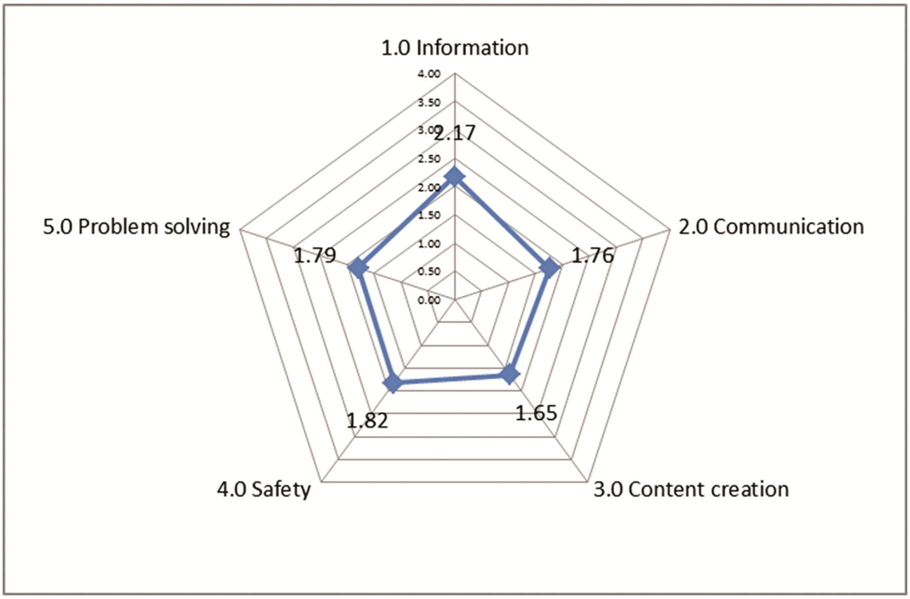

Fig. 2. #eudc_ Group indices

is expressed as six sub-questions and content -creation, safety and problem solving are represented by four questions each.

Students were also invited to complete short, reflective diaries to reflect and record their technology-use experiences in their private, academic and work lives, and to report their perceptions of digital literacy, comment on the views concerning the acquisition of skills, areas for further development, and provide feedback suggestions on how the university can facilitate the enhancement of their digital skills. 15 students out of 30 completed the reflective diaries corresponding to a significant percentage (50 %) of the participants. The analysis was conducted by using QSR NVivo 10 software and coding the reflective diaries into themes following the Glaser and Strauss' [5] Grounded Theory approach, as well as the coding recommendations by Miles and Huberman [6] and Guest et al. [7].

Explanations of pertinent ethical considerations, such as confidentiality of collected data, anonymity of the subjects, ownership of the data, and results of the study were provided and the participants were given the choice of participating anonymously, withdrawing without penalties or even dictating conditions on the use of data. Informed consent was obtained in writing according to the research protocol governed by the university's ethical procedures.

3 Results

The 21 questions (organised in 5 competence areas) define 5 key metrics: (a) Information (b) Communication (c) Content Creation (d) Safety and Privacy and (e) Problem Solving (see: Fig. 2). For example, the #eudc_Information index with an average of (2.17) points (on a scale from 0–4 where 0 means no skills, 1 is basic, 2 intermediate and 3 or over is considered as advanced) denotes that on average students have just over an intermediate self-declared competency in the information competence area. The group was least confident about their self-declared skills in the content creation #eudc_ContentCreation competence area with an average score of (1.65) or basic competence. The average values can be used to baseline where the general group competency lies but when combined with the digital literacy group distribution it gives a two-dimensional perspective about the qualities of digital-literacy, group-dynamics and distributions. As evidenced below in Fig. 3 - Digital Literacy Group Distribution – the digital literacy capabilities of the group, varied; information, communication and problem solving were closer to the upper limit of basic competence trending towards intermediate competency, while safety, privacy and content creation were closer to basic competency. It is interesting to note that seven individuals were rated at both extremes.

The 21 participants of the questionnaire were all female, 16 (76 %) between 18–25 years of age, 3 (14 %) between 26–35 years of age and 2 (10 %) between 46-55 years of age. When asked how they are informed about new digital technologies they reported that they learn about technologies primarily from friends and family (21), traditional media (16), online digital sources (14), library services (3) and only few from their course at university (4).

The participants were also asked to identify their technology use, and to establish the utilisation of technology and the different types of technology that should be of

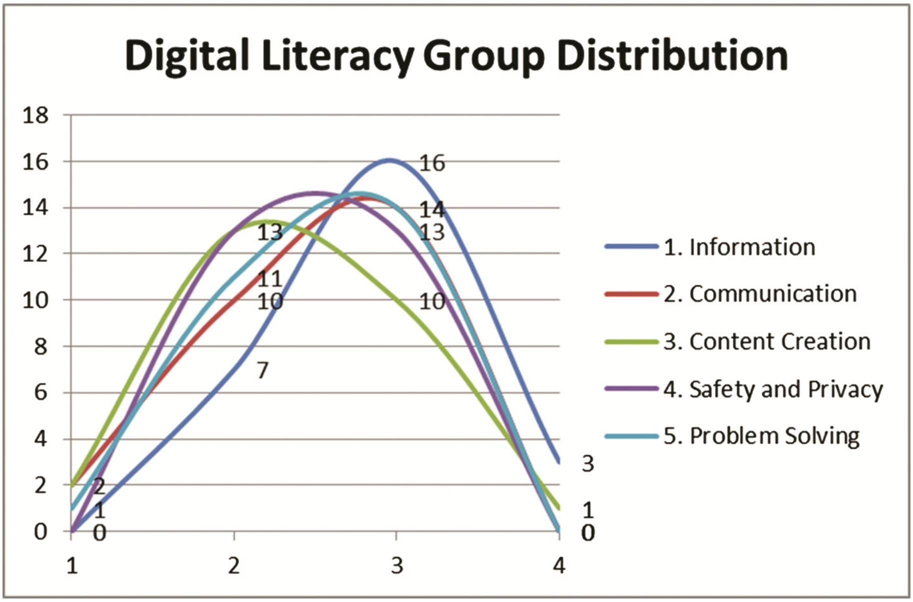

Fig. 3. Digital literacy group distribution

concern in a student's private, academic and work life. Figure 4 - Technology Use shows that a laptop computer (20) is still the predominant technology in formal learning, with desktop computers (16) and tablets (15) being closely second and mobile telephone equipment being used to a limited extend (10). In their private lives, students seem to

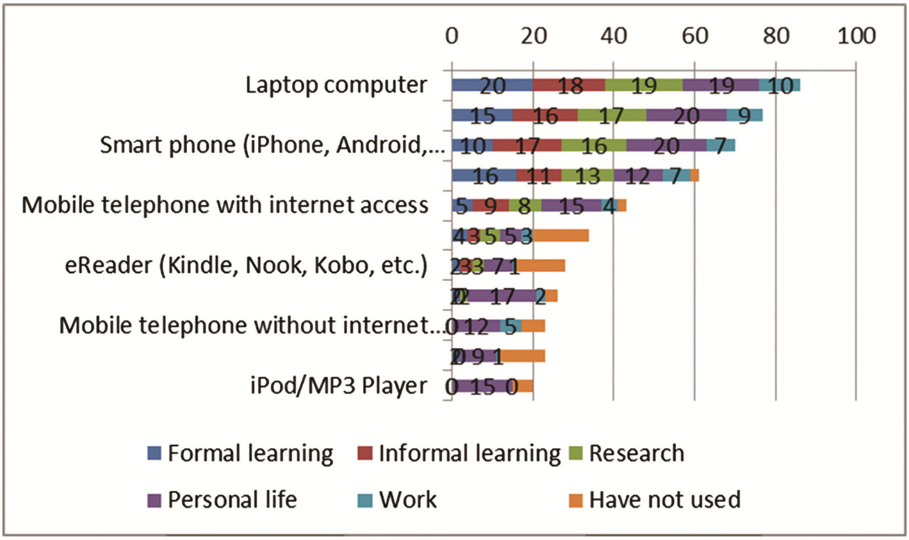

Fig. 4. Technology use

use a much larger variety of technologies where tablets (20), smart phones (20) and laptops (19) are frequently used. In research laptops (19), tablets (17) and smart phones (16) are often used.

Twelve weeks after the students were given the tablets and completed the questionnaire they were asked to consider their digital literacy learning and development cycle and critically document their experiences on using and learning about and with mobile tablet digital-technologies in their (a) private, (b) academic and (c) work lives by using self-reflect on their experiences.

The initial analysis of the reflective diaries showed that in private life students were concerned with communication (11), usability (11), and experience (9). Social networking and communicating with friends and family when travelling or being on the move was one of the most appreciated affordances of technology. Students also use mobile digital technologies to access systems for carrying out everyday activities including communication and interacting with the university. They expect a seamless experience when accessing systems from their smart phones or tablets and expect to be supported when things do not work properly (Table 2).

Table 2. Diary analysis top three categories

Private		Academic		Work	
Communication	11	Experience	12	Experience	10
Usability	11	Usage	11	Communication	8
Experience	9	Information	8	Organisation	8

In academic life they are concerned with experience (12), usage (11) and information (8). Most participants admitted that technology engagement for higher education study is a necessity and that they generally feel comfortable in using more than one types of technology. Tablet and smart phone use was widespread, and although some individuals admitted they were lacking the necessary skills for making effective use, they were willing to acquire the missing competences and skills. The main usage-patterns included the use of subject-specific apps to acquire knowledge, revising the PowerPoint handouts from the VLE, using single sign-on to access the university infrastructure, using tablet apps for note taking, access university information and timetabling, and e-submission of the assessment nurse competencies. From the information perspective mobile technologies are used for exam revisions, information retrieval online that includes books, journals and websites enabling the users' studies. Eight students emphasised the value of using tablet devices within lectures to broaden their understanding, check facts and definitions or review and focus their study on difficult concepts.

In work life experience (10), communication (8), and organisation (8) are the top three categories of concern. There is consensus that mobile technologies are becoming increasingly pervasive in all aspects of everyday life including work and usage in the workplace. Participants generally felt comfortable with using the tablet devices for work and they drew examples on how these tablets were successfully used for data entry in restaurants. The participants also reported that similar applications of technology could potentially change their work attitudes. From a communication perspective they generally found it useful to have access to technology when in clinical placements as they often needed to access information and/or communicate with the university and their tutors. Examples of organisational implications of technology-use in the workplace include the use of mobile devices, applications such as the calendar, reminders which are used to manage diaries, and the setting of work-related reminders and notes. One participant reflected, '*… for patients for their doctors' visits, and their families' visits*', while another reported the use of social media as tools for publishing and managing rotas.

4 Discussion and Conclusions

This action research multi-method approach gathered two sets of data: (a) the digital literacy quantitative indicators #eudc_ and demographics and technology-use distributions and (b) the reflective diaries where students self-reflected on their digital- literacy affordances.

At a group level the quantitative metrics seemed to accurately measure a snap-shot of the digital competences, skills and attitudes of the DIGCOMP framework. Students as a group seemed to be reasonably comfortable in using technologies to communicate, learn, research and generally engage with technologies in a number of ways as individuals; on average they showed a command of above-basic digital competences located at the borderline of intermediate. This type of analysis is of interest for the optimisation of teaching. Although the individual data tells a different story, it must be stressed that the purpose of this research was the consideration of group dynamics.

Interestingly, the frequency distribution indicated normal distribution of individual digital-competence. The 7 individual 'outliers' were students who lacked digital skills and students who had expert profiles. This method offers possibilities for early identification of students with advanced, and these lacking in essential digital skills. This offers potential in the classroom for early intervention of the latter case and for further development and utilisation of those who possess advanced skills. For teaching, it may be possible to construct more balanced groups, and scaffold informal learning of digital skills by considering Vygotskyian [8] ideas about 'the more capable peer'. From a technology-use perspective student self-reporting of pervasive use of laptops, tablets and their private and work lives was significant. At the same time the group seemed less comfortable in the areas of content creation, communication and problem solving, and more competent in information management and safety.

The research diaries collected for documenting the intricate details of the individual competences, skills and attitudes allowed for the appreciation of the main areas of focus of each student. It seems that students face academic life as a part of their 'everyday' life, and practice placements as their 'workplace'. However, these distinctions were arbitrary as most students reflected from their individual circumstances and experiences. What matters to them is the way they individually use technology to achieve their own aims in their own private, academic and work lives; this attitude offers insights to the academics seeking to support their learning.

This paper established metrics for defining and measuring digital literacies in higher education based on the development of the #eudc_competences as it is defined in the DIGCOMP framework. The metrics offer robust descriptors of digital competence and, when combined with an analysis of technology-use and diary analysis suggest types of technologies with preferred private, workplace and academic contexts for learning.

Further work will include focus groups to investigate further students' views and practices in the use of the mobile tablet devices; but findings thus far already have the potential for re-conceptualising the curricula for the forthcoming intake of nursing students.

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Student Engagement in an Online Environment: Are We Trying to Mimic Contact Education? A South African Perspective

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Abstract. There is no doubt in anyone's mind that human contact can never be replaced 100 % by any other means. When it comes to higher education it is not different. Graduation rates at contact institutions are higher than distance learning institutions. It is equally true that since the inception of distance education the assumption has been that the greater the duplication of contact education the greater the chance of success. Although the content could be identical in both modes of delivering education, and the difference is contact versus non-contact from there on the differences exceed the similarities.

This study examines existing literature in student engagement and uses post facto research. Then it proposes a framework which could enhance student participation which increases the possibility of graduation of a student in an Open Distance Learning institution.

Keywords: Student engagement · Graduation rates · Attrition · eLearning · Open Distance Learning

1 Introduction

Educating the youth in any formal way it could be, face to face mode (F2F), fully online mode (eLearning) or a blended mode (blended, hybrid, mixed), a combination of the first two and predominantly face to face. In all three situations, there is the content, the student, the teacher/ lecturer and the environment that the teaching-learning situation takes place. The ultimate aim of the institution is to produce self-reliant graduates, using the humanist approach to education.

Graduation rates though around the world (excluding highly selective institutions such as Harvard or Oxford) are unacceptable as they vary from around 20 % in distance learning to around 40 % in contact learning [1–4]. Graduation rates in ODL, as a rule, have always been lower than F2F education [2, 4]. However there are studies which show that there is no significant difference in academic success in two controlled groups [5]. As the highest percentage of drop-outs occurs in the first year ([2, 4]) in 2015 Unisa, an Open Distance Learning (ODL) institution, introduced the Extended Programme where the first year of study extends by a year. Among the many factors of attrition identified by the literature ([3–7]) student engagement is one such a factor.

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Many authors [3, 5, 6, 8] agree that student active participation (interaction, engagement) is a major factor for academic success in any mode of education delivery. This study discusses the similarities and differences between face to face (F2F) and ODL education and how can student engagement may be improved.

1.1 eLearning Vesrus Face to Face Learning

Although there are many similarities between the distance and F2F education it is the differences that in the end could be the strong points of each mode of education delivery (see Table 1). Studying the literature for the past decade it revealed that while F2F education is moving more towards blended education, the online education delivery is improving especially through technology. The differences below are self evident and ODL institutions should take advantage of that. As technology has been established to have a positive effect on engagement [2, 6–11] then ODL institutions especially should become more of innovators in the use of technology. F2F institution should also try not to mimic ODL course deliver as O'Neill et al. [11] warn. Use of technology could lead to a competitive disadvantage by increasing student intake for financial reason as attrition will increase and possibly lower standards.

Salmon [7], also warns against the mimicking of F2F by ODL institutions by using instruction and transmission of knowledge as they should rather design their courses for interaction, engagement, building knowledge and skills and flexibility.

Studying Table 1 it is clear that both online and contact institutions have their strengths and their weaknesses. Instead of trying to mimic one another they should use their strengths. Their uniqueness make them both of equal importance.

The most important similarities though are: There is an instructor, expert in their field, syllabus, students are expected to study, discuss and learn, write exams mostly under the same conditions (excluding online exams), receive accredited degrees and at postgraduate level there is no difference as the modus operandi is almost identical. In both cases academic success is measured on what students have learned and throughputs; and in both cases throughputs are unacceptable and many factors of attrition are similar. Student engagement as stated above is one such a factor though the means used to achieve it could differ.

1.2 Student Engagement

Treating an ODL institution as such rather than as a duplicate of a F2F institution, if we accept the statement of Tinto [12] and others [6, 7, 11, 14] that persistence is related to student's engagement with his/her studies and the institution then the question to be answered is: What does the literature says about student engagement and what can a government, through legislation, and the institution, through implementation, do within their limits and control, to enhance student engagement in an ODL environment?

By student engagement is meant that the student will play his/ her part by devoting time and energy on educationally purposive activities given the favourable conditions created by the government and the institution [8]. The institution thus will "employ

Table 1. Differences between online and contact education

Online/Distance	Traditional/contact
(1) Flexibility-fit study around our schedule/ convenient	(1) Follows specific daily/weekly time Table
(2) Instructor more readily available	(2) Instructor could only be available during class or specific times of the week
(3) Can take exams online	(3) As a rule the exam take place in a venue
(4) No time or space constraints	(4) Bound by space and time
(5) Style of instruction mostly student driven	(5) Style of instruction mostly teacher driven
(6) Adaptable teaching styles	(6) Predominantly "one size fits all"
(7) Synchronous/asynchronous	(7) Synchronous
(8) Open access (independent of family, personal or work conditions)	(8) Limited access (mostly for matriculants in undergraduate studies)
(9) Can cater for widely distributed student population (rural, urban, international)	(9) More localised student population
(10) Dynamic classes	(10) Static classes
(12) Low throughput	(11) Higher throughput
(11) Time management promotes self-discipline	(15) Most contact time is determined by the institution
(12) Receive mostly delayed feedback	(12) Could get immediate feedback
(13) Properly conducted virtual classes can be very collaborative, as students feel more free to share their knowledge	(13) F2F can inhibit some student from participating in class
(14) Teachers can answer a great number of students' questions (synchronous/asynchronous)	(14) The time in a class is hardly enough for the teacher to cover the syllabus, never mind answer students' questions
(15) Teaching styles could be modified to accommodate student's learning style	(15) Normally teaching styles are rigid, predictable
(16) Learning content, language proficiency dependent.	(16) Foreign African lecturers are not easily understood when they speak.

effective educational practices to induce students to do the right things [5, 6, 13, 15] and Pascarella and Terenzini [5] go as far as to say that the students' part is "the single best predictor of their learning and personal development."

Research on student engagement in South Africa was done by Strydom and Mentz [14] who adopted the National Survey of Students Engagement (NSSE) into the South African context where the South African Survey of Student Engagement (SASSE) was developed.

The NSSE (SASSE) measures five indicators for good educational practices: These are: Level of academic challenge, whether active and collaborative learning takes place, the degree of student-staff interaction, enriched educational experiences, and supportive campus environment. This study accepts the SASSE as a reliable instrument of measuring student engagement even though was designed for F2F it can be applied in ODL perhaps with a few modifications to take care of some of the differences and be used as an advantage.

1.3 Student Engagement in an ODL Environment

It was stated above that student engagement is used as the main construct for this study and literature showed that student participation could be the single predictor for academic success. The case study by Pirrakeas et al. [1] is used here to focus on certain variables which have been identified to be valid in a South African ODL institution. The reason for using this case study is that having collected data from the institution there are great similarities between the Greek ODL institution and the South African one.

Pirrakeas et al. [1] classified the factors for dropping out into intrinsic (student-rated) and extrinsic (institution-related) factors. Since this study concentrates on student engagement only factors within the control of the individual and the institution are considered and recommendations are made.

As this study deals with the extended programme that was introduced in 2015 a post facto research method is appropriate which aims at taking proactive measures to improve the student engagement of the first year students and the outcomes can only be measured at the end of the year. Preliminary findings already indicate the student activity in the online platform has increased by more than 500 % and submission of the first assignment has increased by 300 %. These percentages sound ‘abnormal’ but not in the applied context where in 2013 there were about 0.002 participations (active or passive) per student and in 2014 became 0.01. The non submissions of the first assignment in 2013 was 30 % while in 2014 it dropped to 12 %. These two factors were identified by Pirrakeas et al. [1].

1.4 Science Foundation Programme, eTutoring and Student Engagement

In South Africa, Subotzky and Prinsloo [16] state that “Despite substantial government funding incentives, numerous policy initiatives and well-intentioned efforts, retention and success rates are notoriously poor”, especially in an ODL environment. They sight among other reasons, under-preparedness for higher education; most students come from disadvantaged backgrounds; lack of high-levels skills shortages; high HIV/AIDS infection rates (especially in South Africa that has high rates of infections); and Tinto’s [3] famous ‘revolving door’ syndrome which is created by opening access without ensuring maximum potential success.

In 2007 an additional programme was implemented what is known now to be the SFP programme (Science Foundation Provision), a kind of supplemental programme. The APS (Admission Point Score) is used for the differentiation. An APS of 19 or less for Diploma courses and less than 25 for Degree courses are used as the cut off points.

In May 2013, the Senate of the University approved that the SFP programme is converted to a new model (rather than supplemental), what is known as an extended programme that came to effect in January 2015, similar to mainstream but the first year is extended by a year.

2 Student Engagement Framework for a Foundation Extended Programme (FEP)

Designing a student engagement FEP for an ODL environment as a rule it cannot be founded in a F2F success programme but extend on Prinsloo's [17] research which was conducted at Unisa. The differences to F2F have to be used as the drivers for such a framework while the similarities should be evaluated and strengthened. The four pillars that the FEP is based on are the teacher, the student, the content and the environment where the education phenomenon takes place, with teaching assistants (TAs) (not just tutors) augmenting online learning. The Framework should be guided by Foundation Principles which cater for the underprepared student and change the normal mainstream role of all four components. Since the content is predetermined, the design of delivery and method and materials augmenting the content are teacher dependent.

The Teacher. The role of an online educator has been defined among other names tutor, teacher, facilitator, promoter, manager, discussion leader and E-moderator and is a complex one (Vlachopoulos cited in [13]). Such complexity is difficult to be described in a limited space. However the most important points are highlighted here below.

When the teacher is aware of the importance of the differences, with exception of points 12, 13, and 14 (see Table 1), they are all connected either directly or indirectly to student engagement as a result his/ her facilitation must contain actions that promote such engagement. Briefly and ODL teacher should:

- be a diagnostic Action Researcher [20, 21] and an innovator.
- Possess Pedagogic Content Knowledge (PCK) [22] and be able to implement the famous '5-stage (access and motivation; socialization; information exchange; knowledge) e-moderating model' by Salmon [6].
- be able to apply the cognitive load theory (CLT) which can improve online discussion by reducing the cognitive load [13].
- be able to use tools based technology such as LMS, social media and mobile technologies, which can be used to 'force' the student to do collaborate, do their assignments online or use of educational games which demand engagement [19]. But one should be aware of 'course overload', as stated above, on students, teacher and TAs [11, 13] as they require comprehensive feedbacks [7].
- also provide a platform for social interaction and collaboration by the use of blogs, discussion forums, wikis and plods by applying '5-stage e-moderating model' by Salmon [6] as stated above.

The Teaching Assistant. The teaching assistant [TA}, must be a qualified educator who can play a very important role in the successful delivery of a course, ensures effective learning outcomes [6, 18] as well as contributing to the student satisfaction and as (s)he is the buffer, an interface [18] between the teacher, the student, and the institution. TAs should also possess PCK. The role of a TA at Unisa other than the duties stipulated in the contract, is briefly one of pedagogical, social, managerial and technical.

Pedagogical because it entails involving students in an active collaboration, facilitating construction and building of knowledge and the testing of this knowledge through interaction with others. Social because (s)he must create a friendly, comfortable and welcoming social environment in which students feel that learning is possible. Managerial, because (s)he must management and administer his/her course, and is usually the students' first point of contact for practical and administrative questions about the course. Finally technical as it includes, supporting the students in becoming competent and comfortable with ICT systems and software that compose the e-Learning environment.

Online Environment. The environment here includes the virtual classroom, the administrative side of the institution (human resource), and the technology (e.g. LMS) used for education delivery which should be reliable and the content could be included. Gönüç and Kuzu [23] found that student engagement is affected by the existing technological structure (ICT), faculty member's technology use, effective technology integration, and student's technology use regarding courses. Part of online environment could also be the whole layout of the site that the module is kept and certain web design rules and regulations prevail.

The institution has to create such environment that anything within its control will ensure the removal of all barriers that contribute to student non-engagement. The ideal environment is suggested to be a collaborative one among the students [1, 3, 7, 13, 15].

The Student. If one accepts that an ODL environment should be student centered, it is not just about what the institution can do for the student to ensure it develops a satisfied engaged student by removing all the institutional barriers but the student is also saddled with enormous responsibility. Both student and the institution are responsible for student engagement [8, 23]. That responsibility at times could be the sole reason for student withdrawal irrespective whether other circumstances contribute to it.

The student's role is briefly contained in the definition of successful student engagement [8]. In simple terms is the amount of time and effort the student spends on academic and other activities that lead to academic success. It must be borne in mind the findings of Xu, Du and Fan [24] who cite a number of authors who found that many students, have a negative attitude towards online groupwork (Smith et al., 2010), prefer to work individually and tend to be larkers (Gafni and Geri 2010) and online students often face the issue of social emotion (Wosnitza and Volet 2005) [24].

Technology: The Common Denominator. As all four components are connected to a greater or lesser extent by technology in a digital knowledge era, it is necessary to examine its role in engaging the student with the other three. A number of authors [2, 7, 14, 16, 24] warn us of hidden dangers in the application of technology:

- Full reliance on technology could have detrimental effects on students' performance and subsequent withdrawal.
- Technology should be used to augment learning.
- The fact that the students (or TAs or teachers) could be competent in using other technologies (e.g. mobile technology) should not be assumed that they are equally

competent with LMS [7]. Günüç and Kuzu [23] speak of digital natives (modern students, technologically competent) and that technology builds the bridge the teacher and them.

3 Conclusion

An ODL institution shares common goals with a F2F institution as well as curricular and a number of factors that contribute to student's academic success. However it also differs from a F2F institution and it has to accepted as such and not mimic it. The unique way of education delivery on the one hand is its greatest advantage on the other hand everything has to be designed around it. For example the teachers' roles, the students' needs, the administration must satisfy eLearning criteria providing a student centered collaborative approach which could lead to student satisfaction and thus get a more engaged student. It is assumed that an engaged student stands a better chance for success than a non-engaged student. The way forward is to create model the above framework using Structural Equation Modeling using the four constructs, teacher, student, tutors and environment and perhaps technology to examine how successful is each in their roles.

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The Impact of Mobile Technology in Education: A Focus on Business Information Systems at the International University of Management in Namibia

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Abstract. This paper is about implementing mobile technology to improve teaching and learning. Mobile technologies include laptops, smartphones, tablets, smart devices and PDAs. Research has shown that there appears to be some gains to both lecturer and students when mobile technology is incorporated into teaching-learning. Mobile technology can also be used by teachers as a tool to deliver lectures to students through recorded materials. The assumption is that all students possess a mobile device adhering to minimum standards be it their own or supplied by the institution. A study was conducted to establish the impact of such devices in the teaching and learning situation focusing on Business Information Systems at the International University of Management (IUM) in Namibia. Mixed methods research paradigm and the quasi- experimental method were used based on the positivistic philosophical approach. The results showed that use of mobile technology can have a positive effect on academic performance.

Keywords: Mobile technology · Education · University · Teaching · Learning · Mobile devices

1 Introduction

Low graduation rates in Higher Education Institutions (HEIs) have been observed for decades and Namibia is no exception. HEIs strive to achieve high pass rates all the time. HEI's educate the future generation and citizens that while they carry their professional activity, they will at the same time deal with human problems [1].

It is common knowledge among the educators around the world that the massification of education and decrease in government subsidies to HEIs, (and Namibia is not different [2]) HEIs among other measures to cut down on spending, increase income, and improve graduation rates they turned to technology. The advent of the Internet justified further the use of technology in education to decrease costs as well as enhance the teaching and learning situation [3].

The last decade or so the use of mobile technology in education has become more intense. According to Hoare [3], the use of technology can be highly motivating, adding value and content in opening up entirely new teaching scenarios. Pillay and Ramdeyal [4],

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state that mobile technology, in developing countries (and Namibia, an African country, is a good example), is seen to be more cost efficient than other technologies which are necessary for eLearning as they are portable and can be used anywhere any time.

The study took place at the International University of Management (IUM) of Namibia. The aim of this study is to determine the effects that mobile technology has in the teaching and learning situation at an HEI.

1.1 Mobile Technologies and Education

Mobile technology can be defined as the combination of hardware, operating systems, networking and software that enables technology to be portable [6, 7]. Devices that store these are called mobile devices. Hardware includes PDAs, like Palm Pilot or Handspring, mobile phones, and video game players. Applications are phone books and calendar programmes.

In the last decade or so, the availability of mobile technologies amongst humans has increased [8]. Many people, nowadays own at least one mobile device [4]. Steinbacher [5] found that college students are armed with smartphones, iPads, laptops and the like, and the colleges themselves are trying to keep up with campus mobile applications and mobile websites.

Although features differ amongst mobile devices, most could have some of the following features: camera, video support, games, email, Internet, SMS, MMS, uploading and storing information and support for apps which add additional functionality to the core functions of the device. These features may assist us in combining work, study and leisure time in meaningful ways.

Mobile technology can then be used in education in many different ways and these include, recording lectures, accessing blogs, conducting online research, downloading study materials, practical sessions and simulations in and outside the classrooms and communication purposes [5].

Mobile devices have many advantages as well as disadvantages. Among the advantages are, creating an environment that encourages student-centered learning [8], cost effective [4], enhance students' sense of individuality and community [9], it is a motivating tool which encourages collaborative learning and socialisation [9], and stimulates a sense of ownership of the content [4]. These advantages can be used to augment the teaching and learning. Pillay and Ramdeyal [4] view the ubiquity of mobile phones as a means that educational services can be delivered and rendered with students' existing mobile devices.

Among the disadvantages are, low storage capacity, small screens and relatively low processing speed [10]. Schreurs [10] sees these as an obstruction to learning when he states that: "Nevertheless, they [mobile phones] have very small screens, limited memory capacity and the large diversity of mobile devices obstruct a good learning experience." El-Hussein and Cronje [11] concur with these.

Since mobile devices are relatively new the research done on its effectiveness in education is inconclusive. For example studies done by [10–13]. found that mobile technology enhances teaching and learning while Hu [13] criticised the claims as samples used in most of the studies were small samples and thus the validity and reliability of the findings can be questioned. Although this could be statistically true, if a great number of small samples arrive at the same conclusions it could be argued that there is a degree of validity and reliability.

2 Research Design

This study involved both qualitative and quantitative data and as a result, the mixed method approach was adopted [14, 15]. As a rule, the sample for the study was a convenience sample, and comprised of 2nd and 4th year students Business Information Systems (BIS) and Digital Communication Technology (DCT) respectively at IUM. The study complied with all academic and research ethics as stipulated by IUM.

Qualitative and quantitative data was collected using interviews, questionnaires, quasi-experiment and observations. Quasi-experimental method is based on the positivistic philosophical approach [16]. Collected data was processed and analysed using qualitative and quantitative appropriate techniques. Qualitative data was analysed using the deductive approach where data collected was explored to see which themes or issues to follow up and concentrate on [16]. The aim of analysis of qualitative data was to discover patterns, concepts, themes and meanings [17].

The process followed in analysing and presenting the data was based on the model derived from the logic model approach based on Actor-Network theory (ANT), a philosophical approach used to comprehend complex social phenomena [18].

2.1 Data Collection and Analysis

2.1.1 Questionnaires

The sample comprised of 48 students (25 DCT and 23 BIS) of which 25 were males and 23 females. The categories shown in Table 1 comprised of various themes and the total of answers for each are shown. The questionnaire comprised of 23 questions covering the categories shown in Table 1 using a 5 point Likert scale.

Looking at Table 1 it appears that the respondents as a rule agree or strongly agree with most of the statements made about various factors when asked in a positive manner. However, in three of them (Internet access, Mobile fluency and online library) they are not very happy about it.

Mobile tech factor is about knowledge of mobile technology. Mobile devices factor deals with the choice of the type of a mobile device that the students prefer. Mobile fluency factor deals with how comfortable the students are when using mobile devices. Mobile ownership factor establishes who owns a smartphone.

Time creation factor is based on the assumption that mobile devices can minimize the time spent on some tasks and be used in other more important tasks such as discussions, practical lectures and collaboration, by eliminating writing of notes. Online library and campus libraries were factors to establish preference between use of mobile devices and the physical availability of a library. Each question which contained one of the categories was designed in such a way so that the respondent will relatively agree or disagree. As all questions were designed to carry a positive message it was easy for the students to make a decision. For example: In order to do assignments using IUM's wi-fi or Intranet the service is always reliable. 20 respondents disagree. This means that it is not very reliable.

The data was analysed using frequency tables and one-way ANOVA. The coefficient of significance varied from 0.000 to 0.037. This means that between 96.7 % and 100 % of the students are pro technology, like to use mobile technology for lectures and university networks as well as for their studies. Only one student did not possess a mobile device out of 48.

Table 1. Results of the questionnaire

Categories (N = 48)	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Mobile tech	1	1	2	30	14
Mobile devices	1	2	1	23	21
Networks	1	1	4	37	5
Lecture delivery	2	2	11	26	7
Educational reasons	1	1	1	19	26
Using mobile devices					
• Social	1	1	1	18	27
• Educational	1	3	2	17	25
• Communication	1	1	1	18	27
Internet access	1	3	2	17	25
Mobile ownership	11	16	2	12	7
Mobile fluency	1	19	3	5	3
Mobile disturbance	1	19	3	5	3
Online access	18	7	4	20	16
Online library	1	2	1	25	19
Campus library	1	3	2	27	14
Paperless tech	2	20	2	10	5
Time creation	11	4	5	22	16
Motivation	1	7	9	20	11
Understanding	3	5	13	20	7

2.1.2 Interviews

The sample comprised of 43 students of which 20 were in their 4th (DCT) year of study and 23 were in their 2nd (BIS) year of study. Structured interviews were conducted on a one to one basis. The interview template contained 9 questions, of which question 1 was used to obtain students' personal data. The other 8 aimed at cross checking the answers of the questionnaire as well as deriving more information about students' perception and feelings about the use of mobile devices and determining any barriers for such a use.

It was found that most of the students felt good about their progress (53 %) while 30 % found it hard or boring. Their comments varied from studies are, "enjoyable and wonderful", "I love the field I am studying", "interesting" to "boring", "hard", "difficult".

With respect to using mobile technology all students agreed that such technology has many advantages such as "you carry a computer with Internet in your pocket", you can have it "anywhere anytime", "use it for research" and if connected to University's network then it can be perfect as "[mobile technologies [here a cell phone] can be used to connect to the world", "portable", "convenient", "efficient and inexpensive", "communicate and entertain" or as another student described it as "a tool used for interactions" among people and content.

Furthermore the results from the interviews correlate highly with the data collected from the questionnaire in number of aspects. For example all interviewers saw the educational value in the usage of technology in their studies to 40 (93 %) of the respondents of the questionnaire, and use the networks for downloading materials.

2.1.3 Summary Review of Experiment

A quasi-experiment was conducted to compare the group using mobiles (Group 1, the experimental group, with mobile devices) with the group not using mobiles (Group 2, the control group, no mobile devices). Equal numbers (25) were chosen whereby the students volunteered to belong to either group. In this experiment, mark of a test was the dependent variable. For this particular experiment by mobile devices is meant to include smartphones only so that certain variables (like speed, screen size, and memory capacity, though the service provider could differ and could have an effect on the results) could be controlled. The data gathered from this experiment were analysed using frequency tables and one-way ANOVA. The values obtained were **F = 121.1 and p-value 0.000 < 0.05.**

The two groups were given exercises to do and were assessed on two occasions (mark 1 and mark 2). The marks for Group 1 varied between 58 % and 98 % (Std.Deviation 11.06) while for Group 2 between 14 % and 34 % (Std.Deviation 20.37). The one-way ANOVA analysis of the data collected from the experiment gave the statistical coefficient of significance differences of .000 that is **F (1.48 = 121.242, p-value .000 < .05)** meaning that there are significant differences in students' performances when mobile technology is used. The data obtained from the experiment was also tested for reliability using SPSS and Cronbach's alpha showed that the experiment was 69.4 % relevant to the study.

2.1.4 Summary of the Observations

More data was collected for the study using observations. The researcher observed the students behavior during and after classes. Some observations were made during the experiment. Group 1, which was using mobile technology, showed more interest in their work than Group 2. It was also observed that during the day the network was very slow as most of the students make use of it during that time. The network connection was used predominantly for academic work while smart phone for socializing. It was also observed that students looked relaxed and comfortable using their devices. They seemed to know how to operate their mobile gadgets without any difficulties.

Finally, more data was collected from the University on success rates on the subject BIS. The number of students enrolled and passes the exam on BIS for the years 2012, 2013 and 2014, the year that this experiment was conducted, were 57 %, 55 % and 70 % respectively.

3 Discussion of Findings

After the data analysis phase, different findings were made from the study. Most of the findings support the hypothesis that students are interested in mobile technology. Many of the respondents suggested the mobile devices should be used to eliminate the shortage of materials (insufficient computers) which they currently are faced with. These findings are in line with Schreurs' [10] and Davies et al. [19] findings.

The findings also showed that the use of mobile technology benefits both students and teachers and thus concur with Davies et al. [19] findings. The majority of the students' opinions supported the use of mobile technology in education. They believe, if properly used in classrooms and outside, mobile technology can improve their understanding and thus become more motivated. Such motivation leads to persistence and subsequent graduation [20]. Some students who do possess the devices before going to a university in a way they expect the lecturers to allow them to use these devices just as El-Hussein and Cronje's [11] had found.

It was also learnt from the study that most of the students own at least one or more mobile devices, are comfortable in using them and have knowledge of other mobile devices (Mobile literate). Pillay and Ramdeyal [4] states that, "Mobile technology, in developing countries, is seen to be more cost efficient than other technologies which are necessary for eLearning." Steinbacher [5] and Pillay and Ramdeyal's [4] also arrived at the same conclusions. Soloway and Norris [21] established that over 90 % of the students preferred a mobile device small enough for them to carry with them at all times such as a smartphone."

After a comparison of results from the experiment and the results obtained by IUM students in the last three years, it was found that students who use mobile technology perform academically much better and these findings concur with Richtel and Stone [22] findings.

Respondents' answers about some uses of mobile technology are similar to those suggested by Sharples et al. [8]. These are: Use them for educational purposes, downloading of study materials, practical classes, research purposes, storage of study materials as soft copies, communication via email and e-learning.

Most students believe that the use of mobile technology coupled with educational software and some rules can be effective in classrooms. This is in agreement with Schachter [23] and Jimmy's [24] thinking that smartphones by themselves represent only half of the requirements for using this new technological platform in the cla.

One important limitation of the study was the size sample and thus these findings are applicable to a particular group and context and cannot be generalized.

4 Conclusion

This case study at IUM in Namibia, a developing country, confirmed research that almost all students possess a mobile device and would not mind using it for educational purposes more than they already doing. This implies IUM does not need to supply such equipment. Using mobile technology it can augment the teaching and learning situation and it is relatively an inexpensive educational tool. It was also established that it can have a sequential effect. If a student likes and knows how to use that form of technology, the more (s)he uses it and the more (s)he benefits in his/her studies, the greater the motivation and persistence to succeed. Depending on how the lecturer uses that tool it can increase student engagement which is a recognized factor that contributes to academic success.

Students do not necessarily need learning managements systems to collaborate as the mobile device has sufficient tool/apps to enhance collaborative learning. What was of a kind of surprise is that a few students that did not own a mobile device they were keen to use them as they saw value. It is true that such devices can be used anywhere anytime and can carry 'their books' in it obviously provided there is reception.

Finally the results showed that mobile devices can have a positive impact on the students' academic success.

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Making Neuroscience Important and Relevant: Online Learning in an Innovative Bachelor of Dementia Care Program

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Abstract. Neuroscience is an important component of STEM disciplines and fundamental to understanding dementia, a growing worldwide public health issue. Understanding the neuropathology and clinical manifestations of dementia is important for those who need to provide effective daily care for adults with dementia. Dementia care workers form a non-traditional student cohort and the Wicking Dementia Research and Education Centre at the University of Tasmania (Australia) has developed a fully online Bachelor of Dementia Care degree to facilitate their educational and professional development. This paper documents the success of 65 adult learners as they completed four neuroscience units in the degree. Adult learners with no previous university experience performed similarly to those with university experience suggesting that this unique online degree is appropriately designed for students with limited educational backgrounds. Analysis of students' comments on the impact of their neuroscience learning indicated increased understanding and confidence in the care they provided.

Keywords: Dementia · Effective care · Neuroscience · Neuropathology · Online learning

1 Introduction

Neuroscience, the study of healthy and disease-related brain function, is an important component of the challenging academic Science, Technology, Engineering, and Mathematics (STEM) disciplines. Knowledge of neuroscience has many applications but is particularly relevant to understanding dementia, a progressive, neurological, age-related, and life-limiting condition. As the number of people aged 65 years and over increases rapidly worldwide, dementia is becoming a global public health issue [1–4]. To address this issue, there is a need for society to be offered quality education about ageing and age-related diseases such as dementia. This education is particularly important for people who provide daily care to adults with dementia. Care workers

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need to understand what is changing in the brains of people with dementia and how these changes are reflected in the adults' cognitive decline and altered behaviour. This understanding is integral to effective person-centred care.

People who provide dementia care are often of mature age, with lower-level qualifications, working in lower-level positions with limited opportunities for advancement, and frequently managing additional, family-related, responsibilities [5]. Typically, these workers, many of whom are women, are not required to have experience or formal qualifications to work with adults with dementia [6–8]. Consequently, their knowledge of dementia and approaches to care is limited [9]. Thus, these care workers form an important non-traditional student cohort for whom knowledge of neuroscience would potentially benefit their provision of effective care.

Online learning provides this non-traditional student cohort with the opportunity to learn about neuroscience [6, 10]. Online learning for these students needs to be flexible, yet structured, with clear learning expectations to reassure and support those who are new to higher education [11]. The learning environment needs to promote active, problem-based, and meaningful learning, comfort with technology, a sense of psychological safety, interest in academic writing, and engagement with others [12–15]. Successful online learning for these students also needs to be supported institutionally with easy access to learning materials, even spacing of assessments across a semester, and timely and in-depth feedback to enable ongoing self-reflection [16]. The purpose of the current paper is to outline the innovative, fully online Bachelor of Dementia Care (BDC) degree program that has been developed by the University of Tasmania (Australia) specifically for this non-traditional student cohort and to detail the neuroscience learning of 65 students as they progress through the degree. Three research questions were posed to explore the impact of the neuroscience units within the BDC on these students' learning:

(1) How successfully has this cohort of 65 students completed each neuroscience unit in their two years of study?
(2) Did students with previous university experience receive higher grades in the neuroscience units compared to students without prior university experience?
(3) Has students' learning in neuroscience units had a positive impact on their work with, or understanding of, people with dementia?

2 The Online Bachelor of Dementia Care (BDC) Degree

This program began as a blended delivery Associate degree in 2012 and transitioned to a fully online Bachelor degree in 2013 with students exposed to a diverse set of technological tools and resources across the learning modules. It is open to any student but is designed for adults employed in aged care who are providing care for people with dementia. The learning pathway is premised on full-time study, i.e., enrolment in four units (courses) per semester. However, part-time enrolment is welcomed and frequently is the most practical approach for students who are also in employment. If students are new to university study, they complete a series of preparatory foundation units, one of which focuses on neuroscience. Then, over the three years of the degree, all students complete 24 units (20 required and 4 elective) in two streams: (a) Models of Healthcare, and (b) Understanding Dementia, which includes the neuroscience of dementia. Each unit is 12–13 weeks in length, fully online and characterised by evidence-based techniques to facilitate the learning of non-traditional students [11–17]. Multiple assessments are offered within each unit. These include case-based reports, quizzes, short answer questions, essays, live presentations online, creative design opportunities (e.g., poster presentations), and participation in interactive discussion boards. There are no traditional examinations. If students have completed tertiary level studies, or have demonstrated professional skills, they can apply for Recognition of Prior Learning (RPL) equivalency for any relevant unit.

Five of the 20 required units focus on neuroscience, four of which are core units that increase in complexity from a foundation to an advanced level. The fifth unit began in 2015 and, as of this submission, has not yet concluded. The learning outcomes of these units are to develop students' (a) knowledge of the neuropathology of dementia and how it presents clinically across the trajectory of the condition, and (b) ability to critically evaluate the science behind approaches to care to optimise the health and quality of life of people with dementia. The first students to complete this degree will graduate at the end of 2015. For this paper, the focus is on data from a cohort of students who began the course in 2012, where they took foundation units, through to their completion of a second year neuroscience unit, CAD201: *The Biology of Ageing and Dementia*, in 2014.

3 Methods

Participants. Sixty-five (76 %) of the 86 students who completed the CAD201 unit gave their informed consent for the study. All resided in Australia with the majority from the states of Tasmania and New South Wales (Tasmania = 31; New South Wales = 23; South Australia = 5; Victoria = 2; no state listed = 4). Most were female and over the age of 40 (20–30 years = 6[9 %]; 31–40 years = 9[14 %]; 41–50 years = 19[29 %]; 51–60 years = 30[46 %]; 61 + years = 1[1 %]). Nearly all (94 %) were working: 40 (62 %) full-time and 21 (32 %) part-time, with 56 (86 %) working with adults with dementia. Their level of education varied: 21 (32 %) had completed a university degree, 10 (15 %) had completed some university studies but not a degree, and 34 (52 %) had completed high school but had not previously studied at a university or tertiary level. Together, these students formed two groups: experience with university study (n = 34; 52 %) and no experience with university study (n = 31; 48 %). In addition to English, 12 students spoke either French, German, Greek, Japanese, and/or Mandarin.

Assessments. Two sets of data were documented to measure students' learning:

(i) Grades for each completed neuroscience unit, and
(ii) Ranked thematic responses to an open-ended question, *How has your understanding of dementia changed as a result of completing this unit?,* to document the impact of the most advanced neuroscience unit to date (CAD201) on their learning.

Procedures. The grades of the students who agreed to participate and their demographic data were documented and the files were de-identified.

Data analysis. The dependent variables in this study were the four completed neuroscience units: CAD004, CAD101, CAD110, and CAD201. The independent variable was experience or no experience with university-level study. Students' data were entered into an SPSS program Version 22.0 for Windows, for analysis. As the data were not normally distributed within each unit, non-parametric Mann-Whitney *U* tests were run to identify any differences in academic performance between those who had prior university experience compared to those who did not. Responses to the open-ended question were collated into a text document and analysed using the qualitative computational linguistics program, Leximancer [6, 18]. This program identifies key terms from the uploaded text and derives word-related concepts and overarching themes; then ranks, by percentage, the most important themes, relative to one another.

4 Results

The neuroscience units offered in the degree program were initiated in 2013. The number of students who have completed them to date are presented in Table 1. All 65 students in this study completed the four neuroscience units over a 15 month period in 2013–2014. Seventeen students received RPL equivalency for CAD004 and this resulted in the smaller number of 48 students in this unit. CAD110 was an elective unit which 18 of the 65 students completed.

Table 1. Number of students enrolled in neuroscience units 2013–2015.

Unit	Year of enrolment		
	2013	2014	2015
CAD004: Neurospeak – Understanding the Nervous System	297 (2 deliveries)	416 (3 deliveries)	172 (1 delivery)
CAD101: Introduction to Ageing, the Brain, and Dementia	160 (1 delivery)	293 (2 deliveries)	251 (1 delivery)
CAD110: Negotiated Studies in Understanding Dementia (elective)	299 (1 delivery)	412 (1 delivery)	258 (1 delivery)
CAD201: The Biology of Ageing and Dementia	–	86 (1 delivery)	137 (1 delivery)
CAD301: Neuroscience Research in Dementia	–	–	41 (1 delivery)
Total	756	1293	859

Note. CAD301 was offered for the first time in 2015 (February–May). Thirty-seven of the 65 students in the study cohort are currently enrolled.

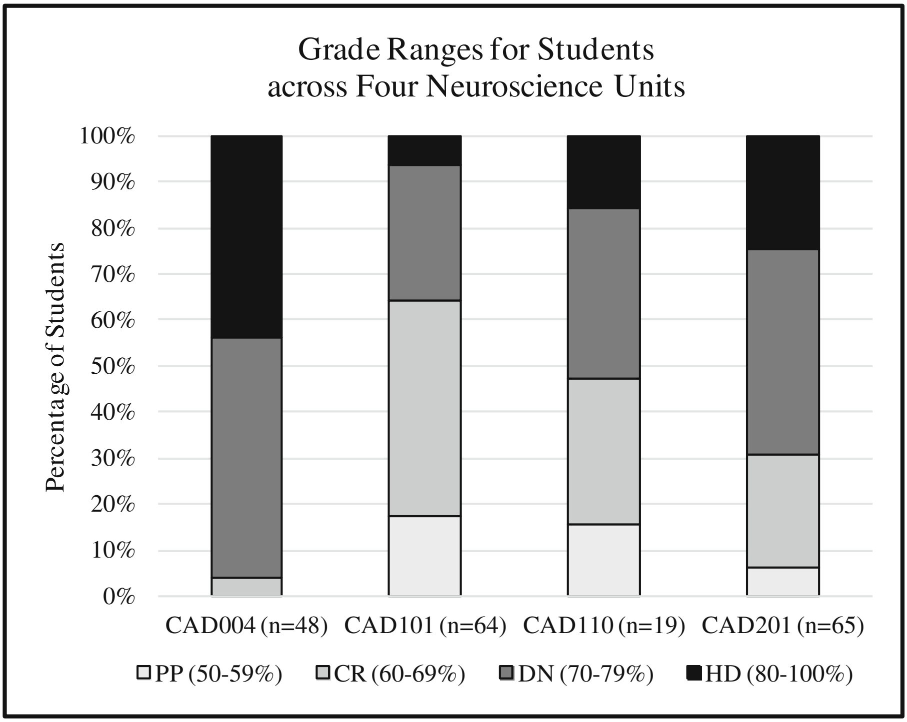

Fig. 1. Comparison of students' grades in four neuroscience units in order of completion and increasing complexity by year.

All of the 65 students received at least a passing grade for the four neuroscience units with the majority achieving a credit-level grade or higher for each unit. There was a trend for increasing achievement as the complexity of the neuroscience content increased from year 1 units to year 2 (Fig. 1). Students with university experience scored significantly higher than students with no university experience in CAD101 (U = 357.50, p = 0.04; Cohen's d = 0.51); there was a trend in the same direction toward significance in CAD201 (p = 0.07). However, the mean scores for both groups of students were within the same grade band, i.e., both groups of students in CAD101 received an average score between 60 % and 69 % equating to a credit grade; both groups of students in CAD201 received an average score between 70 and 79 % equating to a distinction grade (Table 2).

All 65 participants responded when asked about the impact of CAD201 on their learning. The Leximancer analysis of their comments identified four themes: improved care (29 %), increased understanding (28 %), increased knowledge (23 %), and increased confidence in their work (20 %). These themes are reflected in the comments that follow Fig. 1.

The more I learn the more relaxed and confident I am in my approach. Having the knowledge and understanding of the different functions of the brain gives me a better understanding of why people with dementia behave the way they do. This increased knowledge helps my care which

Table 2. Effect of previous university experience on students' grades in four neuroscience units.

	n	Mean±*SD*	Mean Rank	Mean Grade Band	*U*	Sig.
CAD004						
All students	48	79.31±5.31				
Univ. experience:						
Yes	15	79.93±4.79	25.87		227.00	0.65
No	33	79.03±5.58	23.88			
CAD101						
All students	64	66.16±8.86				
Univ. experience						
Yes	30	68.50±8.23	37.58	Credit	357.50	0.04*
No	34	64.09±8.99	28.01	(60-69%)		
CAD110						
All students	19	69.63±8.52				
Univ. experience						
Yes	9	70.67±9.76	10.83		37.50	0.54
No	10	68.70±7.65	9.25			
CAD201						
All students	65	73.26±8.53				
Univ. experience						
Yes	31	75.35±8.05	37.40	Distinction	390.50	0.07
No	34	71.35±8.63	28.99	(70-79%)		

SD = standard deviation; *$p \leq 0.05$. Mean grade bands are included only for the units with a significant difference, or trend, between the two groups of students.

has changed dramatically. I see dementia differently and I find myself taking more notice of small differences and changes in the residents. More knowledge has enabled my inclusion and advice in some areas and this has meant that I have more input in my workplace. I would absolutely love to be involved in dementia research at some stage in the future and this unit has provided me with a solid foundation to look further into this possibility.

The greater understanding I am developing around the trajectory of dementia has impacted the care I deliver for residents with dementia living in our facility. I work in a supervisory/management position and therefore I have the ability (albeit limited at times) to influence change.

Having a better understanding of what the changes are in the brain and how this is reflected physically and cognitively helps to better tailor physiotherapy (my profession) for people with dementia and whether they are capable of doing exercises or if massage or another modality would be more appropriate.

I now have a greater understanding of, and time for, those with dementia. Their brain works very differently than ours and knowing this has allowed me to be more aware and able to share this with others. Understanding more about the biomarkers in the neuropathology of dementia has also helped me to communicate better with doctors.

I am now able to recognise the triggers of many more behaviours that I previously had little comprehension of. I find myself talking more about issues of dementia with colleagues at work either from a research point of view or a TV or newspaper article we may have covered or discussed. This in itself gets people talking and thinking and reflecting on how to improve and change the way we care for people living with dementia.

I now have a much deeper understanding of changes in the brain and resulting effects on function. I think it's important for those employed in aged care to understand that dementia is not just one disease and people are affected very differently depending on the type of dementia they are diagnosed with. This is essential knowledge for us to be able to tailor our approaches to care.

5 Discussion

In response to question 1, all 65 students successfully completed the four neuroscience units in this study, achieving a passing grade or higher. In response to question 2, mean scores were comparable in three out of the four neuroscience units between students with and without prior university experience. Although there was a statistically significant difference in one unit, the average scores for students fell within the same grade band. This suggests that students with no prior academic experience performed at a similar level to their counterparts with prior university experience. Further, this indicates that, for this student cohort, the online teaching of dementia-related neuroscience was effective and the unique online degree is appropriately designed with scaffolded learning to support non-traditional students with limited educational backgrounds [11–16].

In response to question 3, students' comments reflected their positive experience in applying their learning from the neuroscience units to their work with, and understanding of, people with dementia. These comments demonstrated their increased knowledge of the neuropathology of dementia, how it presents clinically across the trajectory of the condition, and how alterations in the brain are reflected in changes in adults' cognitive ability and behaviour. Qualitatively, this increased knowledge positively affected students' ability to critically evaluate the science behind approaches to care, and use evidence-based approaches to optimise the health and quality of life of people with dementia. Such results confirm the value of this e-learning Bachelor of Dementia Care initiative in its innovative support of non-traditional students, facilitation of their understanding of neuroscience, and continued educational and professional development in the care of adults with dementia.

6 Conclusion

This study addresses the importance of providing quality education in neuroscience to people who provide daily care for adults with dementia. Neuroscience is fundamental to understanding the alterations that occur in the brain with dementia and the cognitive decline and changes in behaviour that follow. The neuroscience units offered in the innovative, fully online Bachelor of Dementia Care degree were completed successfully by all students in the study cohort and students' comments confirmed their increased understanding of the importance and relevance of neuroscience to their provision of effective dementia care.

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E-learning Project Assessment Using Learners' Topic in Social Media

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Abstract. A correct assessment of e-learning projects is a complex task because there are several aspects (such as contents, technologies, organizations etc.) that must be considered and many actors (learners, teachers, pedagogues, etc.) each one with specific requirements to be met. In recent years, in order to standardize the evaluation and to define the quality features of an e-learning project, several sets of factors (called Critical Success Factors) have been defined. The Critical Success Factors are focused on many aspects but, in our vision, they don't consider properly the learners' opinions. The learner is exactly the main e-learning project stakeholder. Thus, he/she could be considered at the centre of the e-learning system and his/her opinions must be carefully evaluated. In this paper, we describe our idea to support the analysis of the learners' discussions posted on the web2.0 media (like forums, wikis, etc.) and to support the subsequent evaluation of the lacks and the benefits of e-learning projects.

Keywords: E-learning · Unstructured sources · Knowledge extraction · Social media

1 Introduction

E-learning can be viewed as the delivery of course contents via electronic media, such as Internet, satellite broadcast, interactive TV, etc. [1]. E-learning is one of the new learning trends that challenge the traditional "bucket theory" or the banking concept of education [2]. If the economic assessment of e-learning project is quite simple, it is really difficult to evaluate its efficacy because there are many parameters that must be considered. The quality of the e-learning is related not only to the quality of its contents but also to the usability of the system, to the organization, etc. A right evaluation has to consider:

- General Information and Accessibility: at the beginning of the course, learners must be informed correctly with general information that will support them in completing the course and in understanding the objectives and the procedures of the course. Moreover, the learners must find information quickly and must have easily access to the course material;

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- Organization: it is referred to the organization of the course content;
- Language: it evaluates the language appropriateness for the audience;
- Layout: a layout of good quality can facilitate the learning process. It is important to evaluate the attractive material for the course content;
- Goals and Objectives: the goals and the objectives are provided to outline learning expectations at the beginning of the course and of each module.
- Course Content: the contents are the core elements of the course; thus, it is important that they are appropriate according to the subject matter and the learners' background and abilities;
- Instructional or Learning Strategies and Opportunities for Practice and Transfer: the instructional or learning strategies enable the course participants to learn effectively in a variety of ways and to engage them in activities that promote the practice and the transfer of skills;
- Learning Resources: it is referred to the learning resources that should be accessible, appropriate, and accurate;
- Evaluation: the evaluation activities should be feasible, relevant, accurate, and compliant with the objectives, the contents, and the practical applications of the content.

In addition to the above parameters, it is really important to consider the overall aspects related to the evidence that the course has been piloted and that the learners can achieve the objectives of the course.

The evaluation of an e-learning project is still an open issue. In many cases, internal and external reviewers provide the assessment of the courses but the evaluation is strictly related to their experience and their expertise. Thus, in literature many approaches and assessment methodologies are defined. These approaches are related to the organizational aspects and the contents of the course but the opinions of the participants are considered only marginally. In our view the success of e-learning courses is closely related to the participants' satisfaction, considering that the e-learning systems are defined and developed according to the specific needs of the learners.

In this paper we propose a first step in the evaluation of e-learning projects based on the learners' topic posted on the social media. To develop this idea we use a software tool that is able to identify any positive or negative trend analysing the posts that the learners leave in the forum or in the wiki of the e-learning portal.

In the following, Sect. 2 describes the related works regarding the approaches and the assessment methodologies defined in literature. Section 3 illustrates the idea we propose in order to support the e-learning project evaluation. Section 4 describes the system development and implementation. Finally, in Sect. 5 we show the conclusions.

2 Related Works

In many cases the e-learning term is used as synonymous with web-based learning (WBL), web-based instruction (WBI), advanced distributed learning (ADL), online learning (OL) [3]. The term Critical Success Factor (CSF) describes "those things that must be done if a company is to be successful" [4]. It is possible to apply the idea of

CSF to the e-learning area. Papp [5] proposes a set of critical success factors for faculties and universities: intellectual property, suitability of the course for e-learning environment, building of the e-learning project, e-learning project content, e-learning project maintenance, e-learning platform and measuring of the success of an e-learning project. Mainwhile, Benigno and Trentin [6] proposed an evaluation system focusing on the learning aspects and evaluating the students' performances. They considered factors such as students' characteristics, effective support, student–student interaction, learning environment, learning materials, and information technology. On the basis of a survey submitted to 47 students, Volery and Lord [7] identify three groups of CSFs: technology (ease of access, interface design and level of interaction); instructor (attitudes towards students, instructor technical competence and classroom interaction); and previous use of technology from a student's perspective. In the same time, Soong and others [8] propose the following e-learning CSFs: human factors, technical competency of both instructor and student, level of collaboration, and perceived information technology infrastructure.

Dillon and Guawardena [9] and Leidner and Jarvenpaa [10] define three main variables that affect the effectiveness of e-learning environments: technology, instructor characteristics, and students' characteristics. Govindasamy [11] focused on the pedagogical aspects and defined seven CSFs: institutional support, teaching and learning, course development, course structure, faculty support, student support, evaluation and assessment. Baylor and Ritchie [12] studied the impact of seven independent factors related to educational technology (planning, leadership, curriculum alignment, professional development, technology use, instructor openness to change, and instructor computer use outside school) on the dependent measures (instructor's technology competency, instructor's technology integration, instructor morale, impact on students' content acquisition, and higher order thinking skills acquisition).

Focusing on the role of the student and considering that the learner's satisfaction is one of the most important CSF to evaluate the effectiveness of the e-learning project, we propose a first step towards a new approach. Our approach considers the learner at the centre of a complex system and bases the evaluation of the e-learning project through the analyses of the lacks and of the goodness that emerge from the learners post on the web2.0 pages related to the course. The idea to use information extracted from the social networking to improve the quality of the e-learning project is not new. Kadry [13] explores the role of web2.0 technologies in learning and their influence on the learner's behaviour. While Mahmood [14] studies how e-learning systems can improve their performances using Social Network Features. On this basis, we want to use the web2.0 technologies to evaluate the weaknesses and the strengths of a course through the learners' posts and discussions.

3 How to Support E-learning Project Evaluation

The idea described in this paper has the aim to support the e-learning project evaluation using the web2.0 unstructured data in order to analyse the perception of the learners and of the other actors involved in the project (teachers, pedagogues, etc.). It is clear that the achieved information will allow improving the course organization. In the web, the learners express their opinions about something in a free form way and without any constraints. Thus, collecting unstructured sources, making them structured and extracting the hidden information, it is possible to obtain real perception of the e-learning project. As a consequence, improving the e-learning projects starting from this information means to really put in the centre of the attention the key stakeholders: the learners. In our approach, a key role is assumed by the domain knowledge base. In effect, the use of a knowledge base simplifies the comparison of the information present in the web with the information of the specific e-learning domain. Thus, the extraction, from unstructured sources, of the information related to the specific e-learning project is easier. Since there are several knowledge bases about the e-learning domain, it is very important to select the knowledge base the most suitable for the specific e-learning project in order to support the evaluation. In the next section a specific knowledge base will be proposed.

We have developed the idea using a tool realized for the agri-food sector and presented in [15, 16]. The system is able to analyse and to extract information related to specific agri-food products from the users' experiences posted on blogs and social networks. The obtained information can be used for many purposes such as marketing information (which product is more interesting for the customer?) or commercial information (what geographical zone is interesting for the product?).

It is clear that in order to use the already proposed tool in the e-learning context it is important to:

- Identify the source of information: in the e-learning context, the unstructured data are in the e-learning platform and/or in the specific "virtual place" where learners have access. It is important to know where sources are available.
- Define the connection between the information shared in the "virtual place" and the e-learning project.
- Develop a domain knowledge base in order to filter the information not associated with the specific e-learning scenario along with to suggest other concepts related to the exploration.

The output of the system will be:

- The lists of the items the most discussed by the users that take part to the e-learning projects: these items will be organized in a way as clear as possible for the reader.
- Information about how students and teachers talk about these items (for instance in positive or negative way);
- Suggestions, which help the domain expert to find interesting items he/she might not have discovered by himself/herself [17] both attractive and unexpected.

The output of the software will be more precise if a domain expert will interact with the software in order to propose the unstructured data to analyse and to refine the research starting from those obtained. To help in this software-expert dialogue, the software implements the PDCA (Plan-Do-Check-Act) cycle defined in the Fig. 1.

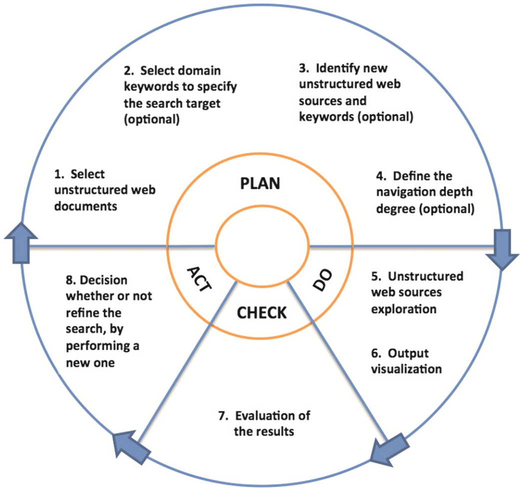

Fig. 1. PDCA cycle for information extraction

In order to support the PDCA cycle the software helps in the:

1. Suggestion of unstructured web sources in order to extract relevant information from them;
2. Suggestion of domain keywords (for instance representing the critical and the success factors of e-learning projects) that the domain expert can use in order to specify the target of the search;
3. Add and allow the analysis of the new unstructured documents and keywords;
4. Define the navigation depth degree within the document pages;
5. Explore unstructured web sources in order to extract significant information. This phase is supported by the use of the selected keywords and of the domain knowledge base;
6. Visualization of output in tabular or graphical form;
7. Support in the evaluation of the results by the domain expert;
8. Support in the research refinement by performing a new exploration.

4 System Development and Implementation

The software operation flow is characterized by a preliminary identification phase of unstructured web sources from which to extract information. They are in the e-learning platform and/or in "virtual places" like wikis, blogs, forums, tweets, etc. and contain the comments along with the discussions of the students and the teachers that take or have taken part to the e-learning project.

These documents can be classified by type (i.e. wikis, blogs, social pages, etc.) and geographical reference (i.e. Southern Italy, Northern Italy, etc.). So, we have searched, identified and inserted in the system database the web addresses of pages and documents of some interesting web sources (Fig. 2).

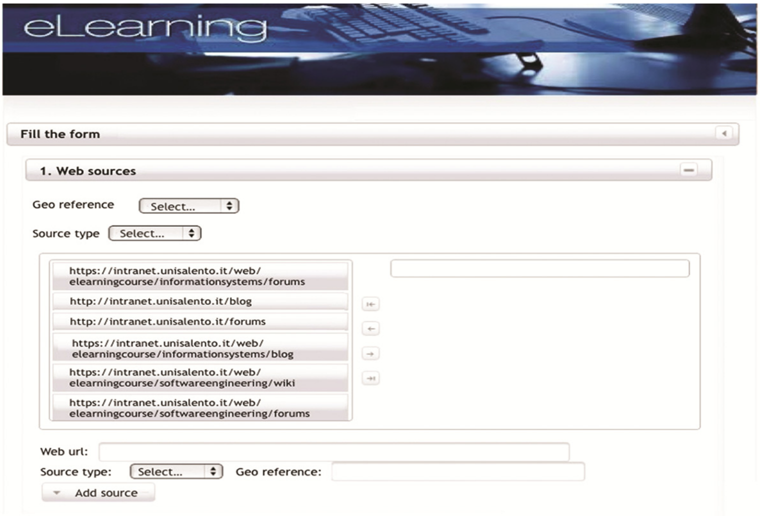

Fig. 2. Web source selection and insert form within the tool web page

In order to retrieve information to improve the assessment of the goodness and the weaknesses of an e-learning project, the content of these unstructured web sources must be structured and cleaned from data not compliant with the specific domain. In this regard, a valid contribution is offered by the use of conceptual modelling that is the definition of domain knowledge bases (often called ontologies) from scratch or from existing ones. In general an ontology is a formal, explicit specification of a shared conceptualization [18].

We have performed a scouting on already defined e-learning knowledge bases that has led to the selection of the ontology shown in Fig. 3. It seemed to be more complete and rich of concepts than the other ontologies found. It has been searched through the tool *Swoogle* [19]. It is a search engine for the semantic web that crawls the web for a special class of web documents called Semantic Web Documents. As said by Sridevi and Umarani [20], even though there are numbers of semantic web search engines, *Swoogle* is placed first, because it ranks the ontologies using an adaptation of the Google Page Rank scoring method.

We have also identified and inserted in the system database the main concepts related to the e-learning domain, that are the critical success factors.

The content elaboration starts from the selection, by the domain expert, of one or more unstructured web sources and, optionally, of one or more keywords, followed by an indication of the navigation depth degree.

At the end of the data processing phase, the software can generate different outputs: A tag cloud, that is a visual representation of concepts the most relevant in relation with the processed documents, the knowledge base concepts and the keywords, if selected. The relevance of a concept is estimated according to the total occurrence within all the analysed web sources and the relative occurrence within each examined document. Another output is a tabular representation with detailed information about concept occurrence in each unstructured web source and about the concepts detected in the same documents.

Fig. 3. e-learning project tag cloud within the tool web page

In order to get the representation in the form of a tag cloud, the system examines the selected web sources, interrogates the knowledge base (for example the rdf file available at http://jelenajovanovic.net/ontologies/loco/user-model.rdf), checks whether it is possible to obtain other concepts semantically related to the search along with discards the information not connected to the e-learning project. Then, the software tool extracts for each web source the concepts the most recurrent in the analysed web sources and calculates the number of occurrences in the text, which are graphically represented by different font size (Fig. 3).

5 Conclusions

The evaluation of the effectiveness of e-learning projects and of the achievement of its goals and objectives is a good practice in order to understand advantages and disadvantages along with strengths and weaknesses of an e-learning project. Thus, many set of critical success factors like contents, technologies, etc. are defined; but, in our opinion, the learners and teachers' point of view must be relevant. This could be done analysing the participants and teachers' comments and the discussions posted in the e-learning platform and in the "virtual places" related to the e-learning projects.

The presented idea focuses on the unstructured information that are analysed through a specific ontology using a tool realized for the agri-food sector. In detail, the system is able to analyse and to extract relevant information related to a specific domain from the users' experience posted on blogs, wikis, social networks, etc. Because of the free form characteristic of web2.0 pages, the system interacts with an e-learning knowledge base in order to not consider the information unrelated to the specific domain. In spite of the subjective opinion of the involved actors, the extracted information about the course is objective because is based on a large number of posts.

As a result the system provides a structuring of unstructured information extracted from the web and a support to the e-learning domain expert in order to identify the goodness and the weaknesses of e-learning projects.

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Enhancing Student Support with a Virtual Assistant

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Abstract. Effective student support can be seen as a key element in enhancing students' learning experience and has the potential to improve retention, progression and student achievement. The purpose of this research was to investigate student responses to the idea of using an avatar-based virtual support system and to develop such a system for piloting in a specific university service. A survey was conducted to establish the perceived need for such a system. A prototype system was then implemented in a limited domain, namely student employability and a further survey was conducted to obtain feedback from potential users as to its efficacy. This was generally positive and our intention is now to roll out the system across other university services.

Keywords: Virtual support · Avatar · Rule-based system

1 Introduction

Effective student support can be vital to progression rates and overall achievement of students [1, 2]. In the university environment, for a typical student, the support role does not rest with a single individual. A student may have a personal tutor, who is the first port of call for issues concerned with their academic progress, and who might refer the student to others to deal with non-academic issues. These others might include counsellors, placement officers, examination officers, accommodation officers etc., each of whom can assume the support role in their specific context. We investigated the desirability of automating this support role, with a view to providing higher quality interaction with university services at times when face-to-face support was not available, through the use of a Virtual Assistant (VA).

For the pilot study, we developed a prototype system to assist with one highly specific support role; that of the university employability service, which advises students on job applications, CV writing, interview technique etc. If successful, the intention was to roll out the system to other academic and non-academic support roles.

Typically, most university services are accessed in the first instance via web pages. There is usually a great volume of static information, together with a few dynamic pages for making appointments or similar. Students often have difficulty in finding the answer to a specific question when trying to navigate these pages [3, 4]. In today's world, students need to access university services at any time of day, and person to person contact is not always possible. In these circumstances, it would clearly be desirable for

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there to be some kind of artificial agent that could conduct a similar dialogue to guide the student to the required information. A number of rule-based text-dialogue systems have been developed and it is possible to combine these with text-to-speech avatar-based interfaces to provide a facsimile of the ideal human-to-human dialogue. The benefits of using a VA include constant availability and the use of natural language communication to provide answers to queries or guide the student towards relevant information.

2 Related Work

Studies have been carried out by a number of different research groups on the use of intelligent virtual systems, some of which cover use in higher education for student support. Augusto, McNair, McCullagh and Roberts [5] explored the idea of providing virtual mentoring for students at the University of Ulster. Whilst the outcome was limited, the potential for further development was acknowledged. Intelligent agent based systems have also been piloted to support students in the learning of programming languages [6, 7].

The University of Granada [3] developed a virtual assistant for their university website, to provide help for users in finding "not only the information that they are looking for, but also some related information which could be of the highest interest". Their argument was that users often waste time looking through websites when using traditional menu or keyboard methods. Their findings, based on six months use of a virtual assistant, were very promising, but the team acknowledged that further work was required, including addressing the issue of the virtual assistant's facial expressions.

An avatar can represent a tutor or an instructor who will guide learners through the materials [8]. A study carried out by Mazlan and Bird [9] investigated whether the use of avatars in online learning settings could motivate students. The results of the study indicated that the "students expressed positive interest in avatars and their motivation to learn".

Use of avatars in health-related work has been considered in a number of studies. Kim and Sundar [8] investigated whether the use of avatars could improve a person's self-image. The findings indicated that for those with highly discrepant self-image, a virtual avatar could become 'more of a motivating force' and could have a positive influence on their behaviour in the real world.

Similar research on self-image by Peña and Kim [10] focused on avatars as part of 'exergames' (video games for exercise; virtual tennis in this case). The study experimented with manipulating the participants' weight from slim to normal to obese to see if this had an effect on their physical performance as they played. They demonstrated that participants increased their physical output when both players' weights were kept normal, but play slowed down and was 'sluggish' when they were made obese. They concluded that "traditional psychological processes can be put to the service of increasing physical exercising and hopefully improving people's well-being through virtual experiences."

The literature provides a number of different descriptions of what is understood by the term 'agent' or 'avatar'. For example, [11] states "an agent is defined as an acting entity, which includes artificial intelligence that renders the control. An avatar, by contrast, is a virtual representation of a human being which is controlled completely by the human." We could describe an avatar as a computerized representation of a character representing a user in another environment. Avatars are used extensively in many computer games, where an avatar character can be controlled by the user.

Studies have been conducted on how people react to agents and avatars, in an attempt to establish why users have a social reaction towards them regardless of the knowledge that they are conversing with a machine. [11, 12] investigated the nature of the changes in people's communication when they interact with intelligent agents, as compared to human-to-human communication.

Cafaro et al. [13] found that "in first encounters people quickly form impressions of each other's personality and interpersonal attitude." They found that even when one of the participants was a virtual agent, it took an average of only 12.5 s for subjects to form an impression. In other words, they reacted to the agent in a similar manner as they would to another human.

According to Baylor [14], the nature of the agent interface does not have much direct impact on actual learning, but does have a positive effect on learner motivation and self-efficacy. Baylor's study discusses the design of agents and the importance of the agent's visual appearance as "the most important design feature as it dictates the learner's perception of the agent as a virtual social model, in the Bandurian sense". Another key feature proposed is "message delivery through a human-like voice with appropriate and relevant emotional expressions".

The Microsoft Office agent 'Clippit' was introduced in the 1990s [3, 15]. This character was intended to act as the users' personal assistant by speaking and acting on voice commands. It was generally seen as being too intrusive and rather 'characterless'. Although users' unfamiliarity with the technology at the time might have been a factor in this, it may be noted that a personal agent will fail if user expectations are not met.

Some rapid advances have been made in technology in recent years, but many challenges remain and one of these is the use of natural language with agents; this requires in-depth understanding of linguistics and semantics in order to create a truly intelligent system [3]. Siri, the voice recognition app and intelligent digital assistant from Apple, uses natural language to help users to find answers to their queries. While Siri's launch caused much excitement, this soon deteriorated when Siri's limited intelligence became apparent.

When an avatar, as part an intelligent system, can engage in conversation with a human being it can be described as an Embodied Conversational Agent (ECA). Cassell [16] states that "Embodied conversational agent interfaces are specifically conversational in their behaviors and specifically humanlike in the way they use their bodies in conversation". As an example of an ECA, Cassell's creation, REA (Real Estate Agent) acts as a salesperson interacting with clients and showing or selling them virtual properties. REA can also engage in 'subtle human like conversation' with clients at appropriate times and use such phrases as 'I see' to indicate agreement with a client or that she is listening. These may appear to be simple features, but human conversation is extremely challenging to model in a computer system and this system required lot of sensors and computational resources to function [3].

3 Research Methodology and Analysis of the Need for a VA

To establish the extent of the perceived need for a virtual assistant, we needed to gather quantitative data on the nature of students' interaction with existing support staff, and also to target a particular university service to obtain the opinions of members of support staff as to the potential value of a virtual assistant system. We chose to use a questionnaire to gather the student data, as it would have taken considerable time to gather data by interviews and the qualitative nature of such data might have skewed the perception gained. For consistency and quantification, the questionnaire contained only closed questions. Aspects explored by the questionnaire included the frequency of contact, the nature of the students' queries, the modes of contact, i.e. face to face, online etc. and the quality of the students' interactions with services. We also sought students' opinions as to whether they would be likely to use a VA for out-of-hours assistance.

The survey was carried out with 125 students from the School of Science and Technology at Middlesex University. The questionnaire was given to students at foundation level (FY), first year (Y1), second year (Y2) and third year (Y3) undergraduate level. Some of the findings were as follows.

The survey showed that students need to contact their tutors most often at FY and least often in Y2. Most students found they needed to contact their tutors frequently throughout the year. The majority of tutors responded to student queries within two days. The main reason for students contacting tutors was for academic issues, although 30 % of the Y1 students contacted their tutors for non-academic issues. The survey confirmed that students regularly accessed online support facilities.

Surprisingly, students had almost no interest in using contact via phone or social media, which contradicts the findings in [2]. Based on our survey, students currently prefer communicating with tutors face-to-face and by email.

A significant proportion of students at all levels stated that it was likely they would contact tutors outside teaching hours. There is a possibility that students have misinterpreted this question; we consider teaching hours to be normal working hours, whereas students may have interpreted this as time outside the classroom. However, the data did suggest that students value the opportunity to contact their tutors at any time.

The survey established that students require support on all aspect of their studies, from general administrative issues to pastoral and academic queries. Whilst students value face-to-face communication and support, they also now expect round the clock support [1]. Students responded very positively when asked how likely they would be to use an online tool such as a Virtual Support Assistant. Almost 80 % of students responded that they would be (quite likely to very likely) to use such a tool. It appears that students value direct contact with tutors (either face to face or by email) for academic matters, but would also value the additional support provided by a VA.

There is evidence [17] that students prefer information provided via the spoken word to written information. Of course, the best way to achieve this is by person-to-person communication. Recorded audio can provide the personal touch but no body language, gestures etc. Recorded video provides the element of body language, but neither audio nor video recordings allow the possibility of interaction to guide the user towards the desired results. An avatar-based system does not have the personal touch, but provides another dimension beyond plain text and facilitates a personalized dialogue.

4 Virtual Assistant Support System

The VA was designed to be a web based application (Fig. 1) that can be accessed 24/7 by staff and students. The system was programmed to interact dynamically with the user and to provide answers to context-specific questions. The web site layout is based on an accordion style menu. The VA is in the form of an avatar that interacts with the user in both text and speech.

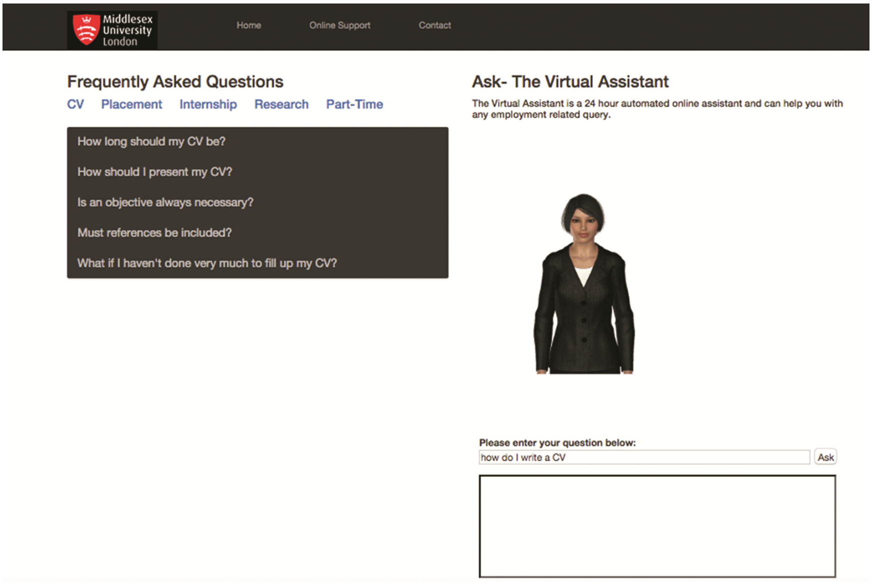

Fig. 1. Virtual Assistant Interface

To achieve the above a combination of applications were used:

- Character Hosting from Media Semantics
- Program-O
- HTML - Hyper Link Markup Language
- AIML - Artificial Intelligence Markup language
- XAMPP to build the system on a localhost

Character Hosting was used to create and customise the avatar, its voice and accent, and add animations. Program-O has its own AIML interpreter, which was used to interpret the rules for user interaction with the avatar. It is coded in PHP and has an inbuilt relational database that can be used to store the interaction between the user and avatar. These can then be retrieved and analysed by the programmer in order to improve the responses and also provide the user with a log of their conversation. AIML code was used to enter the rules for topic-specific questions from the user and provide the knowledge base for the responses.

As mentioned earlier, the university agency targeted was the employability service, and we worked closely with a key member of staff within the service to learn about the nature of the advisory role, how a virtual assistant might augment that role and thereby to develop the content for the AIML rules.

5 Evaluation

To evaluate the pilot system we once again turned to a questionnaire, which was completed by 10 final year students after having being given the opportunity to use the system. The rationale for using final year students for the prototype evaluation was that the system was implemented within the limited domain of student employability, which was of particular interest to those in their final year. However, on reflection, a larger sample of students would have been preferable and consequently our results can only be viewed as indicative at this stage. The questionnaire comprised mainly closed questions, but students were also invited to add additional comments. Not all students answered all of the questions.

The survey revealed that half of the students found the avatar system either extremely easy or moderately easy to use; none of them found it difficult to use.

Eight out of nine students found the avatar's responses to their questions very relevant, quite relevant or moderately relevant. This was encouraging, as the programming of the rules to produce a meaningful dialogue with the avatar was one of the most difficult aspects of the project. Despite the use of wildcards and pattern matching, and the limited nature of the domain, it was still difficult to anticipate and program meaningful reactions to all possible user queries.

Seven out of nine students found the avatar's tone of voice either very appealing, quite appealing or moderately appealing. This was unexpected, as we were not entirely satisfied with the quality of the avatar's voice and previous research [11, 12, 13] has found that subjects respond to artificial voices in the same way as they do with real human voices.

The positive reaction of the students to the avatar system was exemplified by their responses to a question about the extent to which avatar-based interfaces should be used for interacting with the university's online services. Most of the students said that such systems should be used for all services, the majority of services or a lot of services, while one student thought they should be used sparingly. No students believed that avatars should never be used.

Students also gave us some useful feedback on the general layout of the interface and additional employability-related subject content that they would like to see included in the system. Some of their comments (in italics) on the nature of their interaction with the avatar were:

> *"Though it had limited responses, it gave useful information."*
> *"I like that the avatar reads the text to you, this makes the user fully understand and not miss certain words nor paragraphs. I also tried making a couple spelling mistakes such as adding extra letters to words in the question input tab, the system still provided rough the answer and/or rough guidance." (sic)*
> *"The system was relatively consistent and user friendly."*

These were encouraging, as they indicated that students could have a meaningful and valuable interaction with the system. Some responses were contradictory, for example: *"…quick response to question…"* but also *"I would like the avatar response to be quicker than it is now."*

"… make the avatar more appealing, it looks bit dull at the moment" Although only one student made this point, it is generally accepted that it is challenging to make avatars express facial expressions appropriate to the words being spoken, which would be the best way to make them more appealing [16, 18].

"The avatar system is extremely user friendly and this is the very first time I am using it. Receiving a spoken response gives you a feeling that someone is physically there to help you." This last response was very interesting; our intention with this system was to try to simulate the supportive dialogue that a student might have with a member of staff, and this comment suggests that we might, at least in part, have gone some way towards achieving this. A member of the employability service also evaluated the working prototype using a 'think aloud' protocol, and was satisfied that the system was fit for purpose.

6 Conclusions

We established that the introduction of a virtual assistant to supplement face-to-face advice was considered to be desirable by a significant sample of undergraduate students at every level and also by members of the university's employability service.

We then successfully developed, in collaboration with the employability service, a virtual assistant using a rule-based engine and a text-to-voice avatar front end, to advise students on such matters as CV writing. Feedback from students' evaluation of the system was generally positive, with some indication that our goal of providing an (albeit limited) out-of-hours version of the support provided by university employability service staff had been achieved. Feedback from the employability service on the prototype was positive and they foresaw using the VA in providing 24/7 student support for their service.

Our intention now is to roll out this technology to augment other university support services and also some aspects of the role of academic tutors. Ultimately, the success of the project will depend heavily upon the quality of the content and the sophistication of the interaction rules. Obviously, such systems are unlikely to pass the Turing test, but it is important that they are able to provide responses relevant to the user's questions, to maintain a reasonably convincing dialogue and to guide the student towards the required information, and this pilot study has shown that, with careful design, this is possible.

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Using Augmented Reality to Engage STEM Students with an Authentic Curriculum

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Abstract. This paper reports on the introduction of a set of 'Augmented Reality' (AR) tasks, offering an innovative, real world and problem based set of activities for a group of first year University Gaming and Computer Science students. Our initial research identifies a gap in the perceptions of STEM students between the usefulness of discipline based modules and a compulsory 'Professional Development' module where more 'employability' based skills were delivered. It had a history of poor student engagement and attendance, and failed to provide a compelling narrative/links to the outside world. The AR tasks were designed to facilitate group-working and multi-channel communication, and to engage students through the use of a more creative technology. Framed as a rich case study, insights are captured through student blogs, video interviews and a questionnaire. Initial findings indicate higher levels of satisfaction, enhanced student engagement and a greater awareness of the value of transferable skills.

Keywords: STEM · Professional development · Academic skills · Student engagement · Augmented reality · BYOD

1 Introduction

This paper reports on the introduction of a set of creative 'Augmented Reality' (AR) tasks, offering innovative, real world and problem based activities for first year University Gaming and Computer Science students. Our initial research identifies a gap in the perceptions of STEM students between the usefulness of discipline based modules and a compulsory 'Professional Development' module where more 'employability' skills are embedded. It had a history of poor student engagement/attendance, and failed to provide a compelling narrative.

The extensive review of the literature of augmented reality (AR) by Carmigniani and Furht [1] provides a taxonomy of systems and applications, including education. In common with most analysis of AR they focus on how systems deliver content and an interactive, context aware, experience for the user. Since the introduction of AR (1990 s) [2] augmented reality systems have been used in many areas of education, including

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higher education [3] and STEM subjects such as maths [4] and physics [5] Yuen et al. [6] suggested five directions for AR in education – books, gaming, discovery based learning, object modelling and skills training. Each area benefits from the context sensitive delivery of interactive material that can enhance an essentially 'real world', authentic experience. Concluded their overview they noted: "... *most current educators will find that, while it is possible for them, as individuals, to create AR content using the tools mentioned earlier in this paper, truly user-friendly AR creation tools may still be just over the horizon.*"

While this is probably still true for the more sophisticated AR experiences, there is a significant sub-set of simple AR application creation tools that allow those with limited technical ability to become AR creators. These newer, user friendly technologies [7] have combined with the rise of smartphone usage [8] to enable the majority of students to access educational AR applications via their own device. Our study is located within the user-generated content of SMART devices, in that our students are creating their own artefacts using the Aurasma AR 'App'.

1.1 Theoretical Context for AR

The theoretical basis for AR in education can be seen as an extension to the Cognitive Theory of Multimedia Learning that suggests images/other media give more impact to the learning experience. However, in this study we focus on the use of AR as a creative tool. We aim to harness the process of creating AR to provide a context for a range of higher education skills within a Collaborative Learning (CL) framework. A systematic review of the literature in computer supported CL by Shawkey et al. [9] shows AR as one of several computer systems that can be used to facilitate CL and this view is confirmed by Lin et al. [10].

Collaborative Learning is based on the idea that students learn as much, or more, from each other than they do from an instructor – this is particularly relevant to higher education where it is expected that the majority of the work is done by the student outside of the lecture theatre. Vygotsky's theories of learning as a social, constructivist process [11], where individuals establish a shared view of a problem and how to solve it, underpins CL and offered useful insights into the design of the revised set of student tasks [12, 13]. By utilising mobile student devices learning can take place at a time and virtual / physical location and time of the students choosing and offers the advantages of more personalised learning across multiple platform, both personal and institutional [14].

1.2 The Case Study Approach

Drawing upon [15] Stake (1983) we see this case study as a rich case in its own right: comparing and contrasting our student groups feedback offers a rich and deep analysis. Case studies offer insights into both what is common and particular about a case, and a uniqueness that Stouffer [16] refers to as pervasive, extending to factors such as the nature of the case, historic setting, physical context, cases through which this case is recognised and those informant through whom the case can be known. Thus for a complex and nuanced case, looking at our students through this lens offers the advantages of multiple data collection tools, Institutional documents; field notes from the researchers during the process of the intervention; student blogs and video focus groups analysis all that offers insights into the students sense of meaning making after the event as they reflect upon their experiences [17].

1.3 Method

12 sets of 'small focus group' interviews were conducted in class using a set format to ensure uniformity. By their participation students received an authentic research experience which they can use to base similar techniques to get user feedback from their own projects later in the course. All participants took part voluntarily and were aware that participation/non- participation would not have any impact on their marks. The researcher was introduced as a member of staff from the Education department, interested in teamwork and technology projects.

The focus groups were filmed and permission gained for edited clips to be embedded within our own project website and for dissemination purposes. For data transcription purposes, each student had a 'number' placed in front of him/her, to enable accurate analysis. The course tutor led on the filming, and coached different members of the class in how to film as the focus groups took place, thus assisting students to develop another skill to add to their PDP.

Institutional documentation; field notes from both authors; video analysis; blog postings and in class artefact showcasing all contribute to this case study.

2 The Augmented Reality 'mini' Project

2.1 Soft Skills for STEM Students

It is particularly difficult to get technically motivated students from STEM disciplines to consider the softer skills, even when they are aware that these are desired by employers and are likely to be the differentiating factor in recruitment between equally technical applicants. Within the perceived context of a lack of STEM graduates, there is a significant problem that too many lack the soft skills to enable them to be ready for work [18]. Other studies have shown that there is a gap between what companies want in terms of skills, and what is provided by higher education institutions; with communication skills and independent problem solving being identified [19, 20].

The Personal Development Planning (PDP) is a common element in most UK Higher Education as Universities are required to provide a transcript to record their learning and achievement and a process by which they can monitor, build and reflect on their development [21, 22]. Key aspects of this are for students to become more independent, adopt a pro-active approach to their study, extra-curricular pursuits and career planning. In addition to these principles the PDP for first year students in Computer Science and Computer Gaming Technology degrees includes an introduction (or reminder) of basic academic skills. This has traditionally been delivered through a series of one hour tutor led classes/lectures on topics such as:

Self-Evaluation Exercise, Note Taking, Group Work, Presentations, Library and referencing Skills, Report Writing, Keeping a Log Book, Time Management, Submitting Work, Plagiarism and the creation of the PDP portfolio.

End of year Course Reviews identified issues of poor engagement with the module, seen in low pass rates and tutors comments on lack of attendance. Despite the tensions of delivering a STEM curriculum with a high discipline based content, students clearly needed the 'softer skills' developed through this module. Thus a redesign was needed, and a more creative approach considered [23].

2.2 Why AR?

Media interest in AR and application framework development had a surge of activity in 2012, but to some extent AR is regarded as a solution in search of a problem [24]. However, although wider commercial applications remain elusive it has been seen as a promising area for education [25].

Our students were aware of AR but had little experience apart from a few who had played AR games. At all times care was taken that if a student did not wish to engage with the AR mini project they would still be able to complete their PDP tasks and would not be disadvantaged.

AR systems such as Aursama [26] are ultimately financed by revenue generated from advertising/commercial applications. However, to boost user numbers they encourage individual creation of AR artefacts through free user accounts. An advantage of Aurasma is that it allows the complete AR creation process to be carried out on a mobile device with the freely available app (iOS and Android). The Aruasma app runs on a mobile device and uses the camera viewfinder to recognise a trigger image. Once trigged an 'Aura' (i.e. the pre-recorded media) can be viewed on the screen of mobile device. We utilised a 'Bring Your Own Device' (BYOD) model, which included all students even if they did not own a SMART device.

2.3 Project Design and Tasks

Previous studies [27] showed the value of using an interesting and inherently engaging technology (in that case a Virtual World) to facilitate group work and to promote broader skill acquisition. Then, as now, ability with the technology was secondary to the development of the skills needed to achieve the tasks.

Student brief: Self-selecting into small groups of 3/5 groups were asked to create a name and logo and to engage with the University Library, in the broadest sense, by producing an AR artefact. They were encouraged to plan, script and story board their short video. Apart from asking them to observe the intellectual property rights of images, videos and music, students were free to create their own videos. Weekly sessions were used for feedback, discussion and introducing the supporting materials on the student Virtual Learning Environment (VLE). Additional support was offered through email, discussion boards and comments posted on blog sites. Groups were asked to do a short 5 min presentation to the class. Most demonstrated reasonable presentation skills; in many cases showed considerable independent research around the topic. Because they were all related to the same topic students found it easy to ask questions; this promoted lively debate. Time/project management were demonstrated by group meetings and task allocations.

3 Evaluation

3.1 Emergent Themes from the Project

- Groups that met up in person seemed to achieve significantly more than those groups which used online communication exclusively.
- The subject of the project, developing AR artefacts for library purposes, did not seem to inspire them, although it did make them visit the library.
- Students could see the worth of cooperation and recording what they did so that the project could progress.
- For the tutors, working with an authentic task offered something concrete to relate abstract notions of academic skills
- Novelty of application helped the groups working as there was no 'expert'.

These themes are summarized from the overall feedback, as they were the most significant factors, most commonly expressed within the body of evidence.

All the participants were keen video game players and very proud of their choice of course - many had selected it specifically because of the core element of 'hard' programming with 'most' programming modules. This is seen as a key element of obtaining work in the gaming industry, and two students, from an arts and music background, highlighted the programming course element before disclosing their extremely exceptional skills in a different area.

They did not value the PDP module as highly as other 'programming' modules, but when prompted, did acknowledge the value for employment. Some groups already knew one another but for others it was a good way to make contact with fellow students at an early part of their course. The groups communicated in very different ways (see Table 1). Most groups reported a technical/communication issues that they had to overcome by researching their own solution. So despite a relatively easy set of well scaffolded tasks, students reported a genuine sense of achievement, which contributed to confidence and independence.

Table 1. Results from interview sessions.

(id) Group working style	Student comments
(1) Worked as a group on the project, meeting in the library.	"*It's very, very simple to use. It goes through everything that you need to know to create an aura*."
(2) Worked individually with Facebook as a point of contact. Some previous experience with AR, happy to do more with this project.	"*The beauty of it was that we were able to email each other as it was a very technology-based thing*."
(3) Worked individually and as a group, used Facebook as point of contact.	*"I first heard about it, I think it was 2011, demonstrated on an iPad."*
(4) Used Watsapp and the blog to communicate, worked together and visited the library. Made some progress with the project.	"*We found a book about sports which had an aura of somebody doing weightlifting*."
(5) Worked together as a group. Also made an aura from signs at the college.	"*We went for a book that stood out and that didn't have a plain background*."
(6) Used Skype and Facebook to communicate with regular face to face meetings. Posed to the blog as a group and individually.	Made aura for a book on confidence: "*We decided that this* [the book] *was relevant for this kind of PDP course*."
(7) Well organised group. Had problems but managed to create an aura.	*"It's been challenging but we've overcome it*."
(8) The group used the blog but also set up a Facebook page and website. Created a logo and group name.	"*We tried to find a decent trigger image that isn't too widely used and doesn't conflict with copyright*."
(9) Group met up regularly, communicated through Skype /Facebook and in person. Created a group name and a logo and attached some books related to the course.	"*For some reason the university computers just won't pick it up but we've tried our own tablets and it works absolutely fine so we don't know what's going on*."
(10) Worked together and Facebook chats to communicate but already knew each other.	They found the Aurasma app very easy to use "*If you follow the instructions, anyone could do it*."
(11) Used Facebook/Steam to communicate as well as face-to-face meetings. Aurasma app was easy to use.	The group task was commented on as "*It's a bit of a pain but it will help*"
(12) Met as a group but somewhat disorganized. 1 student made an aura and displayed it on their phone and had updated a blog.	"*When I first came to university I didn't know anybody. To be put into a group to meet people is quite nice*."

4 Conclusions

Developing user-generated content, where students have a large degree of autonomy in the design and implementation for the PDP course worked well, and the selection of AR offered the students the opportunity to learn about an interesting subject. There was a marked improvement in performance between this cohort and the previous PDP results. Non-submission improved from 34 % (in a cohort of 55) to 22 % (in a cohort of 78). The PDP is a pass/fail element attached to a larger module that teaches game engine technology. The change in those who engaged with the PDP is even more marked when you consider that in 2013/14, 15 % who submitted the main assessment but did not bother with PDP, but in 2014/15 there was actually one more student who submitted to PDP than for the main assessment.

Our case study has provided some interesting findings about STEM students and their engagement with ‘softer skills’. With such a small study, it is not possible to generalise the findings, however, we have been able to identify some key features to be incorporated for the PDP design for the next iterations.

The first is to have a greater focus around team work and a clearer structure. The students interviewed were unfamiliar with group work of any kind. This because obvious in the interviews where many of the groups seemed clueless when they were asked about task progression. Secondly, as tutors, we need to model and scaffold teamwork in a more overt and clear way.

Finally, we are keen to provide more opportunities to practice communication. When interviewed a significant minority of the students struggle to make eye contact, hold a conversation and speak eloquently about a subject. Preparing and giving presentations in a supportive environment is an excellent way of developing these skills.

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Engaging Our School Teachers: An Augmented Reality (AR) Approach to Continuous Professional Development

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Abstract. Currently, trainee teachers in the UK learn about behaviour management strategies from a theoretical perspective at university, through discussions with their school mentors, and by trial and error at their school placement. Existing literature mainly focuses on these issues from the 'adult' viewpoint, not the voice of the child. This paper reports on work-in-progress developing a range of Augmented Reality (AR) resources, drawing upon co-design research workshops with children from a Year 6 class (aged 10) in a UK Primary School. Our research informs approaches to classroom management by encouraging reflection and analysis of 'critical incidents' identified by the pupils, and explored by trainee teachers in workshops through the medium of AR, giving a reality previously uncaptured in more traditional approaches. Our final resources will be a set of Open Education Resources (OER), offered to the wider community for reuse/repurposing for educational settings through a Creative Commons (cc) licence.

Keywords: Augmented reality · Classroom behaviour · Co-design · Participative research · OER

1 Introduction

Currently, trainee teachers in UK school placement/working settings learn about behaviour management strategies from a theoretical perspective at University and through discussions with their school mentors; however, they learn most by trial and error at their placement setting. Haydn [1] emphasises the importance of reading and talking about managing classrooms with a range of practitioners from other schools as it provides the opportunity to explore and discover new ideas which they had not come across before. Our project is seeking to bridge the gap between university and school settings through the use of 'critical incidents' identified by school pupils, by the medium of Augmented Reality (AR). Our AR materials capture a range 'voices' in the classroom to provide discussion points, such as the children themselves, who have written, designed and acted out scenarios to be filmed for this project, but also those supporting the classroom – the head teacher provides a rationale for the school behaviour policy; the classroom teacher offers his

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perspective; a newly qualified teacher talks about her fears; an Ofsted inspector talks about the framework for national policy; school governors offer their views, as well as the university lecturers giving an overview of key behaviour theories. Thus a rich and critical learning experience is being developed that can be accessed through face-to-face workshops, but additionally in a fully online context.

Augmented reality is identified as a key emergent technology in the NMC Horizon Higher Education Preview [2], and the pedagogic context of its use as an education tool is the focus of research by assessment expert Bloxham [3]. The increased use of Smartphones, individual devices for accessing the internet is rapidly increasing – in 2012, over 40 million subscribers accessed the internet via their mobile phones, an increase of nearly 9 million since 2011 [4]. Just 39 % of high school students said that their school is currently meeting their technology needs according to the 21st Century Classroom Report [5]. It is evident that students at university are now expecting academic staff to lead in the use of educational technology for their learning [6]. Thus, the increasing coverage and use of Bring Your Own Device (BYOD) makes it feasible to implement AR in different learning contexts, and Fink [7] suggests sufficient students now have access to mobile devices with features that enable them to make the most of these materials. Although utilising sophisticated technology, the tools and development environment are now accessible to non-experts (e.g. Vuforia [8]; Aurasma [9]). So, as well as integrating AR resources into the curriculum it is possible for students and staff to create their own artefacts in a constructive learning context. Our materials are hosted through Aurasma, “the world’s leading augmented reality platform. Available as a free app for iPhones, iPads and high-powered Android devices or as a kernel for developers, Aurasma uses advanced image and pattern recognition to blend the real-world with rich interactive content such as videos and animations called ‘Auras’” [9].

2 Schools in the United Kingdom: Complex Policies and Options

Education in the United Kingdom is a complex affair as there are different approaches to the education systems and policies of England, Scotland, Wales and Northern Island. Though there are similar issues relating to behaviour management facing all schools and teachers, our case study is in England, and so for the purposes of this study, our aims are addressing the requirements of the education system in England.

The English education system is broadly divided into the Primary sector, catering for children aged 5–11, and the Secondary sector, aimed at 11–19. Recently, there has been a great deal of change within the English education system with a new national curriculum for all age groups, and changes to the types of schools leading to the development of academies and free schools in both the Primary and Secondary sectors. The government’s defining aim through these changes was to increase the opportunities for school autonomy and thereby develop a culture of self-improvement [10]. As Hanushek, Link and Woessmann [11] suggest the thinking of this policy is that increasing school autonomy, when linked to with greater accountability, can result in raising standards. Such changes have also given schools the opportunity to work in collaboration to produce joint continuous professional development, though a consequence of this policy is that there is a loss of local authority support.

This has meant that often that training of a comparable standard is no longer always possible across schools, and that schools now have either to develop their own professional development or buy into schemes or courses. Conversations with our own trainee teachers in school indicate that some staff training days they have attended (where the school is closed to pupils and staff expected attend to develop their knowledge and skills) are didactic in approach, with little material available to them once the training day sessions are concluded. This project aims to produce an innovative approach to providing focussed high quality training for schools, produced in partnership with schools. The government are keen to encourage schools towards an evidence based practice agenda, and this project fits in well with this approach.

Behaviour management in English schools has always been a matter of some discussion, with many teachers claiming that behaviour is getting worse, though a recent report states that there is no conclusive evidence of this [12]. There is great number of books written to advise teachers on how to deal with behavioural issues in the classroom (see the works of Bill Rogers [13], Phil Beadle [14] and Sue Cowley [15]), and the UK Government also has provided further guidance [16]. However, all of these focus more on what the teacher should do, and do not look so much at the students perspectives. It is worth noting that in a recent survey of teachers in England, 60 % of those who participated stated that they had not received any professional development relating to managing pupil behaviour in the last 12 months, and of those who had 15 % received only informal support from their colleagues [17].

3 Project Methodology

Our case study school is a Primary School in a semi-rural setting in Essex, UK. It has approximately 270 children on the school roll, and has a history of taking Anglia Ruskin University trainee teachers on placement. The head teacher and the Board of Governors take seriously the Government aspirations of evidence based practice, and support staff who are keen to develop their research skills through a range of Continuous Professional Development (CPD) activities, including funding Masters and Doctoral studies, as well as having external links with universities. They have already collaborated with Anglia Ruskin University to capture 'best practice' writing throughout the school [18]; and with funding for staff development being transferred to school budgets, they have been keen to develop resources to assist both their own, but also other trainee teachers working in school classrooms across the East of England.

We worked with the school to agree the scope and parameters of our study, and went through both the school's and the university's risk and ethics approvals to ensure the safety and wellbeing of the children working on the project [19]. The school were happy with the focus on behaviour management, as they could see a real purpose for developing effective CPD in this area. They were particularly interested in the inclusion of AR within the design.

The end product will be a training course with AR triggers which will link to small video clips of 'critical incidents' in the classroom. These can then be discussed, and supported by further short videos of children and staff talking about the issues and possible ways of dealing with them.

The data collection schema comprised:

- A co-design workshop with 8 children age 10 and three members of staff (see below),
- Filming day 1: work with year 6 children (age 10), during which the 'critical incidents' are staged,
- Filming day 2: film staff, pupils from other classes and school Governors, to gain other insights, comments, reactions, etc. to the critical incidents and behaviour management in general,
- Questionnaire evaluation: we have added three questions to the annual school/parent survey relating to behaviour management in schools so as to elicit some views of the parents.

3.1 The Co-Design Workshop Approach

During the children's workshop we followed a co-design approach [20] which helps to identify work-oriented design of computer artefacts in order to understand the requirements and steps; this prompts narration and design steps that children would work through preparing for filming. The co-design workshop consisted of collecting the information generated and proposed by the participants, observing how they created their ideas about classroom behaviour, and is a feature of design based research (DBR). DBR is a genre of research in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigation, which yields theoretical understanding that can inform the work of others [21]. It emerged around a decade ago as an alternative paradigm which situates meaning in interventions offered in real-life settings [22].

3.2 The Co-Design Workshop with the Children

The children were selected for the workshop by their classroom teacher, and comprised four girls and four boys. We divided the children into two groups (each with two girls and two boys) and asked them to identify on cards the key aspects of classroom behaviour that they did not like. The children then ranked the replies in order, and each group selected the 'top' card to develop further ideas with. They were prompted to use storyboards to 'tell' their stories about poor behaviour, and to suggest ideas for dealing with this back in their own classroom context. It was noticeable that the staff working with the children were really surprised and bemused with the quality of thought and feedback. The children then developed a 'film script' storyboard to tell the story of the 'critical incident' they had identified, and worked together drawing narratives and rapidly decided, without adult intervention, that they would writing a script for the potential actors who would be filmed telling the story of the incident.

The themes the children developed are being taken back into the classroom, and will be developed through the English and Drama curricula, and they have invited us into their classroom to film the 'critical incidents'. This will take place before the end of the school year in July. Key themes will be analysed and summarised over the summer, and exemplars will be hosted through the project website, ready for dissemination and

Fig. 1. The co-design workshop in action

feedback at conferences, workshops and talks; after which the final materials will be produced and reviewed in the pilot for the CPD workshop with the teachers (Fig. 1).

4 Emerging Themes

A number of themes are emerging from this study, and they can be grouped into two: themes relating to behaviour management, and themes relating to the use of the technologies. With respect to behaviour management, our initial findings have identified a significant 'gap' in the literature on classroom behaviour in UK schools, in that much of what has been written focusses on the teacher's perspective and little is written about the children's perspective. Consequently, some of the children's responses to the co-design workshop were a surprise. Whereas we would have expected the children to have focussed on the major disruptions in a classroom, in line with the usual concerns of trainee and newly qualified teachers [23], the children expressed most frustration with low level misbehaviour. A further interesting point was that the children initially felt that the punishments should be much more severe than we would have expected. They then softened their responses on discussion with the teachers about why the teachers responded in the ways that they did. This would suggest that it is important that when approaching behaviour management they views of both the children and the adults are included.

A number of themes relating to the use of AR as a technology to support CPD also have begun to emerge. One aspect is the interest that AR can engender in both staff and pupils, and they both became very eager to explore the use of AR, not just for this project, but in other aspects of the learning and teaching in the school. The teachers, in particular, could see it as a way of embedding technology in the curriculum for the children, as well as using to help train teachers in the future (Table 1).

Table 1. The project timeline

Timeline (6 months)	Activities in school	Activities at University
Initial meeting with key staff	Governors, Head teacher, Classroom teacher	
School agree to collaborate	School get necessary consent forms from parents and children, agreement from staff to be filmed	Full ethical processes undertaken
Co-design Workshop	8 children, 4 boys and 4 girls plus two classroom teacher and the researchers	Preparation of materials for workshop Literature review
Filming of staff	Staff who have agreed are filmed answering these four questions: • What behaviour do you find most annoying? • How does disruption in the class make you feel? • What is the best way of tackling disruption in class? • Describe in your own words a good learning environment	Initial themes: • Low level disruption is the key issue • A degree of frustration with having to repeat the same instructions to certain children • Staff were able to articulate effective ways they were able to encourage good behaviour • Staff were very consistent in their views and these aligned to the school policy document
Filming day with full classroom of children	30 children take part in filming 'issues' they have prepared – the children have researcher, written scripts and briefing plans for their group 'film'	Ongoing analysis
Preparation of interactive website	School act as 'critical friends' and review materials	Feed into site development process

5 Conclusions

Our initial findings have identified a significant 'gap' in the literature on classroom behaviour in UK schools, and it implies that there is a greater need to incorporate both the adult and children's voices in any development of training in such issues. Messiou [24] has previously stated that children's voices should be taken into consideration so as to develop inclusive practices, and it is evident from our study that there is much to be gained in this. Clearly, there is also potentially a big interest in schools for the use of interactive technologies, and both staff and pupils are excited by the prospect. The school 'film day' materials are currently being analysed, together with the staff and children's viewpoints. The initial film clips comprising children's stories and our materials will be available to share later this year, and these will be developed into workshop materials. These will then provide a more authentic learning experience through the use of AR and the incorporation of 'real' user-generated content [25].

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Self-directed Learning in e-Portfolios: Design Issues and Investigation of Students' Performance

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Abstract. This paper presents an investigation on students' learning presence in a blended post-graduate course, designed to promote self-directed learning through e-portfolio activities. The theoretical foundations and the key dimensions of e-portfolio learning activities are outlined, i.e. students' construction, reflection and collaboration. Following are presented the organizational and the analysis framework of students' self-directed learning and constructive activities within the e-portfolio. Descriptive analysis and Social Network Analysis of the research data revealed important information regarding individual performance, interaction and collaboration among participants as well as the whole e-portfolio community.

Keywords: e-portfolios · Self-directed learning · e-learning · Social network analysis

1 Introduction

In the past decade, the emerging Web 2.0 technologies have fundamentally changed the way we think about e-learning environments, pedagogical strategies, students' activities and learning outcomes. By providing flexible, participatory, learner-centred, communicative and networked spaces, Web 2.0 tools offer multiple opportunities for students' engagement, communication, reflexive dialogue, creativity, collaborative and self-directed learning [11]. In this context, Web 2.0 technologies challenge educators and institutions to consider new ways of delivering their programs by (a) extending learning environments from time and space bound classroom places and (b) adopting new models of pedagogy which offer authentic learning opportunities through self-directed, participatory, collaborative and social learning processes [4].

Among Web 2.0 tools, e-portfolios constitute a new means of enhancing e-learning in practice; they are increasingly becoming popular in tertiary education to support students' learning and personal development [1, 6]. Literature review indicates that e-portfolios are dynamically used in order to embed learner-centred and reflective strategies in primary and secondary education [3, 12], undergraduate and post-graduate education [9, 16], teacher education [14] and continuing professional development [10]. A wide range of published studies were directed towards students' perceptions of e-portfolios and their experiences during learning activities

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within e-portfolios [2, 5]. Despite the promising uses of e-portfolios in education, empirical research on students' active engagement, collaboration and the consequent learning outcomes is rather limited. This study has the ambition to contribute by proposing a consistent pedagogical framework to design, promote, and analyse students' collaborative learning in e-portfolios, which is based on the principles of *social learning* theory [17]. The methodological issues of the research as well as the preliminary findings of both descriptive analysis and Social Network Analysis are presented in order to depict students' engagement, interaction, creativity and collaboration. Finally, conclusions are drawn for future development and research in the area of e-portfolios and self-directed learning.

2 Theoretical Background

In their traditional view, learning portfolios help students to collect their assignments, to present selected artefacts and showcase examples, and to reflect on their work and achievements. Currently, an e-portfolio is a dynamic Web space maintained and created by a learner, a group of learners, participants in a course or a whole community; it includes demonstrations, resources, accomplishments, articulated experiences, individual and collaborative creations, as well as peer feedback. By embodying Web 2.0 functionalities, e-portfolios enhance their features of publishing, archiving, sharing, communication and collaboration (i.e. by including tools like forums, blogs, wikis, content sharing etc.). In this perspective, the notion of e-portfolio is not restricted to an online collection of individual students' work or selected artefacts. This study considers an e-portfolio as a combination of a *learning process* (a series of individual and collaborative activities) and its *product* (content material and students' creations during the e-portfolio timeline). Overcoming the constraints of time and physical space, the key factors to harness the full advantages of e-portfolios are (a) learners' *reflection* on individual and peer artefacts as well as the overall e-portfolio content, and (b) the *collaboration* and feedback provided by peers.

The theoretical foundations determining this particular research and the design of students' activities within the e-portfolio were rooted in the ideas of social learning. More specifically, we have developed a combined pedagogical framework determined by the notions of *community learning* and *collective thinking* [15, 17]. In this context, three mutually related components were identified, which afford e-portfolios as dynamic learning environments and characterize social participation as the key factor of the learning process [7]:

Construction: This dimension projects (a) planning, organization and development of individual students' work and (b) the documentation of representative work samples (artefacts) that provide tangible evidence of students' knowledge and skills.

Reflection: It is students' critical thinking on individual and peer work, artefacts, knowledge material, achievements and learning. It helps students to construct a sense of their learning and developmental processes.

Collaboration: Meaningful reflection is best facilitated by peer collaboration and mentoring within a learning community evolving in the e-portfolio spaces.

3 Study and Method

3.1 Context and Design of e-Portfolio Activities

The present intervention ran during the spring semester of 2013, in the context of a masters' degree course entitled "e-learning and ICT in education", at the Department of Social and Educational Policy, University of Peloponnese, in Greece. The course was designed in a blended format; it included five face-to-face sessions in the classroom combined with on-line collaborative work in the e-portfolio. Mahara was used as the hosting platform. Twenty three students were enrolled. They all had a bachelor degree in various disciplines related to education; twenty students were in-service primary and secondary education teachers.

Students' individual and collaborative work were deeply interconnected and spread along the timeline of the 24 weeks initiative. The instructor was acting as e-moderator by setting the context, the expectations and the processes of students' self-directed learning. An ongoing cooperation framework was shaped based on dialogue, peer interaction and collaboration. The students were encouraged (a) to change ideas on theoretical and pedagogical issues, (b) to share content material and write articles on the e-portfolio journal, (c) to reflect and debate on course assignments and peer contributions, (d) to share resources, educational material and experiences, and (e) to create interest/working groups and design new educational scenarios applicable in school practice. Each student was requested to publish five articles on the blog and create a WebQuest scenario using the OpenWebQuest platform [13].

3.2 Analysis Framework

Our research approach aimed to better monitor, support and analyse students' repetitive and iterative activities during the course at three mutually related levels, i.e. (a) personal, (b) group and (c) community level. Therefore, the conceptual analysis framework was built around four interrelated dimensions which reflect the complexity of students' learning presence within the e-portfolio community.

Engagement: Individuals' self-presentation and social presence, participation in general discussions and ways of attending e-portfolio activities;

Interaction-Reflection: Negotiation of ideas and meaning through discussion forums and live journal articles, engagement in peer working groups;

Creativity: Students' content contributions, ability to create/share new knowledge and co-create new artefacts in the e-portfolio community;

Cohesion: Ties between individuals and the e-portfolio community as a whole;

Every individual contribution was used as the analysis unit. We have captured a wide range of data, like distinct logins, postings, article publications and commentaries, content additions, working groups, page views, links etc. Therefore, we used three main sources and types of data analysis:

- Log data gathered from the platform to reveal students' engagement.
- Descriptive analysis of individual contributions (i.e. publications and commentaries on the journal area, postings to discussion forum topics etc.).
- Social Network Analysis of individual contributions to reveal members' ties and the dynamics of the e-portfolio community.

4 Results

4.1 Engagement

Figure 1 shows the main page of a typical student e-portfolio. It presents her activities and the artefacts she produced during the course workflow. It is organized in four parts projecting (a) individual and collaborative tasks, (b) personal creations, (c) Web links and suggested readings and (d) articles/personal writings. The majority of the students used a similar structure to organize and project their e-portfolio content.

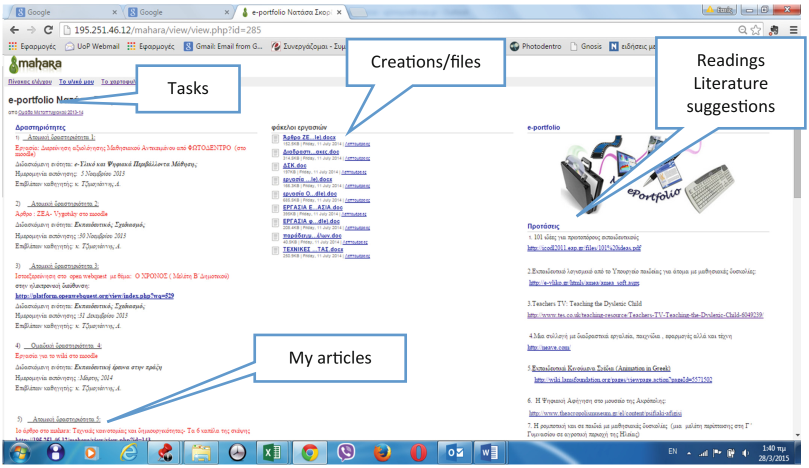

Fig. 1. A typical e-portfolio structure of students' individual and collaborative creations

Engagement indicators are related to students' presence in general discussions as well as individual actions concerning e-portfolio content view. Figure 2 shows the distribution of the community activity depicting distinct logins per week. The arrows indicate the dates of the face to face sessions. Students' activities were continuous and interspersed in a balanced manner; a mean value of 133 distinct logins per week was recorded. Figure 2 gives a picture of an active learning community along the 24 weeks period of operation. The peaks in students' activity are recorded, approximately, a week after the deadline of the article assignments (9th, 12th, 15th, 19th, 22nd week).

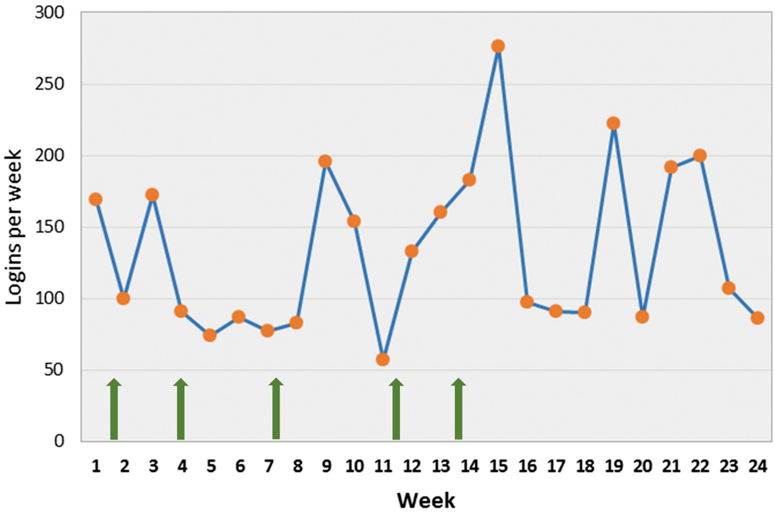

Fig. 2. Students' activity distribution chart

4.2 Creativity and Reflection

The majority of the students were very efficient members towards negotiating and sharing their ideas and knowledge through discussion forums and live journal articles. In addition, 14 working groups were spontaneously appeared in the platform as the outcome of students' initiatives. They were built around common interests with the aim to collaboratively study new educational topics and design new educational scenarios applicable in the school practice.

Table 1 depicts an overall view of students' contributions and creations. A total of 135 original articles were published in Mahara's journal area with regards to theoretical and practical themes of learning and instruction (e.g. *Web 2.0 in practice*, *collaborative learning, educational blogging*, *mobile learning*, *game-based learning* etc.). Comprehensive discussions were evolving around the topics above, which received a total of 647 commentaries. In addition, 21 WebQuest scenarios were individually constructed and shared with peers for further comments and reviewing.

4.3 Social Network Analysis

Social Network Analysis provides a set of algorithms which give insight into the various e-learning situations in terms of network structure parameters, like interactions and ties among members, information exchange, knowledge sharing, group dynamics, community structure etc. [8]. *Cohesion analysis* revealed important information regarding the architecture of the e-portfolio community, i.e. the existence of subgroups (cliques) of students who tend to develop strong ties and interrelations with each other. Overall, 49 cliques were recorded; the majority of them (38 cliques) included 10–12 students. This is an indicator that the e-portfolio network was a cohesive community, i.e. the students developed strong interrelations among them, thus having enhanced opportunities for collaborative construction of knowledge.

Table 1. Students' e-portfolio activities

Indicators	**Actions**
Discussion topics	20
Forum postings	206
Article publications	135
Article Commentaries	647
Article views	10674
WebQuest scenarios	21
Working groups	14
Collaboratively constructed educational scenarios	6

Power analysis measures the operation of the e-portfolio activity and assesses the impact each member had with respect to spreading information and influencing others. The overall network activity was represented by in-degree centrality = 55.73 and out-degree centrality = 55.56. This means that, approximately, 56 % of the students were mutually connected by receiving and sending postings. Students S10 and S15 were the most influential members, since they received a great number of connections (postings) from their peers. On the other hand, students S3, S7 and S13 were the most effective members in the community towards triggering others (they were connected to 83 % of their peers in the course). Figure 3 represents the degree centrality map. The students placed at the centre were the most powerful participants since they were connected to other powerful members. As moving to the periphery, students S11, S9, S2, and S12 are considered as the less powerful members of the e-portfolio network.

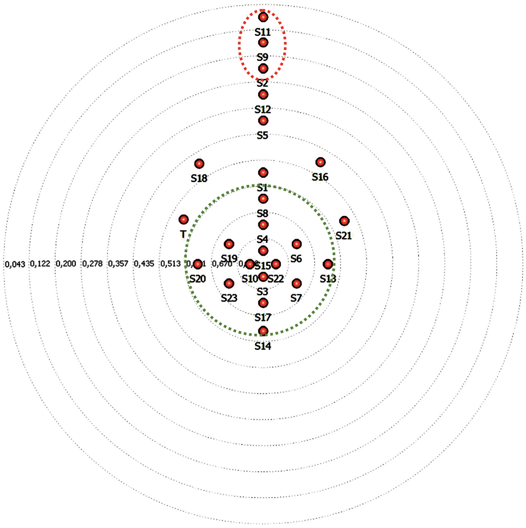

Fig. 3. Degree centrality map of the e-portfolio network

Figure 4 presents the *role analysis* diagram which identifies four classes of members which had certain social roles and performance in the e-portfolio network. The first role group (i.e. the nodes placed in the lower right side of the graph) includes eight students, which were the most active participants, i.e. S3, S7, S15, S23, S13, S22, S14 and S21. They were members in more than 20 cliques and triggered others' participation by expressing ideas and writing articles, posing questions, giving responses or uploading commentaries.

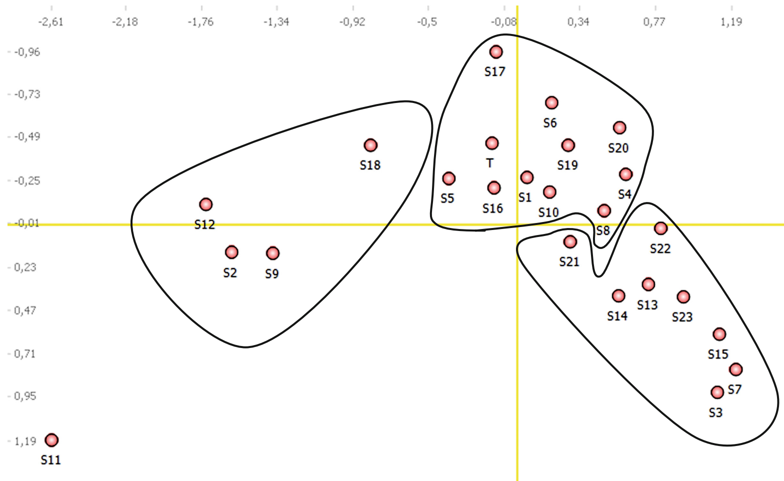

Fig. 4. Role analysis graph

The second role group (i.e. upper right side) is consisted of S8, S10, S4, S20, S6, S19, S1, S16, S17 and S5. The tutor T is also placed therein. Comparing to the members of the first group, they had moderate influence to the network since they were involved in 8–20 cliques. The third role group included four students (i.e. S18, S9, S2, and S12). These participants uploaded fewer articles and postings. Most of them were members in 3–7 cliques. Finally, student S11, who had marginal presence in the e-portfolio activities, is characterized as a lurker or isolate. His presence appeared to be restricted to reading the postings/material uploaded by the other students while he was a member in only one clique.

5 Epilogue

This paper reported on an investigation concerning the design and the implementation of a blended post-graduate course, structured around students' self-directed and collaborative activities in an e-portfolio. The preliminary data provided supportive evidence of an effective learning program that promoted students' engagement and learning presence within a dynamically evolving community. The majority of the participants demonstrated enhanced interest and they were actively engaged into the e-portfolio activities (writing articles, uploading postings, supporting dialogue and discussion topics, interchanging ideas, sharing content and resources, co-creating educational material, etc.). This non-formal, self-directed program offered promising evidence of a decentralized learning community built around e-portfolio.

The results presented contribute to the existing knowledge and could guide both, future research and the design/implementation of efficient e-portfolio projects. This study suggests that properly designed e-portfolio initiatives need to consider students' learning as the outcome of individual and collaborative work as well as self and peer reflection on students' creations. In this context, it is expected that students can achieve higher cognitive levels through communication, collaboration and critical thinking within a supportive community of learning. The conceptual framework proposed can also help educators and instructional designers to adopt an open learning philosophy towards implementing e-portfolio initiatives with the aim to enhance students' engagement, reflection, collaboration and self-directed learning.

Our current efforts are addressed to combine social network analysis with qualitative data extracted from students' interviews and content analysis of their on-line discourse. We expect thus to reveal important information about individual learning presence and knowledge construction, students' connections and influence as well as the learner identity they developed by sharing common practices and values within the e-portfolio community.

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XML Based Pre-processing and Analysis of Log Data in Adaptive E-Learning System: An Algorithmic Approach

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Abstract. E-learning has become the most popular way of delivering education and learning. Adaptive E-learning systems are the systems that adapt according to the requirements of the user. These systems should be capable of capturing the user preferences in terms of their learning styles and adapt the user interface accordingly. Web log analysis of the usage data can provide useful information regarding the learning styles. This analysis is extremely useful to develop an adaptive environment for the learner and at the same time for instructors to see how often their course contents are being used. In this paper a modified literature based approach is proposed where the learner's behavior is tracked by capturing the interactions with e-learning portal. The captured behavior will be stored in the form of sessions which will be grouped together to generate the sequence files in the XML formats. The learning styles have been identified by an algorithmic approach based on the frequency and time that the learners spend on various learning components on the portal. The approach is useful to provide an adaptive user interface which includes adaptive contents and recommendations in learning environment to improve the efficiency of e-learning. The learning style model used is Felder-Silverman Learning Style Model (FSLSM) to fit the learning styles into an adaptive environment.

Keywords: Adaptive E-learning · Data pre-processing · Usage patterns · XML · Felder-Silverman Learning Style Model

1 Introduction

Adaptive E-learning system deals with appropriate personalization and adaptation techniques in order to maximize the effectiveness of learning. It should be capable to detect or identify the user preferences and finally adapt it into the system. User preferences can be mapped to learning styles of the learner's. The Felder-Silverman Learning Style Model (FSLSM) is the popular learning style model available which emphasizes on various categories of learners. The adaptive user interface and contents should satisfy the requirements of FSLSM learners.

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For adaptation purpose, the system should be designed to capture the usage data logs and identify the usage patterns. Web Usage Mining (WUM) applications are based on data which can be collected by capturing the usage data into log files. So in narrow sense WUM is also called as Web Log Analysis [1].

As the e-learning systems are deployed on web server, log data can be derived from several data sources such as server log files and databases. Web log files contain information about a learner's activity. Most of the times the activities captured in the log file produces non relevant information which may lead to wrong analysis of usage patterns. Web Logs Analysis phase of WUM is the important process to understand learner's way of using the e-learning system and based on the utilization usage can be made adaptive. The usage patterns are useful to understand learner's learning styles and it also can provide more information to instructors about the learner's behavior, and can give recommendations to learners by generating adaptive user interface components. To generate valid usage patterns data pre-processing becomes a necessary component which involves time to execute. In this paper, an algorithmic approach for pre-processing of captured log data is proposed. The log data should be pre-processed as per FSLSM sub categories so that the pre-processed data can be directly used for clustering the common user profiles. FSLSM is useful to define the various categories of learners in order to provide adaptation on the portal that satisfies each learner [2]. The data pre-processing phase is time consuming specially when e-learning system should include adaptation in real time. The pre-processed data should try to identify the learning preferences and useful to identify the categories of learners in order to provide adaptive user interface along with the contents.

2 Related Works

Zailani Abdullah et al. [3] proposed a sequential preprocessing model (SPM) and sequential preprocessing tool (SPT) as an attempt to generate the sequential dataset. The result shows that SPT can be used in generating the sequential dataset. They evaluated the performance of the developed model against the log activities captured from e-Learning System called myLearn. Cristbal Romero et al. [4] have done a survey on different types of educational environments and the data. They also discussed the main tasks and issues in the pre-processing of educational data, mainly using moodle. Navin Kumar Tyagi et al. [5] have carried out a survey about the data pre-processing activities like data cleaning, data reduction and related algorithms.

Shivkumar Khosla and Varunakshi Bhojane [6] have mentioned different web log files and pre-processing techniques. They introduced the concept of capturing different web log file while accessing the e-learning portal. Thanakorn Pamutha et al. [7] have focused on the preprocessing of the web log file methods that can be used for the task of session identification from web log file. The work in this study also produces statistical information of user session, such as: (1) total unique IPs; (2) total unique pages; (3) total sessions; (4) Session length and (5) the frequency if visited pages.

Felix Mdritscher et al. [8] have reported about an analysis study in order to approach a strategy towards the realization of LA functionality in the Learn@WU platform. In order to learn about the dependencies between Learning Management System's usage patterns and learning results, they examined the influence of 14 usage variables and the final grades of the participants of three large blended learning courses. Angel Cobo Ortega et al. [9] provides a brief overview of applying educational data mining (EDM) to identify the behaviour of learners in virtual teaching environments. Authors have used a fuzzy clustering algorithm to identify groups of learners based on their social interaction in forums and the temporal evolution of this classification.

Michal Munka and Martin Drlka [10] have focused only on the processes involved in the data preparation stage of web usage mining. They specified the inevitable steps that are required for obtaining valid data from the stored logs of the web based educational system. They compared three datasets of different quality obtained from logs of the web-based educational system and pre-processed in different ways. Chakarida Nukoolkit et al. [11] have performed exploratory data analysis and data mining on an e-Learning web log. The analysis uncovers the e-Learning users' usage behavior in accessing the content. The analysis also discovers e-Learning media popularity and usage patterns, and helps the institution fine tune future courseware, from strategic changes to the fine-grain of lesson content improvement.

Martin Cpay et al. [12] have described the applicability of different types of resources and activity modules in the e-learning courses and the worthiness of their usage. The presented ideas are supported by the outcomes of the questionnaire research realized within the e-learning study as well as the usage analysis of particular e-course. Yannis Psaromiligkos et al. [13] have examined the requirements for data mining facilities in LMSs. They have also described a new approach supported by a tool for analyzing learners' behavior in LMSs.

Shaily Langhnoja et al. [14] have given detailed description of how preprocessing is done on web log file and after that it is sent to next stages of web usage mining. Authors have mentioned areas of preprocessing including data cleansing, session identification, user identification, etc. Renuka Mahajan et al. [15] have discussed about the study which is conducted on usability and effectiveness of the e-content by analyzing the web log. Authors have evaluated different features of e-content that can lead to better learning outcomes for the learners, by understanding their navigational behaviors, their interaction with system and their area of interest. Nawal Sael et al. [16] have defined new static variables according to the Moodle-SCORM content tree and authors have applied more statistics and visualization techniques. In addition, authors have presented multidimensional graphics in order to understand users' accesses.

3 Proposed Methodology

Data pre-processing consists of various steps which are tedious and time consuming to implement in real-time application. Also same steps can not be suitable in e-learning application for analysis. The proposed methodology describes about the issues to be addressed, parameters to be considered and algorithms to generate the XML files. The main objective of the proposed work is to capture the access patterns of the learners in W3C extended log formats and in database. The W3C log files give the usage of different pages accessed as per the learners login and page visit sequence. The database log gives the usage of different files accessed as per the course contents and time spent on that page. The implemented e-learning portal is a combination of learning components called pages and learning contents called files. Each learning component of portal and different types of contents are considered as part of learning objects. To map learning objects onto FSLSM dimensions all learning objects need to be labeled depending on preferences of each learner. The characteristics of FSLSM learner is studied in detail from the various research papers. Mapping of Learning Objects on FSLSM are shown in Table 1:

Table 1. Learning Objects Mapping as per FSLSM

Active	Videos, PPTs, Demo, Exercise, Assignments, Forum, Announcements, References
Reflective	PDFs, PPTs, Videos, Announcements, References, Email
Sensing	Examples, PDFs, Videos, Practical Material, Forum
Intuitive	PDFs, PPTs, Videos, Forum, TopicList, References, Assignments, Advanced topics link
Visual	Images, Charts, Videos, References
Verbal	PDFs, Videos, Email, Announcements
Sequential	Exercise, References, Assignments, Sequential Links, Email
Global	Topic Lists, References, Exercise, Assignments, PPTs, Forum

3.1 Assumptions/Requirements for Pre-processing of Web Log Data:

The following are the parameters considered:

1. Idle time spent on specific file or page is 10 min. If any learner not doing any activity on portal for 10 min then the session will terminate automatically and learner will get log-out from portal as per time oriented heuristic.
2. One specific learner's all sessions will be considered upto 30 min to generate final XML logs.
3. Unique session ids are maintained in every log record of learner.
4. Log records are sorted as per session time and different sessions of one learner are combined to understand usage patterns.

3.2 Parameters to be Considered XML Generation Algorithms:

The following are the parameters considered:

1. Session: Sequence of pages and files accessed by a learner on a particular website during a specified period of time. One sequence includes number of sessions with total time of 30 mins.
2. Frequency: Number of times specific file and page accessed by learners all sessions.
3. Time Spent: Total time spent on file or page by learner's all sessions.
4. Page Sequence: Pages and files accessed in specific order by learner. Page sequence is useful to identify the learning path of each learner.

```
INPUT: A finite set of Learners L = L_1, L_2,....,L_N,
Sessions S =S_1,S_2,....,S_Q,
PageURL P=P_1, P_2,....,P_R
and FileURL F=F_1, F_2,....,F_X
OUTPUT: XML File
  initialize Session_Time ← 0, SessionLog_ID ← 0,
  SessionPageLog_ID ← 0, SessionFileLog_ID ← 0,
  PCount ← 0, PLogTime ← 0,FCount ← 0,
  FLogTime ← 0, Flag ← 0
  for each Sessions S_j where j ← 1 to Q do
    compute Session_Time = Start_Session − End_Session
    if "Session_Time" > 29min then
      get Learner_ID, SessionLog_ID from SessionLog file
    end if
  end for
  for each Session S_j where j ← 1 to Q do
    for each PageURL P_k where k ← 1 to R do
      get SessionPageLog_ID from PageLog file
      if SessionLog_ID == SessionPageLog_ID then
        get Learner_ID, PageURL, Page_ID, LogTime from PageLog
        file
        set Flag ← 1
      end if
    end for
    if Flag == 1 then
      for each PageURL P_k where k ← 1 to R do
        for each Learner L_i where i ← 1 to N do
          if "PageURL "is accessed then
            set PCount = PCount + 1
            set PLogTime = PLogTime + LogTime
          end if
          create XMLTag for
          Session_ID, Learner_ID, PageURL, PLogTime, PCount
        end for
      end for
    end if
  end for
  for each Session S_j where j ← 1 to Q do
    for each FileURL F_d where d ← 1 to X do
      get SessionFileLog_ID from FileLog file
      if SessionLog_ID == SessionFileLog_ID then
        get Learner_ID, FileURL, File_ID, LogTime from FileLog file
        set Flag ← 2
      end if
    end for
    if Flag == 2 then
      for each FileURL F_d where d ← 1 to X do
        for each Learner L_i where i ← 1 to N do
          if "FileURL "is accessed then
            set FCount = FCount + 1
            set FLogTime = FLogTime + LogTime
          end if
          create XMLTag for
          Session_ID, Learner_ID, FileURL, FLogTime, FCount
        end for
      end for
    end if
  end for
```

Algorithm 1. XML File 1 Generation Algorithm

```
INPUT: A finite set of Learners L = L_1, L_2,....,L_N,
Sessions S =S_1,S_2,....,S_Q,
PageURL P=P_1, P_2,....,P_R
and FileURL F=F_1, F_2,....,F_X
OUTPUT: XML File

  initialize Session_Time ← 0, SessionLog_ID ← 0,
  SessionPageLog_ID ← 0, SessionFileLog_ID ← 0, IsPage ← 0
  for each Sessions S_j where j ← 1 to Q do
    compute Session_Time = Start_Session − End_Session
    if "Session_Time" > 29min then
      get Learner_ID, SessionLog_ID from SessionLog file
    end if
  end for
  for each Session S_j where j ← 1 to Q do
    for each PageURL P_k where k ← 1 to R do
      get SessionPageLog_ID from PageLog file
      if SessionLog_ID == SessionPageLog_ID then
        get Learner_ID, PageURL, Page_ID, LogTime from PageLog
        file
        set IsPage ← TRUE
      end if
    end for
    if IsPage ==' TRUE' then
      for each PageURL P_k where k ← 1 to R do
        for each Learner L_i where i ← 1 to N do
          if "PageURL "is accessed then
            create XMLTag for Session_ID, Learner_ID, PageURL
            set Session_ID, Learner_ID, PageURL in
            "UserActivities "table
          end if
        end for
      end for
    end if
  end for
  for each Session S_j where j ← 1 to Q do
    for each FileURL F_d where d ← 1 to X do
      get SessionFileLog_ID from FileLog file
      if SessionLog_ID == SessionFileLog_ID then
        get Learner_ID, FileURL, File_ID, LogTime from FileLog file
        set IsPage ←' FALSE'
      end if
    end for
    if IsPage ==' FALSE then
      for each FileURL F_d where d ← 1 to X do
        for each Learner L_i where i ← 1 to N do
          if "FileURL "is accessed then
            create XMLTag for Session_ID, Learner_ID, FileURL
            set Session_ID, Learner_ID, FileURL in
            "UserActivities "table
          end if
        end for
      end for
    end if
  end for
  for each Learner L_i where i ← 1 to N do
    set UserActivities Orderby Date and Time
  end for
```

Algorithm 2. XML File 2 Generation Algorithm

The log data has been generated in standard XML format based on Assumptions mentioned above. The XML file can directly be useful as input for clustering algorithms. Two different XML files are generated: File1 contains User session data of pages/files, time spent on page/file in each session and frequency of accessing the pages/files. File2 contains page and file sequence of each learner called web sessions.

3.3 XML File1 and File2 Generation:

Session can be described as the time spent on portal by a learner from the moment he/she logged in to the moment he/she logged out. In each session of each learner is combined and identified the time spent of each page/file separately. Session also describes how many time each learner accessed page/file. The total time spent on each page and file as well as frequency of accessing page and file is converted into XML tags with respect to unique learner id as shown in Algorithm 1. Session can also describe as sequence of pages and files accessed by each learner in specific order as shown in Algorithm 2.

4 Experimentation Details

The www.mitelearning.com portal is made available for second year engineering learners and some interested learners for the Android for Beginners online course. The topics are divided into three categories based on prerequisite concept, main concept and advanced concept. The contents for the topics are made available for the learners through the portal in different file formats such as text (doc/pdf), video (mpeg/mp4) and demo (ppt/pptx). The learners can also go through the exercise modules that has been provided for each topic. The learners can also make use of different learning components that has been provided as pages to explore more about a specific topic such as Announcement, Email, Assignments, References, Exercises, TopicList, MyAccount, Forum etc. Around 45 learners have registered in portal out of which 30 learners have accessed the portal for two months. The log details of learners who are accessing the portal are tracked and stored into W3C log files as well in the database of SQL server. In addition to that, the time spent and the files accessed by a specific learner in a particular session has been captured and stored in the database. The stored logs in database are classified into three types: Learners SessionLog, Learners PageLog and Learners FileLog.

5 Results and Discussion

5.1 Pre-processing of Captured Usage Data

The application which generates both XML files is implemented using Microsoft Visual Studio 2010 and Microsoft SQL server 2005. The application fetches session data of each learner from databases and IIS log files.

The resultant XML files can be saved on disk. The XML file generates different tags for each record which will be easy for understanding. The XML file 1 and file 2 is as shown in Figs. 1 and 2 respectively. In Fig. 2 XML file of each learner is having unique SessionId with SequenceId (it is sequence of activity number) and each learner can have multiple SessionId with SequenceId. The XML file 1 is generated to identify the time spent and frequency of accessing each file and page by learner in each session. The XML 2 file generates the sequences of accessing files and pages as per timestamp in combined sessions of


```
<?xml version="1.0"?>
<UserLogs>
 - <Page>
     <UserId>7</UserId>
     <PageURL>/e-learning/Default.aspx</PageURL>
     <LogTime>29</LogTime>
     <StartTime/>
     <EndTime/>
     <SessionId>12345</SessionId>
     <SequenceId>1</SequenceId>
   </Page>
 - <Page>
     <UserId>7</UserId>
     <PageURL>/e-learning/TopicsSearch.aspx</PageURL>
     <LogTime>29</LogTime>
     <StartTime/>
     <EndTime/>
     <SessionId>12345</SessionId>
     <SequenceId>2</SequenceId>
   </Page>
 - <File>
     <UserId>7</UserId>
     <FileURL>http://localhost:49160/EducationPortal/Files/M5L1.pdf</FileURL>
     <LogTime>29</LogTime>
     <StartTime/>
     <EndTime/>
     <SessionId>12345</SessionId>
     <SequenceId>3</SequenceId>
   </File>
 - <File>
     <UserId>7</UserId>
     <FileURL>http://localhost:51629/EducationPortal-CODE-07062011/Files/arrays
```


Fig. 1. XML file 1


```
   </File>
 - <File>
     <UserId>19</UserId>
     <FileURL>lecture4.ppt</FileURL>
     <LogTime>8</LogTime>
     <Count>1</Count>
   </File>
 - <File>
     <UserId>19</UserId>
     <FileURL>L22-LoopingControl Structures.pptx</FileURL>
     <LogTime>31</LogTime>
     <Count>1</Count>
   </File>
 - <File>
     <UserId>19</UserId>
     <FileURL>Basic Array.mp4</FileURL>
     <LogTime>3</LogTime>
     <Count>1</Count>
   </File>
 - <Page>
     <UserId>10</UserId>
     <PageURL>/EducationPortalWeb/Default.aspx</PageURL>
     <LogTime>31</LogTime>
     <Count>1</Count>
   </Page>
 - <Page>
     <UserId>10</UserId>
     <PageURL>/EducationPortalWeb/Announcements.aspx</PageURL>
     <LogTime>8</LogTime>
     <Count>1</Count>
   </Page>
 - <Page>
     <UserId>10</UserId>
     <PageURL>/EducationPortalWeb/TopicsSearch.aspx</PageURL>
```


Fig. 2. XML file 2

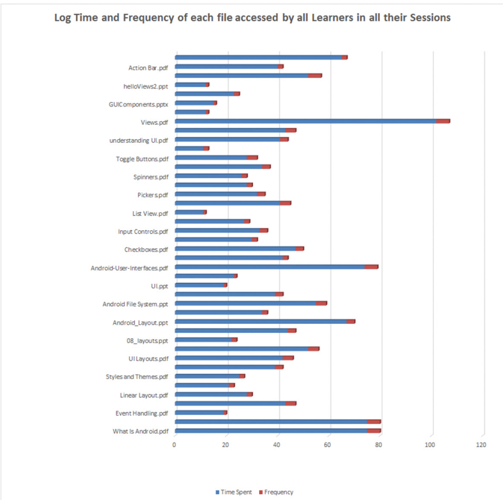

Fig. 3. Graph 1: Time spent and frequency of each file accessed by all learners

each learner. These both XML files are useful to identify common user profile based on aligned sequences, time spent and frequency (Figs. 1 and 2).

5.2 Analysis of Pre-processed Usage Data

After pre-processing the usage data and after generating XML files, usage data is analyzed to identify different statistical information. One of the important information is, how many times (Frequency) each learner accessed file and how much time spent(Log Time in Minutes) on each file by all learners in all their sessions. The graph 1 shows the information about more than 100 files.

6 Conclusion and Future Work

The use of personalized and adaptive e-learning system has become increasingly important in recent years, with extensive research being devoted to finding different ways of tailoring the learning styles for individual students. The work focuses on grouping the session details obtained from different log files. Different algorithms have been implemented to analyze the session log details of learners. The captured web log in the IIS and Database is an important source to identify the learning styles of learners. The learner's session has been considered as the total number of learning objects accessed by that specific learner. The captured database log data consists the details related to pages and files accessed by a learner as per unique session identifier allotted to the learner. The sessions are grouped together based on the time spent and frequency of the accessed learning objects. This helps to generate the sequences of learning objects. The FSLSM model is used to map the sequences into the learning styles. The log data has been converted into the standard XML format for clustering and learning path optimization.

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Open Badges: Encouraging Participation in Software Development Modules

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Abstract. This paper will discuss the initial steps taken to ascertain the suitability of Open Badges as a motivational and pedagogical tool for students undertaking Software Development modules. The literature reviewed suggests that the Open Badges are a positive motivational tool but that careful design is required to maximize their introduction. Students were surveyed to gauge their knowledge of Open Badges and to ascertain their desire for inclusion.

Keywords: Open badges · Student engagement · Software development motivation

1 Introduction

The Open Badge system, as developed by Mozilla, is open to organisations and educational institutions for the purpose of issuing digital badges. A web based technology; badges are "digital images that have built in data about the issuer, criteria, and evidence" [1].

Open Badges are a topic that is growing in stature and relevance within education and as such warrants investigation into its suitability for inclusion and use in Software Development modules. The aim is to use Open Badges as a tool for motivating, engaging and engendering self-worth within the student. Through a portable achievement mechanism that can be used as a skills differentiator for employers and as a form of social achievement.

To ascertain an understanding of the students' perception of Open Badges a survey of undergraduate students, studying on software development degrees, was initiated.

2 Literature Review

Jovanovic and Devedzic note the need for recognition of "soft skills" and "generic competences" as a prime mover in the rise of Open Badges [2]. Goligoski suggests that badges are a good means of capturing skills not just knowledge [3]. Gibson et al. also suggest that badges can provide a detailed breakdown or map of the student's skills achievement [4].

The concept of collecting badges would be fostered amongst the student cohort as a means of encouragement, hopefully, evoking a sense of self-worth and giving a platform for differentiation of ability outside of academia [3].

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Engagement is a perennial issue faced by educators and as such every effort must be made to engage the student in a meaningful and productive way. Open Badges can be proffered as a possible tool to help motivate and engage the student [2].

The motivational quality of Open Badges for the student relies on the following four aspects as identified by Jovanovic and Devedzic [2]: desirability, attainability, challenging nature and awarded for. Glover also acknowledges that desirability, attainability, and challenge will help to motivate the student, but also notes that employers may find badges desirable as a means of depicting the student's skills [5].

There is a view that rewarding or issuing badges based on effort and or improvement provides more encouragement to the student to progress and improve on their learning [2].

The ability of Open Badges to be collected can invoke within the student an inherent motivation or desire to collect all available badges in the same way that people are naturally drawn to collectable based hobbies; anecdotal evidence in [1] adds credence to this postulation.

Findings from Santos et al. study suggest that integrating Open Badges into collaborative learning environments can help to promote motivation and engagement amongst the student cohort [6].

Põldoja and Laanpere have identified four Open Badge design patterns: Composite, Activity-based, Grade-based and Hierarchical [1]. This classification shows the potential for varying the mode of badge achievement within a module or programme of study. Using the definitions provided in [1] composite style badges can be earned through completion of a number of assignments, activity-based badges can be earned by the student meeting the criteria on "measurable learning activities", grade-based badges are, unsurprisingly, based on the students grades and hierarchical based badges use a building block approach to award badges on the basis of previous work at a lower level.

Rughini and Matei have adopted a tiered approach to their implementation of Open Badges based on a medal system i.e. 'Bronze', 'Silver' and 'Gold' [7]. These medals are awarded based on the student's grade point average in the respective range 75 %, 85 % and 95 %. This is an interesting approach and could act as a motivator for students wishing to attain high marks and by implication a 'Gold' standard.

An interesting observation from Santos et al. suggests that regular awarding of badges helps to maintain levels of engagement [8].

The general concept of badges is one of positive activity; however, Santos et al. also created 'negative' badges for awarding to students based on their lack of participation [8]. This is an interesting departure from the normal idea and may well have a positive outcome in itself as evidenced by their findings when students ranked such badges amongst the most important [8].

If badges are to hold any currency outside of academia then they have to somehow have attached to them a record of the student's competency and learning achievements [9]. Badging systems must therefore allow badges to store metadata that will indicate who the badge issuer is, what the student has done to achieve the badge and the level of attainment [9].

Giannetto et al. observes that badges act as a means of "positive feedback" for the student which in turn can engender a "feeling of accomplishment" for the student which in turn will lead to a desire within the student to strive for further attainment [10].

Jovanovic and Devedzic highlight the possibility of intrinsic motivation, engaging with the task through personal interest, being diluted by extrinsic motivation, engaging with the task to gain a reward i.e. the badge, suggesting the occurrence of “motivation displacement” [11].

Ahn et al. observe that badges are a viable pedagogical tool citing the concept of visible badges acting as a “roadmap” indicating to the student the activities and achievements available [12]. Designing badges to encourage “positive learning behaviours” and convey valued knowledge and skills [12].

3 Survey

After consideration of the literature in the previous section, in particularly Jovanovic and Devedzic suggestion that the popularity of Open Badges tends to be in academia and driven by educational technologist [2], it was decided to survey the current student cohort to ascertain their knowledge of and views on Open Badges.

The survey was designed in two parts: firstly to gain an understanding of the student cohort’s knowledge of Open Badges and secondly to determine the student cohort’s thoughts on the introduction of Open Badges to programming modules.

Each survey was created using Google Forms, a highly flexible tool that makes the creation of surveys quick, easy and free. Surveys created using Google Forms are accessible on all formats: web, mobile and tablet. The survey was disseminated to the student cohort via an emailed link.

The first survey was split into three sections although not all sections would be accessed by the student. Using a technique available in Google Forms the order with which the student interacts with the survey could be dictated.

The first question of the survey, Fig. 1, is a simple binary question. If the respondent answers yes, they have heard of Open Badges then they are directed to the second section of the questionnaire. If the respondent, however, responds no, then the survey is complete and no more sections are shown. If the student cohort were unaware of Open Badges then there was no need to proceed to the next section of the survey (Fig. 2).

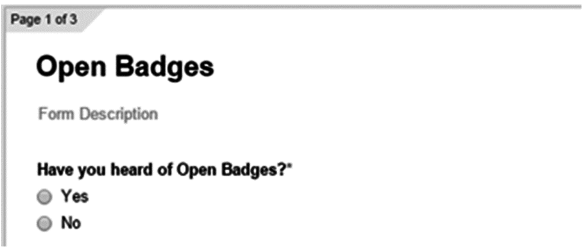
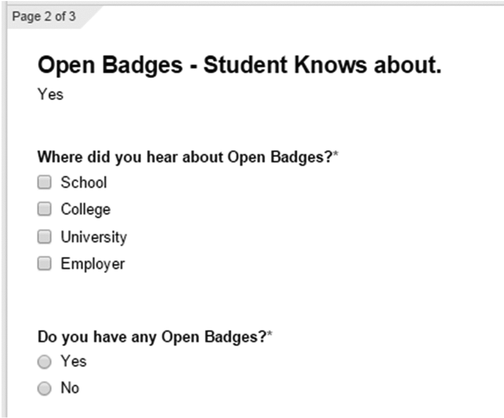


Fig. 1. First question of initial survey.

For those students that had heard about Open badges it was important to gauge where they had heard of them and to determine if they already had any badges. Students who answered yes to having badges were subsequently directed to the third and final part of the survey. Students who answered no were thanked for their participation and did not continue to the third part of the survey.

The questions in Fig. 3 are used to determine the number of badges a student may have and the skill area the badges are in.


Page 2 of 3

Open Badges - Student Knows about.

Yes

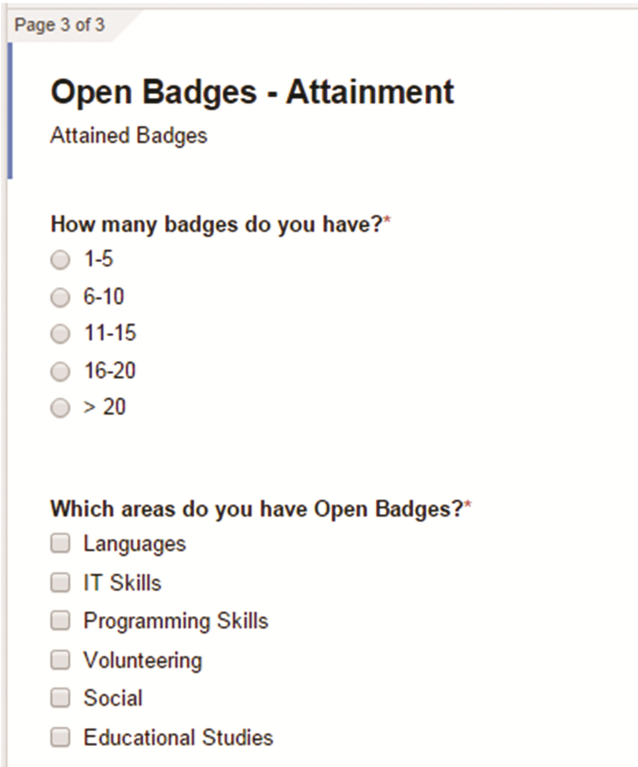
Where did you hear about Open Badges?*

- School
- College
- University
- Employer

Do you have any Open Badges?*

- Yes
- No

Fig. 2. Second part of first survey.


Page 3 of 3

Open Badges - Attainment

Attained Badges

How many badges do you have?*

- 1-5
- 6-10
- 11-15
- 16-20
- > 20

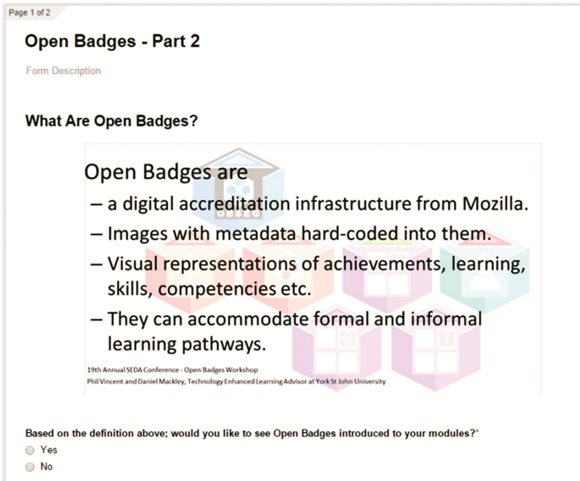
Which areas do you have Open Badges?*

- Languages
- IT Skills
- Programming Skills
- Volunteering
- Social
- Educational Studies

Fig. 3. Final section of first survey.

Like the first survey the second survey was split into two sections and completion of both sections was dependent on the answer to the first question.

For the second survey, Fig. 4, the students were given a definition of Open Badges and asked, based on the definition, if they would like to see Open Badges introduced into their modules.


Page 1 of 2

Open Badges - Part 2

Form Description

What Are Open Badges?

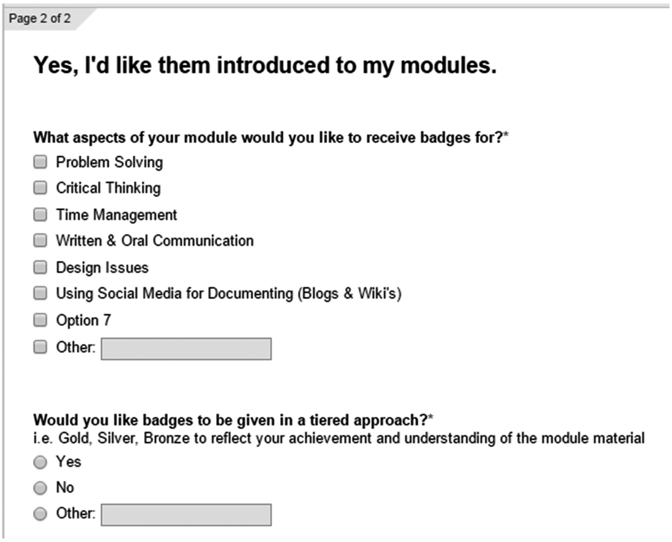
Open Badges are
– a digital accreditation infrastructure from Mozilla.
– Images with metadata hard-coded into them.
– Visual representations of achievements, learning, skills, competencies etc.
– They can accommodate formal and informal learning pathways.

19th Annual SEDA Conference - Open Badges Workshop
Phil Vincent and Daniel Mackley, Technology Enhanced Learning Advisor at York St John University

Based on the definition above; would you like to see Open Badges introduced to your modules?*
- Yes
- No

Fig. 4. Survey 2 first question.

The final section of the questionnaire, Fig. 5, was used to determine the aspects of the module that the students would like to receive credit for and if they would like to see a tiered approach to its implementation.


Page 2 of 2

Yes, I'd like them introduced to my modules.

What aspects of your module would you like to receive badges for?*
- Problem Solving
- Critical Thinking
- Time Management
- Written & Oral Communication
- Design Issues
- Using Social Media for Documenting (Blogs & Wiki's)
- Option 7
- Other:

Would you like badges to be given in a tiered approach?*
i.e. Gold, Silver, Bronze to reflect your achievement and understanding of the module material
- Yes
- No
- Other:

Fig. 5. Survey 2 final section.

4 Results

This section will discuss the results obtained from the two surveys, trying to put them into context for the author's educational establishment. All the students surveyed were undertaking Software Development modules related to Games programming.

This was by far the stand out result of the survey; the expectation was that a high percentage of the student cohort would have had some level of knowledge of Open Badges (Fig 6).

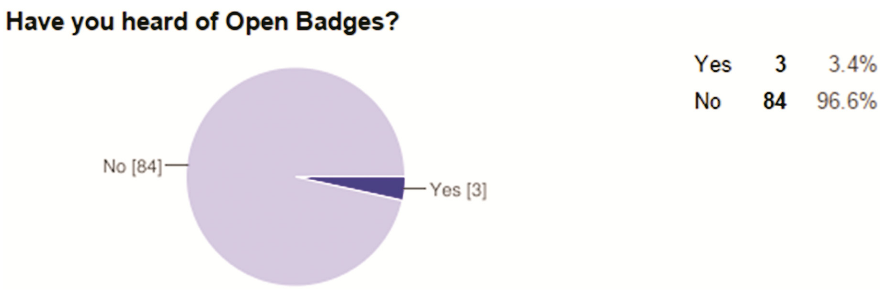


Fig. 6. Number of students aware of Open Badges.

The results in Fig. 7 were interesting but due to the low number not significant that all three students had heard of Open Badges through the University. Not unsurprisingly none of the students that had heard of Open badges actually had any.

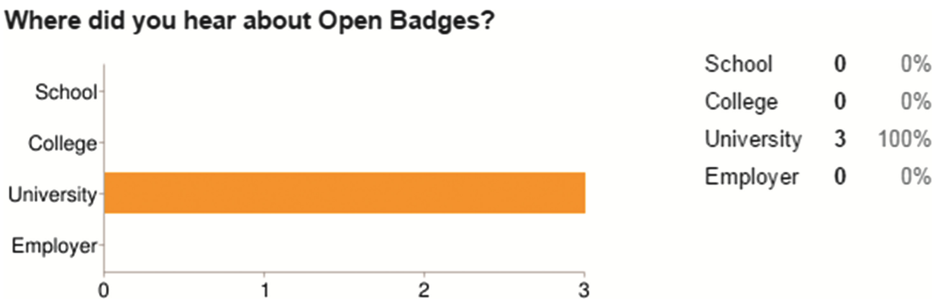


Fig. 7. Where did you hear about Open Badges?

The second survey undertaken by the student cohort had less participants than the first but it still provided some interesting data.

Interestingly, Fig. 8, shows that 14 % of students surveyed would not like to see the introduction of Open Badges to their modules. This was a higher than expected figure.

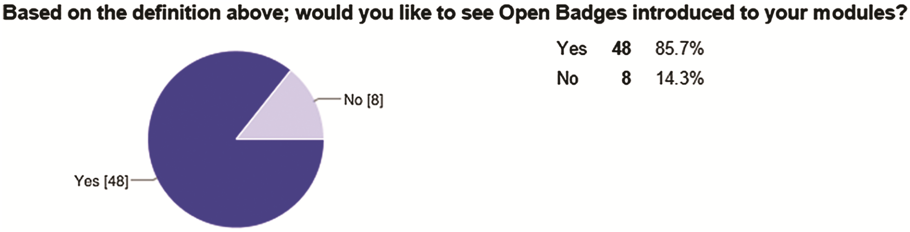


Fig. 8. Would you like to see Open Badges introduced?

The results in Fig. 9 highlight a number of interesting issues. Firstly, the number of students selecting problem solving, making this the top aspect. Currently students undertaking modules in programming do not exhibit strong problem solving skills as there is a reluctance to engage in proper systems analysis prior to coding with students prone to head straight to development. Again, like problem solving, it was surprising to see critical thinking and design issues occupy the second and third place for the same reason mentioned for problem solving.

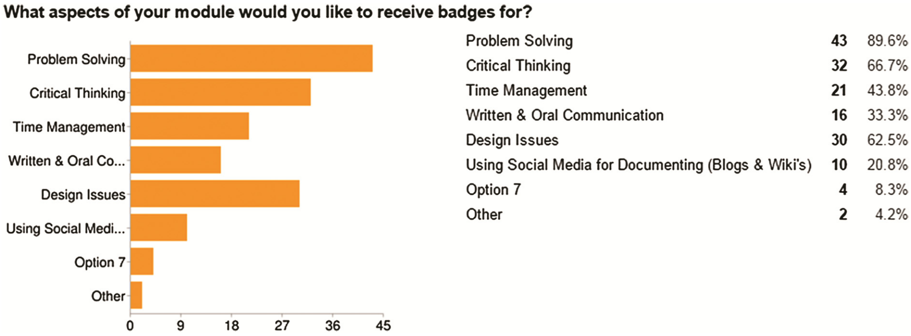


Fig. 9. Aspects of module to receive badges.

It was expected that documenting using Blogs and Wikis would feature higher than it did. The ubiquitous nature of Blogs and Wikis and its media rich format suggested that it would be a good candidate to feature higher in the list.

5 Conclusion

Although 96 % of the students initially surveyed had no knowledge of Open badges the results of the second survey indicated that around 85 % would welcome the inclusion of Open Badges into their modules. Armed with this data it has been decided to introduce Open Badges into Software Development modules as a test in the new academic year. Cognizance will need to be taken of the design issues required for integrating an Open Badge system into the modules to meet not just the expections of the students outlined in the second survey but also to allow a sound pedagogical foundation that will encourage and engender motivation within the students.

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MOOCs Scenarios and Learning Recognition. A Step Further?

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Abstract. This paper introduces some pedagogical reflections about the "lights" and "shadows" of the MOOCs in higher education. It presents the main characteristics of those courses and proposes feasible potential scenarios of online learning recognitions. Currently, there are several modality to design the assessment in the massive courses, but the majority of them focus only on summative assessment function.

Keywords: Moocs · Assessment · Certification · Recognitions · OER

1 Introduction

In the last four years, Massive Online Open Course has become one among the widely used terms - also in the academic field - to envisage and promise a "new" scenario of distance learning. It is too early, probably, to attribute the label of "fifth generation of distance learning". Surely, we could identify some peculiarities able to differentiate the MOOCs from certain types of eLearning. One of these peculiarities is traceable in the MOOC's acronym, intended as massive online courses, open to all of those potential users (students or citizens) who can have access to the "internet world". Thus, MOOCs are courses provided by public educational agencies (such as schools and universities) and private sector (Foundations and Companies) with the mediation of online open source and/or proprietary providers platforms (examples: Coursera, Udacity, EDX etc.). In these courses, the users have the opportunity to know and to explore certain topics through the individual study (xMOOC) or the social (cMOOC) interaction. In the scientific available literature, the acronyms xMOOC and cMOOC identifie two main types of massive courses. The first type, xMOOCs, could be metaphorically exemplified with the image of the "traditional" eLearning, characterized by a low level of interaction among users during their (self) learning processes. Instead, the second category, cMOOC, emphasizes the "connectivist" matrix [1] of the massive course, which is pedagogically designed to sustain the implementation of constructive learning processes both of individual and of groups. Beyond the enthusiasm echoes about the MOOCs affecting in the various areas of education and training, this article attempts to face problematically the phenomena of massive courses in higher education, emphasizing some "lights" and "shadows" of this "new" scenario.

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Are the MOOCs disruptive? To what extent MOOC will be able to revolutionize the paradigms of education? A recent and interesting contribution [2] reports that while many educational institutions debate on the effects of MOOC in their practices, the considerations that are made have little to do with pedagogy. In other words, the constant quantitative diffusion of these courses does not go up with an adequate educational reflection on them. There is the need to test new theoretical scenarios in order to adopt pedagogical perspectives that can effectively support the online education and blended learning [3].

To understand how close and reciprocal are the link between "technical" and "pedagogical MOOCs design", some authors argued that platforms that host MOOCs are one of the variables that can strongly homogenize the learning experiences of students. Therefore, to explicit the teaching architecture programmed into the platform is necessary a step to identify the platform that better meets the theoretical, methodological, educational needs of our massive course.

2 MOOCs: Which Assessment?

Analyze the phenomenon of MOOCs in a pedagogical perspective requires to reflect on ways and tools of assessment available in these "new" learning scenarios. Assessment is a relevant topic in MOOCs by different points of view. MOOCs show a high level of experimentation of technology based assessment, both standard assessment methods such as "machine and peer grading" [4], and semantic web and learning analytics [5, 6].

Generally, taking into account the learning process, the assessment carries out two different and complementary functions. It is formative when it produces information and feedbacks that support the students and teachers to adjust their processes (teaching and learning). It is summative when it allows a balance and a judge on the learning outcomes achieved (with possible certification).

Certainly, the summative assessment and the way of recognition and certification of the learning outcomes are relevant topics discussed in different academic publications. Regarding this aspect in the next paragraph, we discuss and present several modalities of recognitions and – eventually - certification, highlighting restrictions and limitation to their adoption in the academic institutions. This restriction implies a reflection on the relation between the formality of the recognition (certification) and the robustness of the assessment adopted [7].

Despite the evident relevance of the summative assessment, in the environments outlined by MOOCs, it is necessary a more explicit presence of the formative function. It allows the students to receive formative feedback regarding their own learning and to improve their self-regulation process. This point is also important considering that a notable advantage of e-learning modalities, beyond and before MOOCs, there is the possibility for students to have interactions and receive feedbacks on their individual learning process. Despite this, the MOOCs' massive dimension implicates several challenges in order to carry on with this educational trend.

On the other hand, assessment is not designed and implemented in the same way in the two MOOCs categories [6, 8]. Under some conditions while xMOOCs prefer summative assessment, in cMOOCs the assessment of the process is included in its original constructivist pedagogical model. These distinguished differences are well expressed in Table 1 [9].

Table 1. Assessment trends in xMOOCs and cMOOCs [9].

xMOOCs	cMOOCs
Multiple choice tests at the end of each week	Assessment of tasks or resources created
Multiple choice final examination	Use of rubrics
Student recognition protocols (identity check): webcam, digital ID..	One fellow student provide feedback on another
A specific platform is developed to accommodate all the information	Developed on the web using various resources and telematic tools

In a recent study on the state of the art of MOOCs [10], identified similar assessment characteristics comparing cMOOCs and xMOOCS. The first typology was essentially defined by self-assessment, peer assessment and, in some cases, test; instead of Quiz, Test and a minor presence of peer assessment were the most common assessment modalities of xMOOCs.

Thus, the two most common procedures to implement assessment in MOOCs are tests and peer assessment and/or peer grading, and both have advantages and limitations.

Using test to assess students' learning is also common in more traditional course environment, both in presence and on-line, and it is not a negative element especially when it is part of a coherent methodology and there is awareness regarding the type of learning to be assessed, essentially contents.

The problem arises when summative is the only assessment modality also in the case of the eventual certificate achievement. Different kinds of learning, such as skills and attitudes have to be assessed using different modality more oriented to the formative assessment.

Otherwise, peer assessment is a modality present in both typologies of MOOCs, more in cMOOCs but likewise the more important platforms for xMOOCs allow this modality of assessment and teachers use it [10]. Regarding this point, a survey of MOOCs faculty conducted by *The Chronicle of Higher Education* showed that 34 % of teachers used peer grading; 25.8 % consider it "very reliable" and 71 % found it "somewhat reliable" [11].

As stated above peer assessment was used in both cMOOCs and xMOOCS to assess several students' capabilities, through essays and project review and also team tasks, but it could produce some false practices such as the so called "the blind leading the blind" and "the charlatan" [12]. In order to avoid these and other dysfunctions and to effective and non-trivial peer assessment has to be collectively learned and practiced. In other words, the skills to assess cannot be learned by a lecture or a text, they have to be grown through a reflective practice [8].

A pedagogical designed strategy of a MOOC needs to consider a reflective modality of improving assessment including its formative function and this it is also a challenge that MOOCs design has to deal with.

3 MOOCs: How to Recognize the Learning Experience?

Another relevant topic concerns the mismatch between free access to the Online Massive Courses and the level of openness and re-use of its learning contents. Evidently, the free access in a massive course does not usually match with gratuity. With regard to this last point, there are two relevant issues. The recognition of the learning path and the policies of use and re-use of learning resources.

In the first case, the recognition could be achieved through different form of output (certificate, badge, credits.) and it could be differentiated in relation to the target and the user needs. If, for example, any citizen is interested to attend the massive course organized by MIT on the "Artificial Intelligence" he/she can have access freely, independently to obtain or not a formal certification. Thus, a simple "certificate of participation" might be perfect for his/her goal.

However, the problem became more complex if the same course was attended by an university student interested to formally recognize his/her learning outcomes (in terms of credits, final proofs etc.). We acknowledged that in the last five years, European universities have been developing a scientific reflection and strategies to avoid the issues about recognition and certification of the learning occurred in online courses scenarios (Fig. 1).

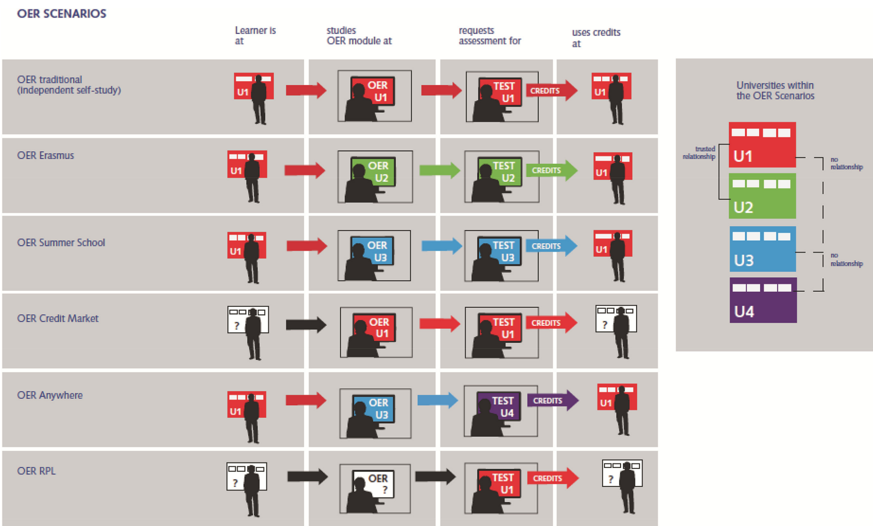

Fig. 1. OER/MOOCs scenarios

Currently, an important obstacle that characterizes the Italian context regards growing proliferation of private entities that does not correspond to the creation, in the public domain, of an "agency" in charge to manage and propose policies addressed to face these issues.

Slowly but surely, something is moving. Taking into account the main results of the European project OERTest (http://edunetworks.ugr.es/oertest/) the Universities can, potentially, activate six scenarios to encourage the formal recognition of online learning courses and/or part of them [13].

- MOOC Traditional: The only difference from traditional eLearning is that this is done using OER-based materials. Self-study modules with credit are not unusual.
- MOOC Erasmus: Under this scenario, a student takes OER-credit from a trusted university, with an existing relationship with their home university.
- MOOC Summer School: Here, U1 has no agreement on standards etc. with U3, and so must assessed quality of the credits, perhaps using exam or portfolio model.
- MOOC Credit Market: In this model, U1 assesses a learner using the methods it has decided are appropriate for its own OER module and offers ECTS credits to be taken away and used, as learner wishes/is able.
- MOOC Anywhere: U1 has no knowledge of the curriculum or standards etc. of the offering at X, and so must assessed quality of the credits using RPL methods, e.g. exam or portfolio model. Learner wishes to enter U1 and offers learning from OER as the basis for entry.
- MOOC RPL: U1 must assess using protocols similar to those used for Recognition of Prior Learning, as it has no prior basis for evaluating standards of the OER curriculum.

Which of those scenarios are feasible? A research addressed to the OERTest Partnership highlighted that, despite the six challenges above mentioned, in the University there are only two usual ways to recognize the online learning courses/or modules: the "MOOC Traditional" and the "MOOC Erasmus". Nevertheless, this survey detects also an increased awareness by policy makers about the strategic importance of coping to the issues. However, if, on one side these institutions begin to clarify this question, and on the other side the adoption of further scenarios requires, inevitably, a reconfiguration of political, economic and organizational aspects. It is obviously that changes cannot be carried out within short time.

4 The Paradox of Access, Use and Reuse of the Digital Contents

Another issue that we briefly describe looks the policies of use and re-use of learning resources that characterize a MOOC. We can state that while access to MOOC is free, the opportunity to access content without costs does not imply, in some cases, the possibility to reuse content in other contexts, edit or combine them into other digital products to create new educational resources. That statement reveals some oxymorons. The massive opening of the courses, in terms of access, does not correspond with the opening (also in terms of licenses and informatics code) of digital learning resources. In most cases, both contents and platforms are characterized by closed policies of copyright, which prohibits for instance, the use, re-use and distribution of digital learning contents. The situation is, therefore, a paradoxical one.

While Europe Union invests economically and culturally to promote politics and practices related to the diffusion of Open Educational Resources, we can notice that the majority of MOOCs are, at the same time, "open" but "closed". This "paradox" could be understandable considering that the MOOCs phenomena are crossing different territories with diverse institutional and economic interests. Thus, the scenario's that is figuring out contemplate the coexistence of a plurality of cultures, that use the same acronym, but that are moving from the profit the non-profit word, from industries to public (and private) universities.

As it happens in the international contexts, even in the academic Italian field the University interested to activate a MOOC prepares a formal request addressed to one of the actors (often private) that "host", in a specific platform, the massive courses. Evidently, through this step, the applicant entity (the University) does not have much chance to intervene on pedagogical design of the course. The university task concerns only on the preparation of learning contents following a pre-structured format. This format, in the majority of case, reproduces the traditional teaching-learning "trasmissive" model, based on activities as reading, repeating and attempting the quiz. Our point of view underlined the dangerousness of rigidity of the majority of the MOOC's format delivered, and we attribute to these "inflexibilities" one the main reasons related to the high levels of dropout and failure of these massive courses.

Finally, we would like to spend a few words about the business model behind the MOOCs. What is, for example, the return of investment (ROI) for the universities whereas the preparation of a massive online courses require more time than the preparation of traditional courses? According to some authors, 2013 was the year of MOOCs sustainable business model. Coursera to release a certificate of course completion, with its Signature Track program, requires from 30 to 100 dollars. Through this strategy, it has earned 1 million dollars. Other business strategies concerns, for example, the customization of the MOOC platform and the student's database consultation from interested institutions [14].

5 Conclusions

This paper highlights how it is important to be aware of the different challenges that higher education institutions have to cope, in order to design and implement a MOOC.

The MOOC pedagogical design, should consider the formative and summative assessment as an integrated part of learning processes. With this regard, it is also important to valorize not only summative strategies and tools but also the formative dimension of the assessment. However, due to the massive number of participants, this is not a simple aspect to manage. Currently, there are several modalities to carry out assessment but they focus, exclusively, on the summative assessment function.

Strictly related to the summative assessment, the recognition and certification of learning outcomes could assume a central role in the MOOC reflections. We have presented six different scenarios of MOOC recognition and certification, each of them with a different level of feasibility in the Higher Education practices. Even if the original meaning related to the first "O" of MOOC, "Openness", includes four dimensions Reuse, Revise, Remix, and Redistribute [15], we have seen that the majority of them are not "open".

To improve the quality of MOOC pedagogical design, take in account also the centrality of the assessment and learning recognition, we need to improve the research available and quickly review currently practices of MOOC, before losing their educational potential.

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Big Data and Organizational Learning: Conceptualizing the Link

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Abstract. Organizational learning is key for organizations in creating and enhancing business processes as well as improving decision making to gain competitive advantage. Big data is becoming a source of competitive advantage, productivity growth, agility and innovation for organizations. Harnessing knowledge from big data has the potential to create individual and collective learning within organizations. Conceptualizing the link between big data and organizational learning is thus worth investigating if big data is to contribute to organizational learning. To understand the big data and organizational learning link, the characteristics of big data, the tools associated with big data and how organizations learn needs to be understood. Big data assist organizational learning by using its tools to aid the knowledge conversion process. The characteristics of big data are exhibited through the use of big data tools in the management of knowledge involved in organizational learning.

Keywords: Organizational learning · Big data

1 Introduction

Big data refers to large amounts of data that organizations gather in structured, semi-structured and unstructured forms and hold intrinsic value that can be extrapolated through analytics (Chen et al. 2012). This data emanates from everywhere: GPS, social media, purchases, corporate IS etc. Analyzing such big data is a source of competitive advantage, productivity growth, agility, innovation and an answer to questions that were previously beyond the reach of organizations (Boyd and Crawford 2012). Harnessing knowledge from such big data has the potential to create individual and more importantly collective learning within organizations (Kabir and Caraynamis 2013). Organizational learning is necessary if companies are to adjust their behavior to reflect their learning by creating new business processes, enhancing existing processes and by changing patterns of management decision making to make them gain competitive advantage (Laudon and Laudon 2013). Organizations that learn can sense and react to their environments rapidly. Such organizations survive longer than organizations that have poor learning mechanisms (Kabir and Caraynamis 2013). Conceptualizing the link between big data and organizational learning is thus worth investigating if big data is to contribute to organizational learning. This paper seeks to conceptualize the link between big data and organizational learning.

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2 Understanding Big Data

To begin conceptualizing the link that exist between big data and organizational learning it is important to understand what makes up big data. According to Wamba et al. (2015), big data is characterized by 3 V's – volume, variety and velocity. However 2 V's – veracity and value – have been added in recent times. Thus the 5 V's of big data are;

- **Volume**: refers to the large sets of data being amassed by organizations ranging from terabytes to petabytes.
- **Variety**: aside structured data, big data includes semi-structured and unstructured data of all types (text, video, audio, logs, clicks, etc.)
- **Veracity**: The quality of data is vital to harness value from big data devoid of errors and misinterpretation.
- **Velocity**: to gain maximum value organizations should be able to use big data as it streams in and still archive it for future use.
- **Value**: obtaining value from big data is the ultimate goal of big data initiatives.

Big data also provides a collection of technological and analytical tools that define the value of data sources and translate the values into actionable elements (Ohlhorst 2012). These are;

- **Business intelligence (BI)**: A wide range of applications and technologies for data gathering, storage, analysis and provision of data access. BI is able to provide current, historic and predictive opinions on business operations.
- **Data mining**: It involves data analysis from varied perspectives to unearth new patterns in data and delivering them in summarized forms which are useful to organizations.
- **Statistical applications**: It involves statistical tools which work on statistical data sets such as census and polls. They normally lead to estimations, testing and predictive analysis to a large population from a sample size that has been analyzed.
- **Data modelling and visualization**. It comprises of multiple "what if" scenarios for whose algorithm multiple data sets can be used on to produce different models. Data modelling and data visualization works hand in hand to uncover insights for a particular business venture.

Organizations learn from tacit and explicit knowledge through individual or collective means (Nonaka and Takeuchi 1995). Big data facilitates this learning process based on the characteristics of big data and the tools associated with big data. Before going any further, it is important to understand how organizations learn so as to thoroughly analyze how big data is linked to organizational learning.

3 How Organizations Learn

Organizational learning is the process of creating, retaining, and transferring knowledge within an organization (Argote and Miron-Spektor 2011). At the basic level knowledge is created by individuals with the organization supporting creative individuals or providing the context for such individuals to create knowledge (Abel 2014). Thus the organization amplifies individual knowledge creation and crystallizes the knowledge as part of knowledge network of the organization to aid organizational learning. Beyond knowledge creation at the organizational leve, l inter-organizational level knowledge can also be created and made part of the knowledge network of the organization to aid organizational learning. Inter-organizational level knowledge is created based on the interaction that spans between the organization and its customers, suppliers, distributors and competitors (Argote and Miron-Spektor 2011). As knowledge creation occurs, there is a conversion process that exist as tacit knowledge of individuals and explicit knowledge interact. This leads to a knowledge conversion process (Nonaka et al. 1994) which can be classified into four modes.

- **Socialization**: Tacit to tacit conversion, a process of sharing experiences through observations, imitation and other mental practices.
- **Externalization**: Tacit to explicit conversion, a process of articulating tacit knowledge into explicit through the use of abstractions, metaphors, analogies, or models;
- **Combination**: Explicit to explicit conversion, a process of creating explicit knowledge by bringing together other explicit knowledge from a number of sources; and
- **Internalization**: Explicit to tacit, a process of embodying explicit knowledge into tacit knowledge. Internalization is facilitated if the knowledge is codified or conveyed in terms of explicit knowledge.

Beyond the creation of knowledge and its conversion process lies the greater role of knowledge management which ensures that knowledge is retained and transferred within an organization. Knowledge management refers to the set of business processes developed in an organization to acquire, create, store, transfer, and apply knowledge. (Singh Sandhawalia and Dalcher 2011). Knowledge management increases the ability of the organization to learn from its environment and to incorporate knowledge into its business processes. Big data can play a vital role in all these processes of knowledge acquisition, creation, storage, transfer, application and the knowledge conversion process to aid organizational learning. The next section looks at the vital role big data can play in organizational learning.

4 Organizational Learning Using Big Data

Big data plays two key roles in organizational learning based on the characteristics and tools big data offers. The first is the role big data plays in the knowledge conversion process and the second is the role big data plays in the knowledge management process or value chain. Table 1 summarizes the role big data plays in the knowledge conversion process.

In organization learning, big data facilitates the process of knowledge management through its characteristics at different stages of knowledge management. Variety in the form of structured, semi-structured and unstructured data are exhibited at the creation stage of managing knowledge using BI tools. Veracity of data and how quick (velocity)

Table 1. The role of big data in the knowledge conversion process for organization learning

Conversion Mode	Knowledge Conversion Process	Big Data Tool Support
Tacit to Tacit (Socialization)	• Capturing individual knowledge • Sharing individual knowledge • Interaction of shared experiences • Feedback without criticism	BI tools are used to harness knowledge as is shared or experienced by collecting them from several social media platforms in the form of unstructured and semi-structured data for analysis and making it part of the organizations knowledge network. Issues of privacy normally arise.
Tacit to Explicit (Externalization)	• Communication (dialogue) • Capturing collective knowledge and explicit knowledge creation • Diffusion of knowledge at the collective level • Instant feedbacks and exchange	BI tools are used to assist the capturing of tacit knowledge in structured form from individuals and groups by intelligently and predictively aiding the capturing process with interfaces that suit either real time processing or batch processing or other procedures.
Explicit to Explicit (Combination)	• Organizing and categorizing of knowledge • Integration of sources of knowledge • Platform for collective/collaborative knowledge creation • Searchable/accessible and distribution • Collecting internal and external knowledge	BI, data modelling, statistical application and data mining tools are used to review existing explicit knowledge to generate an improved explicit knowledge.
Explicit to Tacit (Internalization)	• Access to explicit knowledge • Re-experience others explicit knowledge • Asynchronous learning (any place any time) • Experiential (actualizing concepts and methods)	BI tools, data modelling tools, statistical application tools and data mining tools are used to present analyzed explicit knowledge for decision making and intuitive learning by individuals and groups. Individuals and groups form mental pictures based on analyzed knowledge to share now or later.

Source: Adapted from Boateng, Mbarika & Thomas, (2010) data arrives are crucial at the creation stage. Volume exhibits itself through the use of BI tools to store data at the storage stage with velocity being crucial at the transfer stage. Finally a combination of BI, data modelling, data mining and statistical applications tools are used to harness value from big data at the application stage.

5 Conclusion

To understand the big data and organization learning link, the first recommendation is to understand the characteristics and tools associated with big data. Secondly, an understanding of how organizations learn and manage the knowledge involved in the learning process is essential. Finally, the role of big data in the knowledge conversion process (Table 1) and role of big data in the management of knowledge (Fig. 1) in the learning process is essential.

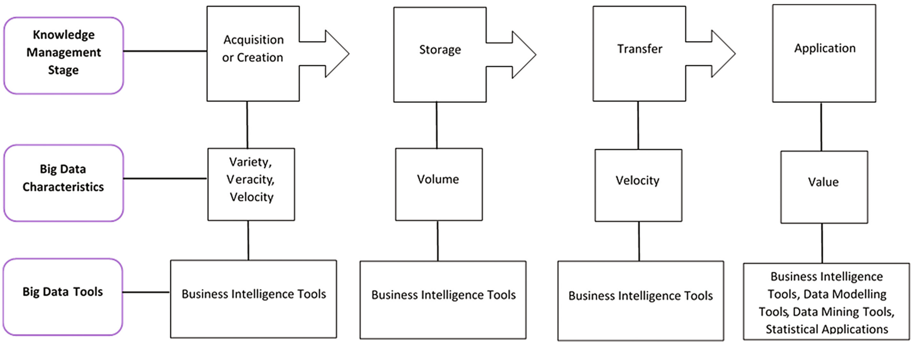

Fig. 1. Big Data Characteristics and Tools associated with managing knowledge for organizational learning

In conclusion, the constructs presented in the paper are just a start in fully showing how big data is linked to organizational learning. More research is need to concretely establish these constructs.

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Fostering Collective Intelligence Education

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Abstract. New educational models are necessary to update learning environments to the digitally shared communication and information reality. Collective intelligence is an emerging field that already has a significant impact in many areas and will have great implications in education, not only from the side of new methodologies but also as a challenge for education, currently more focused on the individual than in the collective. This paper proposes an approach to a collective intelligence model of teaching using Internet to combine two strategies: idea management and real time assessment in the class. A digital tool named Fabricius has been created supporting these two elements to foster the collaboration, empowerment and engagement of students in the learning process. As a result of the research we propose a list of KPI trying to measure individual and collective performance in a course. We are conscious that this is just a first approach to define which aspects of a class following a course can be qualified and quantified. We finally discuss the need to connect research and innovation in this field.

Keywords: Collective intelligence education · Learning patterns · Teaching KPI

1 Introduction

Education is a huge and multidisciplinary field that has been studied from different epistemological perspectives looking for new challenges to improve student's performance. Therefore educational institutions are constantly searching for new models to improve the results of their learning processes.

There is a lot of evidence about the fact that multimedia and Internet based educational tools have potential to improve student learning [1] and there is also evidence about the advantages of distance learning [2]. However education and capacitation in a networked society is not just an extension of the usual capacity building. Besides classical technological competences new ones linked to accessing and processing knowledge are necessary, particularly collective intelligence. New capabilities can't be acquired through the old ways of education: collective capacities building needs new contents and methods [3].

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Collective intelligence CI is defined as the capacity of human groups to engage in intellectual cooperation in order to create, innovate and invent [4]. Although CI is not a new idea, its combination with ICT tools is setting this paradigm as an exciting and emerging area [5, 6]. Several authors have reported about collective intelligence and its impact with the ICT tools in the educational field [7–11], moreover, some researchers have generated papers for refer to the measure of collective intelligence. Engelbart (1995) propose the Collective IQ, term proposed by refers to the measure of a group's collective capacity [12], Woolley et al. (2010) put forward the Factor C [13], Barlow, J. B., & Dennis, A. R. (2014) conclude that a Factor C defined by Woolley et al. (2010) is not a general factor of collective intelligence inherent to groups under all conditions, but it is a measure of a group's general ability to work well in face-to-face settings [14].

This research describes the teaching model based on Fabricius, an ICT tool developed with the general idea of integrating into one framework the two relevant aspects in learning by doing: management of ideas and real time assessment. The general objective of our research is to contribute in the identification of collective intelligence patterns in the behaviour of the class.

The first part of this article is devoted to the introduction of collective intelligence education concepts and the Internet available tools to implement it. The second part presents the design of the model Fabricius and third part outlines the results of its implementation. The paper concludes that a collective intelligence strategy based on Internet tools may facilitate and improve teaching through collective activities and that it is possible to define some kind of KPI to qualify and quantify collective as well as individual performance.

2 Collective Intelligence Education

Collective intelligence in the field of education has been reported by several authors [8, 15, 16]. A significant amount of research in the last decade refers to collective intelligence connected with information technologies and located in education [7]. This interest in such advanced research contrasts with the fact that the educational systems haven't evolved so much during the lasts decades. The incorporation of collective intelligence in education involves not only a technological change or a transformation in the attitude of teachers, but also a redefinition of education [13, 16]. If the concept and models of collective intelligence evolve it should leverage a system of global learning, content and networking. We see currently some indicators of this tendency like MOOC or social networks applied to education.

The collective intelligence in teaching-learning processes affects both teachers and students: evaluations, educational materials or ideas management can use the web as a learning platform strengthening sharing, contribution and collaboration. In addition to the content provided by the teacher, collective intelligence strategies allow students conducting semi-independent research in class [8].

Collective intelligence allows permanent, cooperative and collective learning, guiding students in acquiring knowledge within virtual communities, reflecting a new relationship with knowledge. There is a shift in focus from the pedagogical design of learning content to collectively create and share content, which opens new fields of research for collective intelligence [9]. In their research Thompson et al. (2014) indicate that there is evidence that students can be autonomous in their learning and also participate collaboratively [10].

With the growing of cyberspace, a lot of Internet tools have been designed for catching the knowledge from small and big groups (wikipedia, digg, google, facebook and so on), in this context, we looked for tools that integrate ideas management, decision making process and also pattern recognition for forecasting behaviour of the groups. In the Table 1 we summarize a sampling of Collective Intelligence Internet tools with focus on the educational field.

Table 1. Sumary of collective intelligence internet tools

Tool	Description
Software catalog: Capterra [17]	A ranking software with contributions from the internet users that whit the term "Idea Management" showed 52 products. Most of the products implement processes for declaring challenge and propose and vote ideas.
Project: Catalyst [18]	An example of an open source project aiming to improve collective sense making and creative ideation for the common good in large-scale online debates about social innovation.
Software tool: QLIM [19]	It is an interactive questionnaire management tool, which use the real time Delphi model in its implementation.
Health Consensus [20]	It's a tool initially designed to support participative processes of experts in the health area based on a digitally adapted Delphi model. It has been used to manage e-learning clinical cases.

3 Fabricius. Approaching Collective Intelligence Learning

Considering the theoretical trends and tools identified in collective intelligence in education a prototype of a teaching model and its ICT tool has been designed, developed, tested and is formally introduced in this section. Named Fabricius, synthetically drawn in Fig. 1, combines the individual and collective work from students and experts.

Fabricius may be defined as a digital tool for a teaching method that enables each student individually and collectively in synchronous or asynchronous mode:

- Work with the production and filtering of ideas
- Acti participate in the assessment of the work done by all the students

Moreover the tool collects data of the teaching process that once analyzed through a pattern recognition model allows understanding the behaviour and level of learning of students.

As a result of the pattern recognition obtained during the use of the platform the design of the practice may be improved for next application.

The central hypothesis of the research is that collective intelligence Internet tools like Fabricius facilitate open management of ideas, real time collaborative assessment

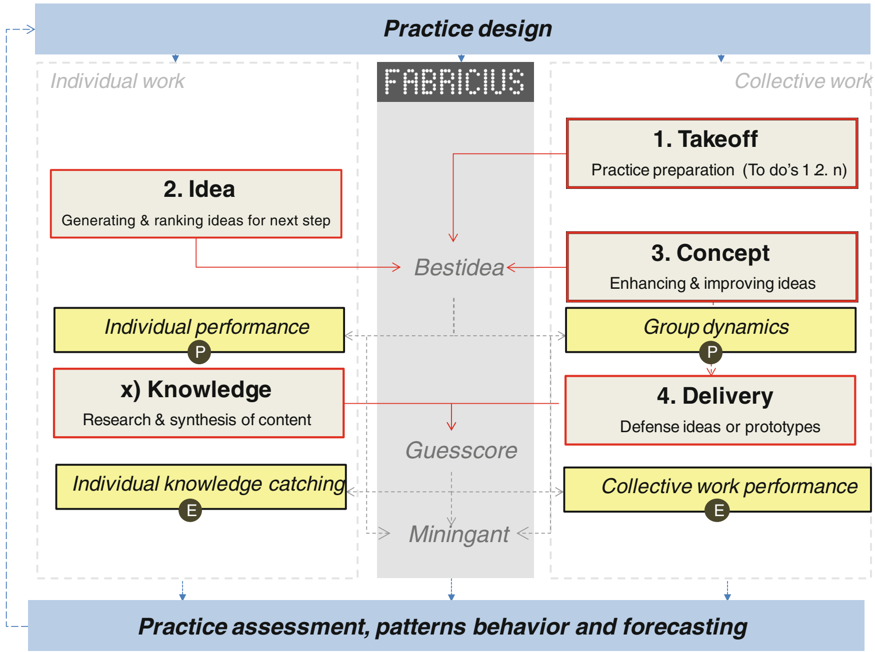

Fig. 1. General view and components of teaching model

and forecasting of work done in the class, consequently they may help fostering the interaction, collaboration, empowerment and engagement of students in the learning process. The idea came from the Kaizen methodology (change for better), where each practice contributes to improve the next. Outcomes of the process try to improve the students and experts' skills working together in a collective environment. Fabricius is formed by three main elements listed and defined in the Table 2:

Practices are organized following a workflow described in Fig. 1 and summarized in Table 3. Let's note that this is a particular distribution of activities that are pertinent for a learning by doing strategy based on practices but might be not appropriated for

Table 2. Main elements of Fabricius

Element	Description
Bestidea	**Individual-collective production of ideas**.- Management of the process of proposing, voting and ranking ideas. It can be used in asynchronous or in synchronous mode.
Guesscore	**Collective real time assessment**.- Individual as well as collective work of students can be assessed during the classes through a synchronous real time collective voting [21–23].
Miningant	**Pattern recognition and forecasting of individual-collective behaviour**.- The track created by students using Bestidea and Guesscore incorporate individual and collective data that conveniently treated through data mining techniques may reflect the behaviour of students and learning process

Table 3. Stages of model

Stage	Description
Stage 1, 2 & 3	**Working with Bestidea.** The Bestidea component of Fabricius is used to create the ideas that will be discussed and evaluated to prepare the practice
1.-Take Off	The practice begins with a Takeoff session (synchronous or asynchronous) that is composed of: • Statement of practice and Lecture. • Work with to do's (1, 2.. until n) using Bestidea. To do's are consecutive and each to do (except the first) is based in the results obtained in the previous one. To do's follow the same cycle: 1st Students propose ideas individually, 2nd Group votes ideas in order to prioritize and 3th Winning ideas, one or more, are inspirations for the next to do
2.-Idea	Considering what has been learnt with the work done during Take-off, each student individually proposes ideas for the key to do. The participants in the class will vote all ideas proposed by their classmates. Students of the class will be randomly assigned to vote ideas of any of the groups participating (Llullian method[24]), except their own group. At the end of stage 2 there exists a list of individual ideas ordered according to the relative value voted by the participants
3.-Concept.	The list of prioritized ideas from stage 2 is the departing point for the collective generation of a "concept" to solve the last to do. Each group will use the same strategy (NGT[25] as a strategy to elaborate a concept with a certain degree of detail) to enhance and extend previous ideas working ahead proposing and prioritizing new items (ideas). Proposing as many items as the group decides a consistent concept is gradually elaborated. At the end of the stage 3 the group of students has collectively created the ideas and items that will allow proposing and defending a final Concept. Let's note that the contributions of students are not symmetric.
Stages 4 & X.	**Working with Guesscore** The Guesscore component of Fabricius is used to assess the ideas and the content proposed by the groups or by students
4.-Delivery	The groups of students defend their final concept for the practice and their classmates and the experts (teachers) assess real time the concept presented. As said before the concept responds to the last to do of the practice. As a result of this assessment each group has a score but each student that has voted has also an individual score depending on the accuracy of their judgments.
X.- Knowledge	Each practice consists of the application of some particular content (theories and or techniques) that has been introduced with a lecture and the activities during the Take-off. Each student (or group) is asked to contribute with some original knowledge to the content of the practice. Original knowledge may come in the form of: Interesting people that have applied the content object of the practice, or products and services or any kind of organization that highlights the content. The student (or group) gets extra point when their proposal has been approved by the expert and is voted by classmates in this assessment stage.

other courses. The instructive process consists of solving a list of to do's, (normally 4) where the last one is the key activity, while the previous to do's are just for learning and preparing the ground for this.

Just to clarify, we consider individual students, groups of students (4 to 7 members) and the class with all the students enrolled.

The stages of model showed in Table 3, generates data that are used to analyze and evaluate the behavior of the students and the class. Table 4 presents the elements that are measured during the execution of the practice.

Table 4. Analytics of the Fabricius teaching model

Element	Description
Individual performance	Measuring individual contributions during take-off, idea and concept.
Individual knowledge catching	Measuring individual accuracy of Guesscore judgments.
Group dynamics	Measuring evolution of level of consensus among the group members during collective activities.
Collective work performance	Score partially corrected with score from classmates.

At the end of each practice student can access to all the measures and assessments available.

4 Results Applying Fabricius

Fabricius is initially intended for the management of learning by doing in degree courses and has been used in the areas of design-engineering and pre-primary education teaching (Polytechnic University of Catalonia UPC Spain, University of Forces Armed ESPE - Ecuador), in this section have been summarized its application according to conceptual model (Table 5).

Table 5. Courses of the empirical experience

Course	Students	Women	Practices	Ideas	Votes
Design-engineering 1	63	29	7	378	6753
Design-engineering 2	26	5	7	151	3246
Pre-primary education teaching.	24	24	1	155	584

It has been possible to extract some patterns from the data and consequently propose a set of Teaching Key Performance Indicators that could help to measure aspects related to collective intelligence. In Table 6 we propose the 4 KPI.

Table 6. Indicators that could estimate collective intelligence in education

KPI	Type	Description
Value from ideas	Individual	Score obtained by the ideas that each individual student proposed.
Accuracy in assessment	Individual	Deviation between score assigned by experts and score assigned by each student in all the assessments done during the practice.
Value from Collective work	Collective	Score obtained by the group during the defense of all the group proposals.
Self-assessment accuracy	Collective	Deviation between score assigned by experts and score assigned by each student in all the assessments done during the practice

5 Discussion

The main conclusion from this work is that Fabricius makes it feasible to apply a level of transparency and participation in the teaching-learning process that facilitates collective intelligence. Fabricius allow the real time calculation of KPI that encourage the commitment of students in the learning process. More in detail, we concluded that the this kind of tools effectively facilitate open management of ideas and real time collaborative assessment of work done in the class.

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Change of Attitude in Class for Creating Slides to Present Product

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Abstract. The creation of product presentation slides using PowerPoint was implemented in order to ensure that students acquire the knowledge and information required to use computers. Students created slides presenting products in which they were interested, inserting animation and recording narration. This class combined evaluation and revision activities and implemented active learning and, along with enhancing computer skills, awareness relating to a variety of skills required for problem solving were enhanced in an attempt to cultivate independent thinking skills. In particular, the aim was not only to enhance PowerPoint skills but also to improve expressiveness, planning ability and ability to make proposals. This paper reports on the class to create product presentation slides, its contents and its learning effects.

Keywords: Product presentation · Creation of slides · Evaluation activities · Revision activities · Problem-solving ability · Higher education

1 Introduction

There have been many attempts to propose new class methods and implement effective classroom practice in the past. Recently, the Central Council for Education pointed out that a switch to active learning in which students independently detect problems and find solutions is essential and reports that active learning will be implemented in order to promote high quality undergraduate education that stimulates independent study in order to accumulate independent study experience and acquire skills for lifelong learning [4]. Some classroom practice showed that it was possible to develop classes that implement active learning, to enhance problem-solving ability and cultivate independent thinking skills by incorporating self-evaluation, evaluation by others and repeated revision tasks for some tasks for university students [5]. We believe that it is possible to cultivate the skills to solve these problems by creating things that people desire and things that people will use.

There are some studies concerning storytelling [2, 3, 9, 10]. Creative activities that produce works that inform and entertain people by describing real and imaginary events, using graphics, narration, and music are called storytelling [2, 11]. In digital storytelling, still pictures such as photographs, figures, and drawn pictures are displayed sequentially to create a storytelling and narrated. Digital stories can be easily reconstructed. Still pictures are easy to handle for the producers of such assignments,

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and students can reflect upon memories or what they have learned through reviewing still pictures [1]. In experiments for one of the themes, Creation of Storytelling, computer science experiments for required 3-hour/week subjects in the 3rd year, had students creating projects that looked at the students themselves and asked them to talk about themselves in order to promote self-understanding [6]. This creation process incorporated evaluation and revision activities and it was reported that it was possible to cultivate skills to solve tasks [7, 8].

In this study, the aim was not only to enhance PowerPoint skills but also to improve expressiveness; planning ability and ability to make proposals and classes to create slides to present products were implemented using PowerPoint. This is active learning in which it is not possible for students to complete their project unless they participate actively in classes. Students created slides presenting products in which they were interested, inserting animation and recording narration. Students viewed each other's slides and learned from each other. Mutual evaluation was used for interaction, students evaluated others and commented. Following this, slides were revised and the students again viewed and evaluated each other's slides. By actively participating in evaluation and revision activities while interacting, awareness relating to a variety of skills required for problem solving was enhanced in an attempt to cultivate independent thinking skills. Learning effect for the class to create slides to present products is reported up to now.

Below is an explanation of class contents, project contents, creation methods and evaluation sheet contents and the analysis of this information and its results are reported.

2 Class Contents

The target was the IT subject displayed in Table 1, a required subject for the second half of the 3rd year Computer Science course at University A. In this class, students chose their preferred theme from three possibilities and worked on this theme in 15 classes. Approximately one third of the class students attended (29 students). The students are all Japanese and consist of one female and 28 males. Each class was 90 min long and each student created two projects. The class was taught according to the plan in Table 1. The first seven classes were used to create slides presenting

Table 1. Class plan

Time	Class plan	Plan related to assignment
1	Explaining Experiment method	Problem description, information retrieval, considering the description to introduce, inputing evaluation sheet 1
2	Creating slides to introduce products	Submission of the entry form, creating slide
3	〃	Creating slide, putting the animation
4	〃	Creating slide, recording narration, writing report 1
5	Evaluation and correction of slides to introduce products	Mutual evaluation, inputting evaluation sheet 2, modifying slide, writing report 2
6	Evaluation of slides to introduce products and report	Mutual evaluation, inputting evaluation sheet 3, writing report 3
7	Completion of the report and the evaluation	Completing report and evaluation sheet

products and the next seven classes were used to create slides presenting books. Viewing and evaluations were carried out twice and revisions were carried out once.

This paper reports on the classes to create slides presenting products. The aim of these classes was to ensuring that students acquire knowledge about computers they have learned about through classes in which they actually use computers and to utilize this knowledge. Furthermore, students selected the product they were interested in and created six slides with product details and features, why they liked the product, advertising, positioning in terms of competitors' products and proposals to improve the product. Students incorporated movement into the slides using animation so that the contents were easier to understand. Students created the contents of explanations in order to narrate the slides and then recorded this narration to complete slides to be viewed by the whole class. By doing this, written expression as well as expression using images was cultivated. By creating product presentation slides, evaluation activities were incorporated into creation, awareness relating to a variety of skills required for problem solving was enhanced and independent thinking skills were cultivated.

In the creation of slides, it was important to create explanations to present the product and students were encouraged to think about the composition of product images and photos and how to express them. Students learned about placing details, images, animation and narration in the appropriate places, how to communicate their own thoughts and ideas to other people and the importance of thinking about how to convince people to buy the product. In this class, after creating slides, students viewed the slides, noted the reaction to them and reviewed their projects.

A 39-page experiment booklet was distributed in the first class. Based on this booklet, there was an explanation of the aim of the class, its contents, plan, how to create slides and the experiment method. A sheet (the size of 2 A4 sheets) to fill was distributed and students were told to create a product presentation, fill in the right side of the sheet and draw on the left by the next class. The second class gave an explanation of how to incorporate animation and the students created the product presentation slides. The third class explained how to write reports and record navigation and students incorporated their animations. The fourth class had student record narration and complete the product presentation slides. Files with product presentation slides were submitted at the end of this class. The teacher then amalgamated all the projects into one. The evaluation by others sheet was distributed in the fifth class, all the projects were viewed and evaluated and the evaluation sheets were submitted. Following this, student revised their projects. The revised product presentation slides were viewed again in the sixth class, evaluation was conducted again and evaluation sheets were submitted. Students wrote one third of their reports for the days before the fourth, fifth and sixth classes and these were returned to the students with suggested revisions during the classes. Reports were completed in the seventh class and all evaluation worksheets were completed and submitted.

The framework for product presentation documents, the framework for reports and evaluation files were available to download from an e-learning site. The teacher created the evaluation sheets required for class evaluation activities as evaluation worksheets. These were three self-evaluation sheets, two evaluations by others sheets, two self-re-evaluation sheets, evaluation of awareness relating to improved skills and level of software skills, etc. Students downloaded the files, filled in the applicable details and stored them.

3 Contents of Production Presentation Slides Created by Students

The aim of the theme was to think about how to convince people to buy products such as electronic or industrial goods, to present a product in which the student was interested or that the student would like to buy with slides and convince other people to buy it. In the future, hypothetical product development plans can also be considered. Select a specific product. Insert images of this product without exception. However, do not include game software.

Presentations are composed of six slides. The slideshow is no longer than two minutes. Font size is 28 or more, as much as possible.

The contents of the six slides were composed as follows:

(1) Product Name and Catchphrase

The title should be a catchphrase such as "(adjective) product" or "X product is (adjective)". Concrete presentation of a product that is currently on sale.

(2) Product Details

Clearly state product name, company name, product details, model number, year of launch, etc. Product details include an explanation of what the product does. Explain what kind of object the presentation is about.

(3) Product Features and what the Student likes about the Product

Explain production functions, convenient points and good points, etc. Students present what they liked about the product when they used it. Explain the reason for recommending the product and its appeal. Explain impressions from use and convince the viewer to buy the product.

(4) Advertising

Create newspaper/magazine advertising or newspaper insertion advertising. Create advertising by considering ways to appeal to the consumer in order to convince them to buy the product.

(5) Positioning in Terms of Competitors' Products

Display product sketch, specifications, prices, amount sold, market share, competitor information and points for each company name and product name to demonstrate the position of the presented product in terms of competitors' products. Use graphs and tables to give a visual image.

(6) Proposals to improve the Product

Think about inconvenient points and functions that could be added. On the basis of making a proposal to the company, consider sales strategy and methods to promote sales in order to sell more units than are being sold currently and make proposals to improve the product.

4 Results of Analysis

Six types of survey were used in order to understand the learning effects of creating the product presentation slides detailed in the previous section. The foundation of learning was considered to be in securing time for each activity therefore time relating to class activities was surveyed on report sheets. Next, project narration time was analyzed and the time required for viewing the projects was investigated. Awareness relating to skills was surveyed before and after the class and, through these changes, it was possible to understand the level of achievement of the aim of the class.

Below, the results of statistical significance are acceptable with a significance level of 5 %. The symbols m, SD, t and p represent mean, standard deviation, test statistic and (significant) probability respectively. Significance levels of 0.1 %, 1 %, 5 %, 10 % are represented by ***, **, *, + respectively.

4.1 Time Taken for Each Part of Experiment

The total number of hours required for research in order to provide explanations and create slides, to work on the creation of product presentation slides and to write the report was stated on the title page of the report. These times were aggregated and averages are shown in Table 2. The average time taken for the project was 19.8 h of which approximately 5 h was class time and an average of approximately 15 h was spent for creating slides and writing the report outside the class.

Table 2. Time taken for each part of class (Hours)

necessary time	Survey	Creating slide	Writing report	Total
m	4.9	7.3	7.7	19.8
SD	2.5	3.1	3.1	6.3

4.2 Project Narration Time

Twenty-eight students submitted product presentation slide files. Approximately two minutes was required to view each project and approximately one minute was required for evaluation by others. Narration times for projects created by students are shown in Table 3. There were six PowerPoint slides with a total runtime of 115.2 s. The first slide was the title page therefore the time used was slightly shorter than the others. By limiting the number of PowerPoint slides to six, time taken was approximately 1.92 min. Maximum and minimum times taken were 223 s and 62 s respectively. The time limit was set at two minutes and most projects were close to this limit.

Table 3. Project narration time (seconds)

Slide No.	1	2	3	4	5	6	Total
m	9.3	18.7	28.4	16.5	24.1	22.4	115.2
SD	5.4	7.1	11.8	8.4	14.1	10.6	51.7

Total viewing time and time for evaluation by others was approximately 90 s. Due to this, class time was slightly exceeded.

4.3 Changes in Awareness Relating to Skills

Awareness relating to skills shown in Table 4 was recorded before the class (1st class) and after the class (7th class) and submitted. There were nine grades for evaluation

Table 4. Statistical significance test results for awareness relating to skills

Attitude related to Ability	Before		After		Elongation		Significance Test	
	m	SD	m	SD	m	SD	t	p
(1) Interest in and curiosity about computers	4.4	1.4	5.3	1.4	0.9	1.2	3.6	***
(2) Understanding of computers	3.8	1.2	5.1	1.8	1.3	1.5	4.5	***
(3) Computer operation skills	4.0	1.3	5.2	1.4	1.2	1.0	6.0	***
(4) Computer usage methods and broadening of situations	4.0	1.1	4.9	1.3	0.9	0.9	5.0	***
(5) Ability to set challenges, ability to discover problems	3.8	1.0	4.9	1.3	1.1	0.9	6.1	***
(6) Ability to plan, to do things in a planned manner	3.7	1.2	4.8	1.3	1.1	1.2	4.6	***
(7) Cultivation of understanding of knowledge learned	3.9	1.3	5.2	1.2	1.3	1.3	5.2	***
(8) Ability to study by oneself, ability to learn	4.1	1.5	5.1	1.6	1.0	1.2	4.3	***
(9) Ability to gather information, ability to conduct research	4.4	1.6	5.6	1.5	1.1	1.6	3.6	***
(10) Ability to sort through related information or data	4.0	1.2	5.3	1.2	1.3	1.3	5.1	***
(11) Ability to analyse information	4.2	1.2	5.0	1.3	0.8	0.8	5.1	***
(12) Ability to express thoughts in writing	3.9	1.4	5.0	1.5	1.2	1.0	5.9	***
(13) Ability to express thoughts through media other than writing	3.6	1.2	4.9	1.6	1.3	1.3	5.1	***
(14) Ability to speak and explain things to others in an easy-to-understand manner	3.4	1.2	4.8	1.6	1.4	1.1	6.4	***
(15) Ability to make presentations	3.6	1.4	5.0	1.4	1.3	1.2	5.5	***
(16) Ability to listen to what people are saying and ability to ask people questions	4.3	1.7	5.0	1.7	0.7	0.9	4.2	***
(17) Communication ability	4.3	1.7	5.0	1.6	0.7	0.8	4.4	***
(18) Ability to appropriately self-evaluate one's thoughts	4.3	1.2	5.3	1.4	0.9	1.1	4.2	***
(19) Ability to appropriately evaluate other people's thoughts	4.4	1.3	5.1	1.4	0.7	1.0	3.4	***
(20) Ability to correct and improve on one's own thoughts	4.4	1.4	5.2	1.4	0.8	1.0	4.1	***
(21) Ability to pursue matters deeply, ability to explore matters	4.1	1.1	4.9	1.2	0.7	0.9	4.2	***
(22) Ability to execute, ability to practice, ability to put into action	4.0	1.2	4.7	1.2	0.7	0.9	4.0	***
(23) Ability to cooperate with others, ability to study in cooperation with other	4.7	1.6	5.3	1.6	0.7	1.2	2.7	*
(24) Sense of accomplishment, sense of satisfaction	4.3	1.5	5.2	1.5	0.9	1.3	3.3	***
(25) Sense of fulfilment, sense of achievement	4.4	1.5	5.2	1.5	0.7	1.2	3.1	**
(26) Ability to solve problems	4.3	1.4	5.0	1.4	0.7	1.0	3.4	***
(27) Ability to construct and create knowledge	3.9	1.4	4.7	1.6	0.8	1.0	4.1	***
(28) Ability to think, consider and come up with ideas by oneself	4.1	1.4	5.1	1.4	1.0	1.2	4.4	***
(29) Creativity/ability to create	4.2	1.5	5.0	1.3	0.7	1.3	3.0	**
(30) Interest in and curiosity about this field	4.7	1.5	5.3	1.6	0.7	1.5	2.3	*
Average	4.1	1.4	5.1	1.5	1.0	1.2	23.1	***

*** $p<.001$, ** $p<.01$, * $p<.05$

including: 1. None at all, 3. Slight awareness, 5. A little awareness and 9. Extremely high awareness. Twenty-seven students responded to both pre- and post-class questions concerning awareness. Average assessment values for the 30 categories of awareness relating to skills pre- and post-class showed a significance level of 0.1 ($t(809) = 23.1^{***}$, $p < 0.001$) as a result of paired statistical significance tests.Overall, it was demonstrated that students felt improvements in awareness relating to skills.

The results of paired statistical significance for pre- and post- class average assessment values for each category for awareness relating to skills showed statistical significance in all 30 categories. It was understood from this that students felt that all awareness relating to skills had improved. In this way, it was understood that awareness of skills and emotions relating to problem-solving in the classes held had an improving effect.

The test results in Table 4 showed improvements in (1), (2), (3) and (4). Consequently, one of the aims of this class, to ensure that students acquire knowledge about computers they have learned about, can be considered to have been achieved, at least in terms of awareness.

31, 26, 26, 6, 6, 4, 3, 2, 1, 1, 1 and 1 students filled in the learned how to or how to use narration, PowerPoint, animation, self-objectification, appropriate evaluation by others, written expression, presentation, Word, microphone, Paint, BGM and touch typing respectively in the report in which students wrote about what they had learned from the experiment. The total number of written comments was 108, giving an average of 4.0 per person. All students wrote that they had become able to do one of the above. One more aim of the class, to enhance computer skills, can be considered to have been achieved according to student reports.

Through the creation of product presentation slides, written expression skills were cultivated by writing presentation text and reports and expression skills other than in the written form were also cultivated not only by inputting explanations into slides but also by pasting in products images or related photos. Enhancing awareness of a variety of skills which is required for problem-solving also significantly improved as shown in Table 6 and awareness aims can be considered to have been achieved.

5 Conclusion

Active learning was incorporated to design and hold classes to create product presentation slides using PowerPoint. Students determined the product they wanted to present, researched this product, thought about how to explain the project, created slides, inserted animation and recorded narration. All students viewed each other's slides and learned from each other. Mutual evaluation was conducted and comments were made. Following this, slides were revised and all students mutually viewed and evaluated the slides again. Students mutually interacted and cooperated with other students and by actively participating in evaluation and revision activities in the process of completing their projects, problem-solving abilities were enhanced and classroom practice that cultivated independent thinking skills was reported.

The findings from this class can be summarized as follows.

(1) Total time taken for surveys of explanations and creation of slides, the creation of product presentation slides and the creation of reports was 19.8 h on average.
(2) Total narration time for projects was 115.2 s on average.
(3) Assessment values for awareness relating to skills were felt to have improved overall.
(4) Statistical significance tests for each category for awareness relating to skills showed awareness in all 30 categories was felt to have improved overall.

In the future, we would like to reveal useful activities in improving attitude in class by analyzing the post survey of attitude. In addition, we would like to compare the effects of the above-mentioned storytelling [5] and the effects of this class. We would also like to apply innovation to class methods to improve learning ability for students with a wide range of learning abilities.

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Students' Perception of Privacy Risks in Using Social Networking Sites for Learning: A Study of Uganda Christian University

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Abstract. Although social networking sites (SNSs) present a great deal of opportunities to support learning, the privacy risk is perceived by learners as a friction point that affects their full use for learning. Privacy risks in SNSs can be divided into risks that are posed by the SNS provider itself and risks that result from user's social interactions. Using an online survey questionnaire, this study explored the students' perception of the benefits in using social networking sites for learning purposes and their perceived privacy risks. A sample of 214 students from Uganda Christian University in Africa was studied. The results show that although 88 % of participants indicated the usefulness of SNSs for learning, they are also aware of the risks associated with these sites. Most of the participants are concerned with privacy risks such as identity theft, cyber bullying, and impersonation that might influence their online learning participation in SNSs.

Keywords: Social networking sites · Online social network · Privacy risks · Learning · Students

1 Introduction

One of the contentious topics that emerge when communication is mediated by a social networking site (SNS) is the privacy issue [1]. Although SNSs present a great deal of opportunities to support learning, the privacy risk is perceived by learners as a friction point that affects its full use for learning. Users of these sites often establish hundreds to even thousands of online social networks (OSN) with other users whom they interact and collaborate in their daily life.

SNSs are "Web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system" [2]. They facilitate sharing, interaction and collaboration among users [3–5]. Although they are commercial products initially designed for the social interaction purpose [6], these sites have a powerful influence on all aspects of life [7] and provide great potentials for transforming the learning process [4, 5].

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Since the basic principle of SNS is information sharing, SNS providers encourage their users to actively participate and interact in their network. Thus, the higher the number of (particularly active) users, the higher value a particular SNS holds. This is the reason why SNS providers focus on the 'quality' of the content in ensuring better connectivity to their users [8]. In order to achieve this, one approach is by implementing 'real name policy' by requiring users to provide their real name and information [9] when signing up.

However providing real name and personal information may invite privacy risks to users. Users who participate in SNSs voluntarily share their personal information with their 'friends' online. By disclosing their personal information, users are vulnerable to privacy risks in SNSs [10]. With the growing popularity and massive amount of personal information (the largest database), SNSs are vulnerable to cyber-attacks [11].

Whereas users do perceive the use of SNS for learning, the imminent privacy concern may affect their full interaction and collaboration whilst they are online. This study explored the perception of undergraduate students of Uganda Christian University on the use of SNSs for learning purpose and their perceived privacy risks.

2 Background

Social networking has occurred almost as long as societies themselves have existed but the potential of the online (social networking) tools have made it a more popular concept especially among the younger Internet users, who are able to create and disseminate contents to their friends [12]. The concept of social networking refers to the practice of expanding the number of one's social network by making connections through other individuals. By so doing, individuals build online social networks (OSN) or social relations among people who share interests, activities, backgrounds or real-life connections.

Use of SNSs has become commonplace within higher education as they facilitate active participation, connectivity, collaboration and sharing of knowledge and ideas among learners [4]. Since they are a read-write form of Web [13, 14], they are very useful for learning purposes. However the privacy risks associated with the use of these sites may affect their full utilization for learning.

One of the privacy concerns involving the use of SNSs is the users' personal information that is being shared online. While SNSs allow users to restrict access to their personal data, there is currently no mechanism to enforce privacy concerns over materials posted by them [15] or by other users about them. As information that a user posts may be shared by others, privacy of this information goes beyond the discretion the user. What Facebook, Google+, LinkedIn and other SNSs do with our data, and what they enable others to do, too is a big concern for users.

Therefore users' privacy concerns might reduce their full participation in online learning because users are considering the trade-offs between the perceived benefit and risk of their participation. This behavior which is typically known as privacy calculus theory suggest that users intention to disclose information will depend on privacy concern and expected benefit [16].

In general privacy risks in SNSs can be categorised into two dimensions that is, a vertical risk and a horizontal risk [17]. The, vertical risks are the risks posed by the SNS provider itself in using personal data, aggregating and collecting information while the horizontal risks represent social interactions among the users where they share their information, thoughts and activities.

2.1 Vertical Privacy Risks

The literature suggests that SNS provider's privacy policy is one of user's privacy concerns [17–20]. In a survey of 45 SNSs, research in [18] discovered that although most SNSs have a privacy policy, many are considered substandard, and some have no privacy policy at all. The researchers discovered in their study that two sites integrate privacy policy with *Terms of Use*, one site has questionable privacy policy, and generally all sites provide lengthy privacy policies which discourage users from reading fully.

Additionally, SNS providers are authorised to amend the content of agreement without the requirement to refer to the user. Further to their findings, it was discovered that the best SNSs will act is providing a minimum notice period before any changes takes effect [18]. However this clause only appears in 11 % of the total SNSs surveyed. The default privacy settings in Facebook (at the time of the research), for example aggravate to the problem of privacy where it is at the lowest privacy level and requires user to be proactive if they want to protect their privacy [17].

Furthermore, researchers also reported that SNSs specifically Facebook's privacy practices is poor, insufficient and misleading [19]. One example of Facebook's confusing privacy policies was the changing of user's privacy configuration four times in four years between 2006 to 2010 [20].

In general, SNS providers have the advantages of collecting a great deal of information about their users and further use this for offering personalisation services and sharing with third parties. They are involved in selling these information to third parties [11]. Since SNSs offer their services for free, the main and only source of income is targeted advertising, the selling of personal information to third parties assists in their sustainability [11].

2.2 Horizontal Privacy Risks

On the other hand, user's willingness to disclose too much information is another factor that affects user's privacy. Although users are concerned about what and to whom they share, most of them have limited understanding of how to manage their profile privacy settings. This has led to user's personal information being highly visible to unintended audience. The abundance of information has attracted various parties who might misuse the viewable contents. SNSs have become an important and a convenient source of targets for their malicious activities [21]. While sharing (sensitive) information with online friends can facilitate relationship development, the behaviour of online friends can reveal a user's personal information [22].

SNSs attract many horizontal privacy risks such as identity theft attacks, since this kind of attack is relatively cheap to implement and difficult to prosecute [23]. With the rapid development and advancement of online technologies, the attackers simply collects available personal information from SNSs and uses that personal information in an unauthorized manner with the intention to commit fraud or other crimes [11]. Another example of horizontal privacy risk is cyber bullying, which refers to harassment that makes use of technologies such as email, text, mobile phones, and websites [24]. There is also another risk known as social surveillance. Social surveillance is an act of observing SNS users in order to gain awareness of their offline and online behaviour. This may be done by the government or individual SNS users [26]. Besides building relationship and keeping in touch with friends, SNSs are also being used for social surveillance purpose [25]. Government and individuals are able to monitor users' behaviour and get updated on their activities. This high-degree of surveillance can cause privacy concerns to users [26].

3 Methodology

3.1 Research Questions

The main aim of this study was to explore students' perception of the benefit in using SNSs for learning purposes and their perceived privacy risks. The following research questions were set to guide this study:

i. What do students think about the usefulness of social networking sites in supporting their learning activities?
ii. What are the negative effects of using social networking sites for learning purposes?

In answering these research questions, this work explored the various types of risks associated with social networking sites mentioned in literature whilst matching them with what were perceived by the students who participated in this study. The result of which will illustrate the emerging gap and effects of these risks on the participation of users online.

3.2 Selection of Participants

In this study, a convenience sample of 214 participants was drawn from Uganda Christian University, where the study was based. Uganda Christian University has over 11,000 students offering a wide range of programmes at its five campuses throughout Uganda. However, the study was based at the main campus with some 6,000 students within seven units (one school and six faculties). The participants in this study were drawn from the six faculties using the class schedules and year of study. Before recruitment, they were briefed about the study by the research team. Participation was completely voluntary but informed consent was sought prior to administering the survey. A fairly balanced gender participation was realized; 124 (57.9 %) were male, 88 (41.1 %) were female, while 2 (0.9 %) preferred not to specify their gender. 199 (93 %) of the participants were of age group 18–25 years, 11 (5.1 %) were between 26 and 30 years old and 4 (1.8 %) were above 30 years old. The majority of participants were undergraduate students taking Bachelor's Degree (82.7 %), Diploma (14.5 %), and Certificate (0.9 %).

3.3 Data Collection and Analysis

This study was part of the doctoral research which employed a mixed method approach involving survey questionnaires, interviews, focus groups, and observation. However, the data reported here was collected in the first round of data collection using online survey questionnaire. The survey was designed using Google docs and participants accessed the online survey through a link that was provided to them by the research team. Questions of quantitative and qualitative nature were asked. A computer software tool, NVivo version 10 was used to analyze the qualitative data.

4 Findings

It was evident from the data obtained that social networking sites (SNSs) and other online social network (OSN) tools have become commonplace among the students. 195 (91.1 %) of the participants reported to have at least one social network profile and only 19 (8.9 %) did not have any social network profile. This result indicate higher usage than what was reported in a study by Pew Research Center in 2009 about the social network sites usage by young adult in the US, indicating that some 72 % of the users were in the age group 18–29 years had social networking profiles [27].

4.1 Benefits of SNSs

On the question of what they think about the usefulness of social networking sites in supporting their learning activities, participants overwhelmingly responded positively: 124 (57.9 %) indicated that SNSs are very useful, 65 (30.4 %) responded that SNSs are useful, and only 1 (0.5 %) indicated that SNSs are not useful. Whilst 3 (1.4 %) were not sure about the usefulness, 21 (9.8 %) didn't express any feeling about the usefulness of SNS.

4.2 Privacy Risks Perception by Students

Whereas the majority (88.3 %) of participants indicated that SNSs are useful in supporting their learning, they also identified several privacy risks that limit their full participation whilst using these tools. In fact, all of the risks, highlighted by participants, fall under horizontal privacy risks category. No mention was made of the vertical privacy risks.

Generally, most of the horizontal risks are more easily noticeable hence, they are more aware of them. Most of the responses reflected personal experience meaning that one has had an encounter with the incidence resulting from these risks. As a result, many participants reported to have had negative motivation to use SNSs for learning purposes.

4.3 Types of Privacy Risks

In responding to the question of what risks on the OSN that negatively impacts their learning, participants reported several risks, mainly from social aspect of their lives which had impact on the way they use these tools for learning. The types of privacy risks perceived by the participants fall under horizontal privacy risks which have been explained below:

Identity Theft: Many respondents indicated that the greatest privacy risk to them is theft of their identity by unscrupulous attackers. When a malicious person fraudulently gains knowledge of sensitive personal information such as social security number, name, address, phone number, cell number or even banking and credit card information, he/she could do a number of things with that including committing fraud using a person's identity. The respondents felt that the SNSs are insecure and therefore attractive to hackers and 'con men' who may get access to their profiles and personal information.

Impersonation: The respondents expressed concern about the exposure of personal information specifically on false identity or impersonation "it can lead to impersonation in order to attain the information by false pretence". They felt nearly all SNSs that they use do not possess a feasible measure to prevent exposure or abuse of other users' personal information which can go viral over the OSN. Currently, privacy in SNSs cannot be entirely maintained and established by individuals, as it is not wholly dependent on individual choices or control over data. According to [28], providing private information protection within a networked context is determined through a combination of audience, technical mechanisms, and social norms. Because contexts shift and overlap over time, protecting personal information is a continuous and active process.

Cyber Bullying: Some of the respondents expressed the risk of disturbance from colleagues or strangers. Cyber bullying is harassment which makes use of technologies such as email, text, mobile phones, and websites [24]. One of the forms of cyber bullying is *cyber stalking*. Cyber stalking refers to "harassment on the Internet using various modes of transmission such as electronic mail (e-mail), chat rooms, newsgroups, mail exploders, and the World Wide Web." [29]. A study on German SNS StudiVZ, suggested more than 40 % of users experienced cyber stalking at least once with the duration of cyberstalking in some cases lasting more than one year [30].

4.4 How Privacy Risks Manifest

It is also recognized that personal information may be leaked by other means. Maintaining relationship with friends is the main purpose for users joining SNSs. However *online friends* are one of the ways in which individual's personal information becomes exposed. Friends might actively disclose individual's information by posting updates, photograph, events, or tagging photos in SNSs. In this study some participants reported using unfriending strategies in order to preserve their privacy [22]. Others needed to research when they were attacked, for example:

> "Dear Friends, a funny post has been put on my wall by some unknown unscrupulous ….. Kindly ignore, do not open, forward or do anything with it. I am exploring way with FB to take it down. Sorry for any offense it could have caused to you even though am not responsible!!!"

This demonstrates little emphasis on privacy settings in Facebook. Photo tagging in SNSs creates a link from the photo to the person's profile. The decision to tag an individual does not lie with the tagged person but rather to the other party. The tagged person has little or no control about being tagged and may bear damaging implications if it reveals sensitive information of the user [31].

There is evidence from literature to show that users have inadequate knowledge to protect their own privacy. For example, users in Norway were found to have difficulties in understanding and configuring privacy control on OSNs [32]. A study showed that users privacy expectation failed to meet users privacy requirement [33]. Another study in [34] suggested that users did not understand privacy configurations. They discovered that 50 % of the published personal information was shared using default privacy settings and this was not the intention by the majority of the users.

5 Conclusion

This paper reported that participants perceived horizontal risks and no vertical risks. The finding suggests that most of the respondents are aware of privacy risks when using SNSs. The majority of respondents clearly responded towards the horizontal dimension of risks and pointed out several different types of privacy threats for example identity theft, cyber bullying, and information exposure and abuse were highlighted. Some of the risks mentioned could be attributed to the users themselves such as inadequate knowledge for protecting their privacy on SNSs and sharing too much information on SNSs.

These risks are particularly exposed by users' social interaction when interacting online. The risks that emerge out of users' digital activities on SNSs should be made known to them and it is their responsibilities to protect their personal information. Since students perceived the usefulness of SNS for learning purposes, the interplay between privacy concern and participation in learning needs to be addressed in order to encourage students' full and honest participation as students have recognized these tools as being useful for learning purposes.

Students identified horizontal risks without mentioning any of the vertical risks. This would imply that their awareness of possible risks is limited since little information is usually available to them. The limitation of this paper is that the findings are entirely based on the participants' responses in a survey. However, more investigations will be conducted using other qualitative approaches in future.

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Using Social Networking Tools for Teaching and Learning: A Perspective of University Lecturers and Students

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Abstract. The use of online social networking tools (SNTs) has become commonplace within higher education. In this paper a definition and a typology of educational affordance of social networking service (SNS) are presented. The paper also explores the educational affordances whilst examining how university lecturers and students use SNTs to support their educational activities. The data presented here were obtained through a survey in which 38 participants from three universities took part; two universities in Uganda and one in the United Kingdom. The results show that Facebook is the most popular tool with 75 % of participants having profiles. Whilst most participants perceived the educational significance of these tools, social affordances remain more pronounced compared to pedagogical and technological affordances. The limitations of this study have also been discussed.

Keywords: Social networking tools · Social networking services · Online social networks · Educational affordance · Typology · E-learning · Students · Lecturers

1 Introduction

The traditional approach to managing e-learning has been through the learning management system (LMS). LMS platforms, such as Blackboard and Moodle, have dominated teaching and learning landscape in higher education for the past decade [1]. The study in [2] shows that LMS does not provide the pedagogical conditions of interaction and collaboration. Students do not only want to "listen but also to ask questions, to express opinion, to answer questions and tasks, and to change content and learning forms" which may explain why they resort to social networking tools (SNTs), such as Facebook and Twitter, to support their educational interactions and collaborations. Research demonstrates that Facebook, for example, impacts students' motivation to learn, affective learning, and classroom climate [3].

SNTs are online tools that facilitate sharing, interaction and collaboration among users [4, 5]. Like other genres of social media, SNTs are commercial products initially

This study was part of a doctoral research (in its second year) exploring adoption of social collaborative e-learning in higher education.

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designed for the social interaction purpose [6] but they have a powerful influence on all aspects of our society [7] and provide great potentials for transforming teaching and learning [5, 6]. “However, technology alone cannot guarantee positive learning outcomes” [8] which is why much of the studies in this area focus on affordances of these Social networking services (SNSs) [5, 9]. SNSs are online services provided by SNTs for establishing and participating on online social networks of people who share interests or activities. This paper explores the affordances of SNSs as perceived by university students and lecturers in three universities; Makerere University and Uganda Christian University in Uganda, and University of Reading in the United Kingdom.

2 Educational Affordance of Social Networking Services

2.1 Defining Educational Affordance of Social Networking Services

The concepts derived from affordance theories are very useful in understanding the role of online networking services in learning [10]. Typical SNTs provide different possibilities for action, allowing users to generate, modify and share contents in addition to connecting and collaborating over the Internet.

The possibility for action is referred to as affordance [11]; Gibson was influential in establishing the affordance theory which states that “the world is perceived not only in terms of object shapes and spatial relationships but also in terms of object possibilities for action (affordances) — perception driving action”.

It is important thus to understand that technology and educational contexts are mutually shaped. From Gibson’s theory it can be inferred that; SNTs are “objects”, users’ interactions and collaboration are “actions”, and socio-educational structures are “environments”. Therefore it can be recognized that SNTs have an empowering potential for educational utilization. Perceiving educational affordance of SNSs can enhance users’ local and global connectivity and provide users an additional means for educational interaction. This paper presents educational affordance of SNS, defined (in Fig. 1) as *abilities of a user to utilize social networking tools’ capabilities for specific educational activity within socio-educational environment*.

This means that the properties of SNSs will enable or constrain educational activities depending on the pedagogical, social, and technological environment in which users operate. The factors that define the affordances of SNSs may be classified in three broad categories namely technological, user, and environmental. The choice of social networking technology tool, the quality of users, and the environment determine how the affordances are derived from these services.

2.2 Typology of Educational Affordances of Social Networking Services

The educational affordances offered by SNSs are categorised in to three perspectives namely: pedagogical, social, and technological affordances [4]. The significance of the second is normally overemphasised but this paper argues that all the three perspectives are significant for effective integration of SNS into educational system. Pedagogical affordances relate to: innovative learning approaches, motivates learners’ participation, present multimedia materials and enables students' reflections. Social affordances regard interaction in different scopes (such as peer-to-peer, small group and whole class) and communication in different formats (asynchronous and synchronous). Technological affordances provides open and customisable environment for users to interact and collaborate.

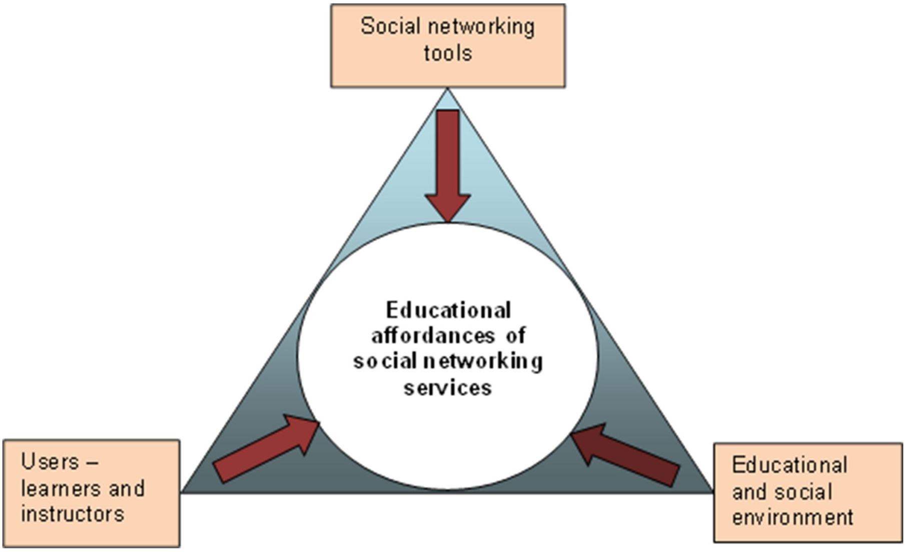

Fig. 1. Educational affordances of social networking service

Educational environment is a socio-cultural system in which users (learners and instructors) engage using various tools and forms of interaction to create collective and collaborative activities, supported by technology affordances [5]. The users in this environment are motivated by various factors (referred here as purpose for action). The following are five broad categories of purpose for action of users when they choose to engage in SNT: networking, creating, modifying, aggregating, and lurking. The services provided to users whilst they engage in the SNTs offer possibilities for action (affordances) in pedagogical, social, and technological perspectives. The typology presented in Table 1 distinguishes between three perspectives of educational affordances of SNSs whilst listing possible activities and tools supporting the five categories of purpose for usage of SNTs.

Other attempts have been made to categorize usage of SNTs. For instance, a study in [12] explored the factors that drive students to use online SNTs; this study, which conceptualized the use of online SNT as intentional social action, investigated the 'We-Intention' to use online Facebook. The 'We-Intention' used in this study focuses on the presence of 'we' together in making an intention about using online SNT in the future. Li [13] categorized usage of social tools using a ladder of levels of a participation. Li's six levels of a participation in social tools are: creators, critics, collectors, joiners, spectators, and inactives. Li's emphasis is on the level of participation but the typology developed in this paper uses matrix classification based on purpose of use and the perspective of affordance.

Table 1. A typology of educational affordances of social networking services

Purpose of use	Pedagogical affordances	Social affordances	Technological affordances
Networking	Informal learning; reaching out; communication and engagement; sharing experiences and reflections	Identity seeking; social rapport - appreciating members, activities, and contents; and connecting socially	Comments, like & Share buttons; friend request; profile editing tools; digital literacies; status updates
Creating	Publishing page, course content, slides, games and other materials; creating educational and research activities; asking questions; setting polls; creating topics for discussion	Setting social events, group activities, setting group meeting; inviting members to join activities, or event; uploading contents	Tools to create web-based activities, event, and content; open source and tools for creating text, audio and video; webinars
Modifying	Giving response/feedback; editing and reformulating learning content	Participating in discussion forum; critiquing views; posting reviews; commenting	Group chat; discussion forum; RSS, podcasting, and vodcasting; syndication; open editing; and review structure
Aggregating	Organizing references to learning materials, sites, and contents; adding links of networking profile; saving Tweets to favourites	Sharing links and Tweets	Subscribing; liking; sharing; aggregation of text, audio, and video content
Lurking	Subscribing to the tags of others, reading, listening, and watching contents	'Liking' and tagging; reading updates and other users' posts	Tagging tools; media players

3 The Sample and Context

In order to get the perspective of both lecturers and students, 36 participants were selected to take part in the pilot study in May 2014. This study was an initial stage of a case study aimed at exploring adoption of social collaborative e-learning at a university level education. There were 8 lecturers and 28 students from three universities; University of Reading in the United Kingdom, Uganda Christian University, and Makerere University in Uganda. An invitation email with the URL link to the online survey questionnaire was sent to a number of students and lecturers (mostly through personal contacts, class leaders and lecturers). To increase the response rate, Facebook messages, phone text messages (SMS), and oral reminders were also sent.

Both students and lecturers were asked similar questions in the survey which included five sections and was taking between 10–20 min. There were also some open ended questions in which participants were invited to give their own views about using SNSs for educational purposes and to comment in their own words about any aspect of learning technologies or teaching innovation.

It is difficult however to speculate on the nature of the sample as compared to the population of students and lecturers as this was a convenience sample drawn from those easily accessible to pre-empt the response from the main study, carried out at a later date. However analysis of the data showed that the respondents' distribution by sex and age was a realized. There were both female and male lecturers of ages varying between 26 and 45 years. The students included both females and males of ages mainly varying between 18 and 40 years.

4 Discussion of the Findings

Key aspects of findings discussed here attempt to map of the perception of lecturers and students about the use of SNTs to the typology of educational affordances of SNSs which is presented in Table 1. That is, the discussion attempts to show how the lecturers and students perceive the use of SNTs and how they are actually using them in relation to the typology.

4.1 The Role of Social Networking Tools

To find out the role of SNTs in the lives of participants, this paper examines the proportion of participants, and the time spent on social networking. This study reveals that the majority of students and lecturers are using SNSs. 83 percent of the participants indicated that they had at least a profile on the SNT. Only six percent did indicate that they haven't and profile. The other 11 percent didn't indicate whether or not they have profiles.

On Average, the time participants spend social networking is 21 h per week. This is similar for students and lecturers. This shows how SNTs have become part of the life of users.

4.2 Social Networking Tools Used by Participants

To find out the most popular SNTs among the participants, this study established which tool is used by most participants and why certain platforms are preferred over others. Figures 2 and 3 demonstrate that Facebook, Twitter, LinkedIn, and Google + are the popular platforms. Facebook is mainly preferred because of its ease to use interface. Participants indicated that each of the tools was effective for a particular type of interaction. For instance, Facebook group chat feature is used for class announcements and other group activities. LinkedIn was used for professional connection and getting career information.

4.3 Purpose of Using Social Networking Tools

This study examined participants' use of their social networking profile in order to determine their purpose of using SNTs in educational environment. Although chatting seems to dominate the purpose of social networking, this study reveals that seeking and sharing information is prominent. This is an evidence of informal learning within these tools (Table 2).

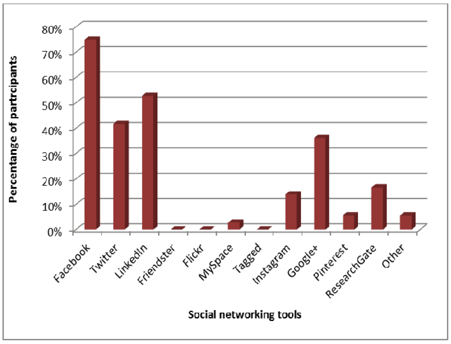

Fig. 2. Percentage of participants using social networking tools

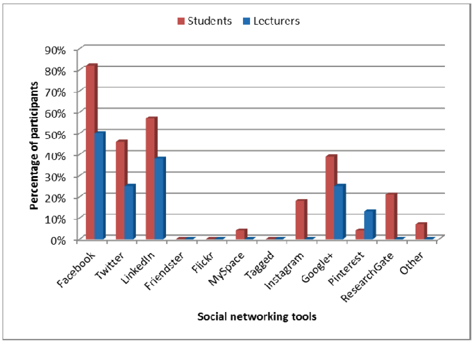

Fig. 3. Number of students and lecturers using social networking tools

Table 2. Purpose of using social networking tools

Purpose	Students	Lecturers
Chatting	82 %	50 %
Sharing information	82 %	50 %
Seeking information	64 %	50 %
Making friends	64 %	38 %
Entertainment	57 %	25 %
Getting news	57 %	13 %
Collaborating on group work	54 %	0 %
Checking other friends' profiles	43 %	38 %
Learning	50 %	13 %
Brainstorming	32 %	13 %
Giving feedback	29 %	13 %
Student/Lecturer interaction	18 %	13 %
Other	7 %	0 %

4.4 Overall Perception

In order to establish the views of the participants on the educational use of SNTs, the study explored activities participants perform whilst using SNTs whilst the factors influencing adoption of these tools.

The reasons given by lecturers for using SNSs are: getting updates on events, sharing ideas and information, collaboration, and learning from others. On the other hand, students are motivated by: Collaboration, linking with professionals, access to information, sharing information, connecting with friends, participation, brainstorming, learning from other, closing the physical gap, avoiding cost on face-to-face meeting, increasing motivation and interaction, enabling diverse ideas, research and educational activities, organizing learning meetings, instantly reach out to many members, and organizing events.

Finally, in order to relate perception of students and lecturers on the educational affordances of SNSs and the typology proposed in Table 1, the following observations can be made. The participants' responses on the purpose of using SNSs are mapped on the typology in order to determine what perspective of educational affordances is more emphasized. The results showed some difference in the perception of students and lecturers. Whereas there is evidence of pedagogical and technical affordance, social affordance is more recognized by students.

When asked about usefulness of social media for educational purpose, 75 % of the students responded in affirmative (Table 3). This signifies the overall view of the possibility for action that the students attach to SNSs. The lecturers however seem not to perceive a great deal of use of these tools for educational purposes. This indicates that students perceive the usefulness more than the lecturers do, which is consistent with the findings in [2]. The low response (49 %) of lecturers indicates the high level of uncertainty about the usefulness of these tools.

Table 3. Perception on the usefulness of social networking tools

Usefulness	Students	Lecturers
Very useful	14 %	0 %
Useful	61 %	25 %
Not sure	14 %	13 %
Not useful	4 %	13 %
No Response	7 %	49 %

4.5 Limitation of the Study

The sample was not representative of the composition of the three universities therefore the results cannot be generalizable. The time was short and being a busy time for the academic calendar, it was not possible to get high number of responses. However, these limitations have been addressed in the main study that has been conducted in two Ugandan universities.

5 Conclusion

The shift from using the LMS to a more social and collaborative approach using SNTs has also been highlighted in the paper. This shift is largely due to the emergence of Web

2.0 technology [14, 15] which enables users to create and disseminate contents. Educational affordance of SNS was defined and a typology which distinguishes between pedagogical, social and technological affordances was presented whilst illustrating the purposes of use of these tools by students and lecturers. The results presented showed that although the majority of participants are using these tools. The majority of the students perceived educational affordances but further research is still required in order achieve full utilization of these tools for educational purposes. The limitation of this study paper is that the results are based on the responses obtained through a survey. However, more investigations will be conducted using other qualitative approaches in future.

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Student Action Prediction for Automatic Tutoring for Procedural Training in 3D Virtual Environments

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Abstract. This paper presents a way to predict student actions, by using student logs generated by a 3D virtual environment for procedural training. Each student log is categorized in a cluster based on the number of errors and the total time spent to complete the entire practice. For each cluster an extended automata is created, which allows us to generate more reliable predictions according to each student type. States of this extended automata represent the effect of a student correct or failed action. The most common behaviors can be predicted considering the sequences of more frequent actions. This is useful to anticipate common student errors, and this can help an Intelligent Tutoring System to generate feedback proactively.

Keywords: Intelligent Tutoring Systems · Educational Data Mining · e-learning · Procedural training · Virtual environments

1 Introduction

Interactive environments have been used as tools to improve the "learning by doing" approach. Virtual worlds are one class of this environments, and are one of the most promising lines of research and development in e-learning.

Two important events in the evolution of educational technology are the emergence of Intelligent Tutoring Systems (ITS), and the rise of Educational Data Mining (EDM) [18] thanks to Learning Management Systems.

As a preamble of the work presented in this paper, a 3D biotechnology virtual lab was developed by our research group [15]. As part of this lab a Reactive Tutor was implemented, which can validate the students' actions and show hints to them, whenever is pedagogically appropriate. After evaluating this virtual lab, we saw the chance to include data mining of the students' logs to improve this tutor.

To provide a better and adaptive tutoring feedback we propose a model that can be used to infer the next most probable action or error of each student. This feedback could prevent students before committing an error, as long as this will be a pedagogically appropriate prevention. This model is intended for any 3D virtual environment (VE) for procedural training, although our starting point

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was the virtual lab of biotechnology. In addition, we think that this model also may be applied to 2D virtual environments, as long as they serve for procedural training.

Section 2 shows relevant works in the field of educational VEs and EDM. Next, Sect. 3 describes the proposed architecture for the ITS, which leverages the predictive student action model detailed later in Sect. 4. Finally, in Sect. 5 we show the conclusions of this work and future work.

2 Related Work

We have divided this section into two subsections, the first presents an overview of educational virtual environments for procedural training and the second one addresses the use of data mining to improve education.

2.1 Educational Virtual Environments

In the literature exists a wide variety of educational VEs. Some of them show information to students through pictures, videos and interactive objects or help teachers make virtual lectures. Other environments create situations in which students have to perform some tasks. Moreover, there are some VEs that, in addition to simulate situations, supervise the execution of these tasks by employing an ITS and provide clues to students about the actions to be executed.

Among these applications, one of the most well-known is *STEVE* [11], a 3D animated agent that assist one or more students to learn a task that follows a given procedure. A project that takes advantage of STEVE's architecture is MRE (Mission Rehearsal Exercise) [20].

Another recognized project is Lahystotrain [13], developed to train surgeons in laparoscopy and hysteroscopy operations. Students receive proactive and reactive help from an automatic tutor on how to properly perform the surgery.

To the best of our knowledge, these applications were not designed in a generic way, so that some of their key components cannot be reused in new applications easily. However, there exist a few proposals where generic architectures for educational VEs are present. These were designed to provide an automatic tutor that can be adapted to different educational aims. One of these proposals is called MAEVIF [7,10] and consists in a multi-agent system that represents an extension of the classic ITS architecture [19] specifically intended for VEs.

Another generic architecture is defined in MASCARET (Multi-Agent Systems to simulate Collaborative, Adaptive and Realistic Environments for Training) [4], which is an agent based system that integrates an ITS. A recent work by the same authors is called Pegase [3], and proposes a generic and adaptable ITS based on a multi-agent system.

2.2 Educational Data Mining

A large majority of researchers in the field of EDM have been dedicated to study data or logs registered by e-learning systems like Moodle. One of these works is called System for Educational Data Mining (SEDM) [12], and it tries to study the representative behavior of students that had dropped-out an online course before taking the final exam versus the others who did not.

Another work uses Moodle logs to discover a specific behavior student model [2]. They divide these logs in student groups with similar characteristics using a clustering method and then apply process mining to each cluster to create a model (represented by a directed cyclic graph) that shows the most frequent sequences of students' actions.

The authors found that graphs, models or visual representations are easier to comprehend, and making these representations accessible to teachers and students their results could be very useful for monitoring the learning process and providing feedback.

Other works analyze data collected from students' grade records, for example, Dekker et al. [8] try to predict students drop-out rate at the Eindhoven University of Technology, with the aiming to provide individual attention to students in the "risk group".

Some works try to solve specific problems, like CanadarmTutor Tutoring System [9], which simulates the robotic arm Canadarm2 used in the International Space Station. This ITS provides assistance to users on how to follow a correct solution path with hints of the arm operations. For this, it integrates a cognitive model to assess skills and spatial reasoning, and an expert system that generates solution paths automatically. In addition, it uses data mining techniques to extract a partial task model from past user solutions.

Despite the work that has already been done in this area, the community misses more generic results [17], i.e., results than can be used with other students, or replications of experiments showing that a predictive model can be applied in more than one distinct context. It is also remarkable the lack of intelligent educational systems that take advantage of models developed by EDM [1].

The work presented in this paper represents a step forward towards the development of an ITS that leverages a predictive model computed by means of EDM to offer a better tutoring feedback. Moreover, this ITS is intended for procedural training in VEs and is domain independent.

3 ITS Arcitecture Proposal

The ITS architecture proposal is inspired on MAEVIF architecture [7,10] and is depicted in Fig. 1. The modules of this architecture are: Communication Module, Student Module, Expert Module, World Module and Tutoring Module.

The Communication Module serves as a link between the graphic engine (OpenSim, Unity 3D, Open Wonderland, etc.) and the tutoring system.

The Student Module (integrated as an agent within the MAEVIF [7,10]) is an adaptive, extensible and reusable student model that infers the student knowledge state using a pedagogic-cognitive diagnosis with non-monotonic reasoning abilities. The purpose of this module is to know the status of each student's learning, that is, what he/she knows of the subject or what he/she does not. This can serve to support a personalized automatic tutoring for each student.

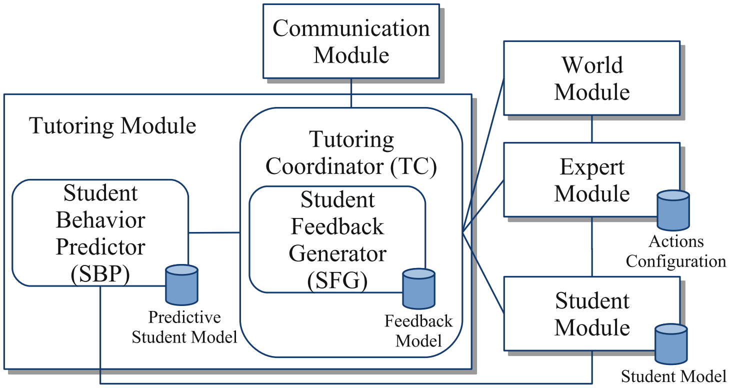

Fig. 1. ITS architecture proposed

One of the disadvantages of the student module is that it needs a lot of prior information on each student and about the knowledge addressed in the actual course to give information with high confidence. This work is detailed in a journal paper and in a Ph.D. dissertation [5,6].

Next, the Expert Module defines the procedure to be learned and the tutoring strategy for each action. This procedure details every step or action that the student should perform and the preconditions (detailed in [15]) that must be met to consider such action as valid in a certain moment of the practice.

The World Module keeps information on the objects implemented inside the VE and their status. This module mainly manages locks of the objects that are being used by students, and therefore they cannot be used by others.

Tutoring Module works as the core of the ITS, because it performs most of the computational logic of the tutoring task. This module is responsible of validating the students' actions by using the information in the Expert Module. In addition, it is also responsible for showing the hints or error messages that more pedagogically appropriate in each moment. The Tutoring Coordinator (TC) and the Student Behavior Predictor (SBP) are the main components of it.

The TC comprises the operation of the reactive tutor, detailed in a paper and in a master thesis [15,16], regarding the validation of students' actions. If the action attempt is correct, it informs this attempt to the SBP and the Student Module, and depending on what they reply the TC generates a feedback using its sub-component called Student Feedback Generator (SFG).

The SBP is the component that concerns us in this paper, because within it lies the Student Predictive Model. This component attempts to predict the next most probable action based on the action records of past students. For this, it relies on the Predictive Student Model that has these action records summarized. Once the most probable action is found, it is delivered to the SFG along with the confidence of this prediction.

4 Predictive Student Model

This model is created using historical data from past students and is continually refined with the actions from students under supervision. Taking into account the Knowledge Discovery in Databases Process and its adaptation into EDM formulated by Romero and Ventura [17], our model can be considered a result of the Models/Patterns phase of this well-known process.

The idea of building this model arose from our experiences evaluating the 3D virtual lab of biotechnology [15]. During the model design, it was necessary to observe the behavior of students in the virtual world following the ethnographic method. Subsequently, as recommended by Mostow et al. [14], the logs generated by the reactive tutor were analyzed by hand to identify interesting phenomena.

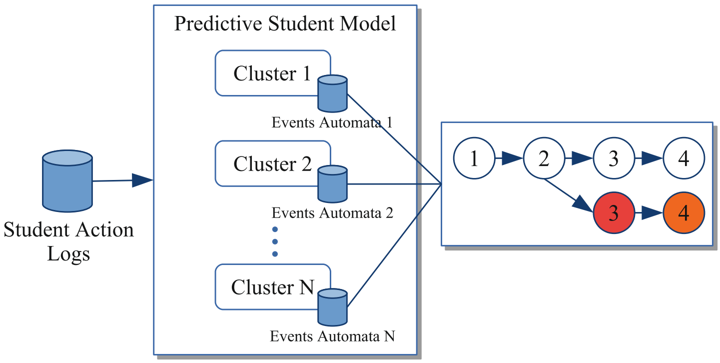

Fig. 2. Predictive Model

The model (see Fig. 2) consists of several clusters of students where each of them contains an extended automata (detailed in Sect. 4.1). These clusters help to provide automatic tutoring adapted to each type of student.

The creation process of this model is similar to the one proposed by Bogarín et al. [2], and it is executed at the tutor start-up. In fact, it consists in taking events from student logs stored in the Student Model. First, students in this logs are clustered based on the number of errors and the time they spent to complete the entire training process. Then, an automata for each cluster is built from the student logs included in each cluster. Later, at training time the SBP component updates the model with each new student action informed by the TC component.

4.1 Extended Automata Definition

This automata consists of states (represented by circles) and transitions (represented as arrows) as shown in Fig. 3. Furthermore, the states are grouped into three zones: Correct Flow, Irrelevant Errors and Relevant Errors Zone.

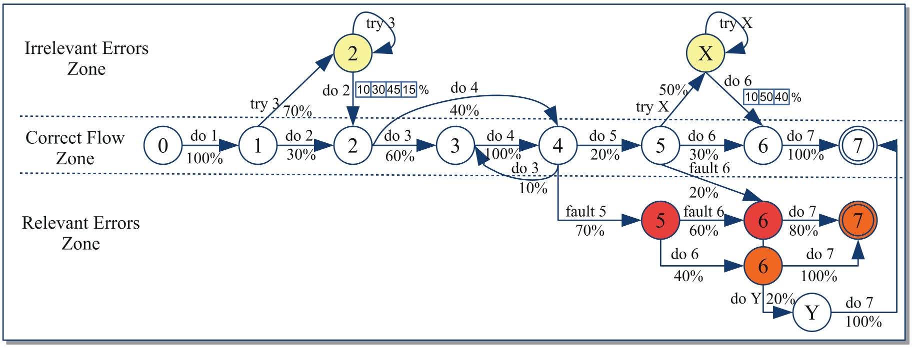

Fig. 3. Example of an extended automata

Transitions denote events provoked by students across an exercise, such as actions or action attempts that past students have performed so far and new students may repeat in the future. An event may be a valid action of an exercise or an error detected by the tutor at the time of validating an action attempt. Accordingly, states represent the different situations derived from the events provoked by students.

It can be seen in Fig. 3 how an event associated with a right action, registered in student logs, produces a correct state. For example, the event of "doing action 1" conducts to state 1 and the "doing action 3" event conducts to state 3. Each state and each transition contain the number of students whose logged sequences of events have passed through, which permit to calculate event probabilities between states.

In the case of states with loops, event frequencies to next states are reflected in a vector. In this way, the probability of a student leaving the loop at each iteration can be calculated.

Correct Flow Zone. In this area are the events that represent the valid sequence of actions for an exercise, which logically ends up with a final satisfactory state. These states are graphically represented by white circles (see Fig. 3).

Irrelevant Errors Zone. This zone groups states derived from error events that do not influence in the final result. These error events are associated with action attempts blocked by the tutor (blocking errors [15]). These are graphically represented by a yellow circle.

Relevant Errors Zone. This area encompasses states derived from error events that actually influence in the final result, i.e., if an event of this type occurs the final result will be wrong unless a repairing action is done (non-blocking errors [15]). In this case there will be an error propagation to the subsequent states, because it does not matter what the student does later (except for some repairing action), the subsequent states will be considered also erroneous. The states derived directly from these errors are graphically represented by red circles and the subsequent correct states by orange circles.

In addition, repairing actions can be found in this area. These actions fix errors occurred earlier and redirect to one state in the correct flow.

5 Conclusions

This proposal achieves an automatic tutoring adapted to each type of student by applying methods of extraction and analysis of data, which can anticipate possible errors depending on its configuration.

The principal application of the presented predictive model is to help students with preventing messages, i.e., messages that can prevent students from making possible future errors. For this, we have designed an ITS, presented above, which leverages the predictive model to provide that kind of tutoring.

We saw that data mining results from student logs can allow ITSs to discover which tutoring actions help more students in each situation. As a direct result, the ITS can help students in a more personalized way and in real time (as also pointed out by Mostow et al. in [14]).

We agree with Mostow et al. [14] in which the advice of an expert educator or teacher of the subject is essential at design time, despite this ITS may become very independent once its tutoring strategy is configured. This is because the resulting predictive model needs to be analyzed for refining the tutoring strategy. In order to facilitate this task, it will be necessary to develop an application that displays the model to the expert or professor. In this way, this person could visualize where students make more mistakes or where the practice is easier for them, and with this information he/she could decide where and what tutoring feedback is needed. Additionally, this could also help a teacher to improve his/her own teaching.

Another future line of work is to improve the world module to use an ontology that defines the virtual world objects. With this and some other extensions, the ITS could offer a more flexible tutoring feedback using objects salience or the calculation of the objects paths.

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Utilizing LMS Tools to Help with Student Assessment

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Abstract. Feedback is important to student progress. Formative assessments allow the student to adjust or improve their learning progress, but take valuable time. This paper describes how using available LMS tools can assist faculty in assessing student work and provide helpful feedback to students. The research measures the results of formative assessments on students' grades. The tools available for faculty to use can be set up to save time for the faculty during assessments. Students have the opportunity for multiple attempts at assignments and receive feedback on each to help measure their learning. The rubric tool was used to not only grade student papers but also to provide appropriate feedback for student performance on the levels of achievement. Quizzes can be automatically graded. Results from this study show the benefits of multiple attempts at quizzes and written assignments. Future research is discussed to help further this pedagogical approach.

Keywords: Assessment · Student assessment · Learning management systems · LMS · Rubric · Alignment

1 Introduction

Many times in education the assessment is an examination or a written paper. The examinations tend to test students' recall of facts and basic information, or their cognitive knowledge of the subject area. Written papers allow students to illustrate how they can apply what they learned in the course or analyze information based on their subject learning. Typically, the student only has one attempt on tests and papers, and their grade is based on assessment of this one attempt. With the technology available now, whether face-to-face or online, these assessments can be conducted electronically, typically utilizing a Learning Management System (LMS). Even so, these types of assessments provide some measurement and feedback without a subsequent opportunity to improve.

The research reported here illustrates a different approach from "one-shot" assessments to incorporate additional chances. This involves utilizing the technology built into the LMS and including rubrics for assessing writing assignments to give students appropriate feedback for improvement and later use. Specifically, this research explains how multiple assessments were implemented in courses and reports some results from exploratory analysis of this approach.

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2 Assessment

Virtual Instructors need to assess student learning. Assessments are classified or talked about in several ways. Lepi [1] reports on six different types of assessments, for example. But generally, the assessment can be considered formative or summative: formative in that it assists the student and instructor in knowing what type of progress is being made toward a goal, and summative as the "final" measurement of student learning used to assign grades. Biggs says, "In the course of knowledge construction, students inevitably create misconceptions, which need to be corrected. But, first, you have to find out what they are, by *formative assessment*" [2]. Jones and Harmon also emphasize that assessment can be an aid to student learning, and students who know how well they are doing can make needed adjustments [3].

Ramsden agrees, stating, "Giving really helpful feedback on students' work is an equally essential commitment" [4].

Ramsden tells us, "The aims and objectives of the course should be devised at the same time as the teacher thinks about their assessment . . . [then] the central purpose of the course . . . will have been carefully articulated and linked to the assessment methods used" [4]. This is often called alignment. Alignment of student learning activities with assessment of student learning is a key concept in Quality Matters (QM), a non-profit organization dedicated to quality assurance in Online Education (see https://www.qualitymatters.org). The instructor of the course was trained in QM principles and designed the online course using the QM approach and also revised the face-to-face course to implement many of the aspects from the QM approach. "The teacher with a well-developed understanding of assessment will strive to connect his or her goals for learning firmly with the assessment strategies he or she uses" [4].

Biggs discusses constructive alignment as a blueprint for teaching. This involves three aspects, (1) saying what the "desired outcomes" are (the objectives), (2) deciding if the outcomes are learned "in a reasonably effective manner" (the assessment), and (3) deciding what "reasonably effective" might mean in terms of our grading system [2]. In getting students to "engage in (appropriate) learning activities" we are teaching them effectively.

The objectives for this course state that by the end of this course, the student should be able to:

1. Identify the major theoretical approaches to communication;
2. Explain many of the specific theories used in studying communication; and
3. Apply theory to understand a communication event.

One difficulty is trying to balance the "cognitive" (learning the facts and basic information) and "application" learning assessments. Often, instructors assess student learning by examinations for cognitive learning and by written papers, case studies or extended examples for application of learning. In this course, the assessments included quizzes to assess student knowledge of theories and papers to assess students' application of theories to communication events.

Although assessment, or measuring student learning, sounds rather straightforward, there are problems with assessment. As Ramsden says, assessment "must be handled with infinite care" [4]. This paper does not focus on the problems related to development of quality assessments so much as the implementation of assessments.

Specifically, the focus is how to deal with one of the biggest problems with assessment, particularly formative assessment throughout a course, and that is time. Many instructors fear they "don't have the time to provide the kind of feedback they would like to deliver" [5]. This problem can be overwhelming when an instructor has a large class or teaches multiple classes, and when the course includes writing assignments. Although instructors may complain about the time needed, Lepi reminds us that assessments do have value and have an important place in our learning structure [1]. In the approach described here, the classes were set up with multiple trials for tests and multiple trials for papers in the LMS by using the settings and tools in the LMS. First, we look at the assessment by quizzes then the assessment by written papers.

2.1 Assessment by Quizzes

Creating and grading examinations or quizzes is a regular activity for instructors. With the benefit of the LMS tools, quizzes can become less time consuming, whether in an online or face-to-face class. Quizzes and examinations easily measure the students' knowledge or comprehension levels, using Bloom's categories [6].

In this case, the instructor developed a test bank of questions for each unit of the course. For multiple assessments of a unit, multiple quizzes can be given without redundancy. The LMS quiz tool allows random selection of questions from the test bank for that unit so each quiz has unique questions and students are not simply taking the same quiz repeatedly. The LMS can be set up to automatically grade the quiz and provide the score to the student. Students then can decide, based on the feedback from that assessment, whether or not they should take another quiz. If they receive the score they need, even if not a perfect score, they may move on to the next unit. If their score is lower than they need or want they may study more and take another quiz over that unit.

According to Haskell, "In games, we experience a remarkable amount of failure. It is this ability to fail without long lasting penalties that serves as a central construct of the learning process. Moreover, mastery requires that we learn from this failure to move on" [7]. Ideally, students would study before taking a subsequent quiz, but there were not controls available to require that in this LMS. Yet they are not "punished" for failure. They simply receive feedback about their progress. The student receives feedback that helps the student determine whether or not their quiz attempt was a success or failure, which results in helping them know if they need to correct or add to their knowledge.

2.2 Assessment of Written Assignments

Whereas the quizzes measured knowledge or comprehension of information and concepts, the papers assessed the application or analysis levels of learning. In this course, the written assignments were applications of the theory where students had to provide an extended example from their own experience illustrating the theory and its concepts.

Students had opportunity to write multiple papers, receive feedback on each and use that feedback to improve their subsequent papers. Specifically, students were allowed to write up to eight papers, one per unit the second half of the term, but only the top four scores would be used in calculation of their final grade. "Formative assessment, as a vital function of teaching, should always be present, but the results should not be 'counted', unless the student agrees" [2]. This is the design of this assessment – students decide whether to use the score on a paper as their grade or to use that feedback to write a better paper and better fulfill the assignment goals.

Any assessment of written work tends to be time consuming. Yet Grey says, "When assigning written projects, it is wise to require more than just the final product" [8]. Using a rubric for the written assignment helps assure that the assignment is instructionally relevant and focuses on the learning outcomes. Rubrics are often used to grade student work, but they can serve another, more important, role as well. According to Andrade, "Rubrics can teach as well as evaluate. When used as part of a formative, student-centered approach to assessment, rubrics have the potential to help students develop understanding and skill, as well as make dependable judgments about the quality of their own work" [9].

Students can use the rubric to clarify standards for quality and to guide their progress toward those standards. Basically, a rubric describes levels of achievement for stated objectives or standards of performance. For example, each objective or standard could have a description of identifiable performance characteristics reflecting a beginning level of performance, a developing level of performance and a mastery level of performance.

"Students are understandably angry when they receive feedback on an assignment that consists only of a mark or grade" [4]. The LMS allows for a rubric with feedback for each level in every category, so students receive specific feedback instead of just a score or grade. "Of all the facets of good teaching that are important to them, feedback on assessed work is perhaps the most commonly mentioned" [4], so the feedback function in the LMS rubric tool was used. In this course, students had the opportunity to write multiple, short papers (2-3 page), receive feedback on each through the rubric and improve their subsequent papers. Rubric categories included (1) writing style and mechanics, (2) accuracy of the theory explanation, and (3) specificity and accuracy of the example provided as an illustration of the theory. With these categories and various levels in each, students received specific feedback on their paper instead of simply an overall score or grade. The instructor simply clicks on the level of achievement for each category and the LMS calculates the score for the paper and provides the appropriate feedback to the student. For example, the rubric expectation for writing and grammar at one level was, "OK – several errors in spelling, grammar or punctuation making it difficult to read due to these distractions," and if selected by the instructor would automatically provide the feedback, "Many errors; you must proof read more closely; have someone else read it before turning it in." An example of the rubric expectation for the "Theory Example" criterion is, "OK – some details provided; but not enough or not accurate," and the automatic feedback provided read, "Too few details provided; make sure your explanation is accurate." Using this information from the assessment, the student will then know what areas do or do not need improvement for subsequent papers.

3 Subjects

Subjects included two fully online sections (n = 46) and two face-to-face sections (n = 164) of the same communication theory class in 2012 and 2013 taught by the same instructor to help assure consistency of teaching styles, materials, and assignments across sections. Students at this university in the USA registered for classes on their own, so there is no randomization of students nor classes, and no control group, limiting generalizability of the results. The majority of students were communication majors who needed a 'C' or better in the course (70 % or higher) as a requirement for their major, so earning a particular grade was more important than simply passing the course (with a D- or 60 % or better).

4 Results

The LMS and technology provides a simpler or quicker way for instructors to assess student work. This research utilized the LMS tools for this purpose. This was an exploratory study to examine the utility or benefit of providing multiple attempts of an assignment. The specific assignments include quizzes and written papers in both online and face-to-face courses.

The students' GPA prior to this course was measured. Overall, there was a significant difference in the students' grade point average (GPA) upon entering the course (t = -2.13; df = 200; sig. < .05). Students in the online sections had a mean GPA of 3.05, and the face-to-face students' GPA was 2.87 (on a 4-point scale). There was also a significant difference in the final grade between the two groups (t = -6.74; df = 116.14; sig. < .001) with the online students' mean grade of 89.6 percent and the face-to-face students mean grade of 81.2 percent.

There was some question as to the impact of a student's GPA on their success in the course (their final grade). To try to determine if the better students (as measured by GPA) would get better grades Pearson Correlations were run. The students' prior GPA was significantly correlated to their Course Grade overall and for both the online (r = .440; sig. = .05) and face-to-face student groups (r = .570; sig. = .001).

4.1 Quizzes

There were 13 quizzes in the courses, one for each unit. Overall, the final mean score on quizzes was 80.38 percent. Students in the online course could repeat any quiz as many times as they liked. Students in the face-to-face course did not have that option and were used as a comparison (a type of control group) for this analysis.

Online Results. Only two students of the 47 did not repeat any quizzes in the online class. On average, students took 23 quizzes. The mode was 18 (14.9 %). The average final quiz score (as opposed to the average first attempt score) was 89.64 %. The difference between the first attempt and the final quiz grade showed an improvement of over

10 % on average. There was a significant difference between the grade on the students' first attempt and the students' final quiz grade (t = 9.707; df = 46; sig. = .000).

Did this have any relevance to the students' success or final grade in the course? Students improved their quiz scores by three to 43 percent by re-taking quizzes. The rate of improvement (the difference between the first and final scores) was not correlated to the student's final course grade (r = -.167; n = 46; sig. = ns). There was a significant correlation between the students' course grade and the score on the lowest quiz that was not re-taken (r = .481; sig. < .001). This relationship signifies that the lower the score on a quiz that the student did not re-take, the lower the student's grade in the course. This seems to suggest that it was advantageous to re-take quizzes. However, the number of quizzes taken was not significantly related to the final quiz grade (r = -.173; ns) nor the course grade (r = -.182; ns). The number of quizzes re-taken also were not significantly related to the final quiz grade (r = -.031; ns) nor the course grade (r = -.090; ns). It did not seem to matter how many quizzes the student took or re-took.

The results showed a significant correlation between the students' final quiz grade and their course grade (r = .885; sig. < .001). It must be noted, however, that quizzes were not the only graded assignments in the course. Final grades for the course included the quizzes, papers, and participation in online discussions. For the online students, neither the number of quizzes taken nor the number of quizzes re-taken were significantly correlated to the students' prior GPA. It seems that GPA is not an indicator of effort in this case (as indicated by retaking quizzes).

Comparative Results. This research studied whether or not having multiple attempts would benefit the student. Comparing the online student (those with multiple attempts possible) with the face-to-face student (those without multiple attempts possible) showed that there were significant differences in their final quiz grades (t = -9.53; df = 144.09; sig. < .001). Online students received a mean of 89.8 percent while face-to- face students received a mean of 77.8 percent on quizzes. This would suggest that providing multiple attempts for quizzes may increase student success.

4.2 Papers

The students were required to write at least four papers. Both online and face-to-face students were able to write up to eight papers, and the top four grades were to be used in the calculation of their course grade. Most students (73.2 percent) wrote the minimum number of papers. Students who wrote more than the minimum number of papers improved their scores on papers by one to 35 percent overall.

Did this have any relevance to the students' success in the course or final grade in the course? The final score on the papers was significantly correlated to the student's final grade in the class (r = .532; sig. < .001). However, there was no significant difference in the final paper scores between the students who wrote the minimum number of papers and those who wrote more than the minimum number of papers (t = - 1.170: df = 208; sig. = ns). Also, there was no significant difference in the final grade for the course between the students who wrote the minimum number of papers and those who wrote more than the minimum number of papers (t = -1.688; df = 208; sig. = ns).

The lower initial paper scores was significantly and negatively correlated to the amount of improvement in papers (r = -.698; n = 46; sig. < .001), meaning that the lower the initial paper score, the more the improvement in the scores. But the improvement in the students' paper scores was not significantly correlated to the student's final course grade (r = -.086; n = 46; sig. = ns).

5 Conclusion

This study was about how to use LMS capabilities to help manage instructors' time investment involved in assessment while still providing helpful, multiple assessments and feedback to students as they continue their learning, not just a single, final assessment. It is important, then to have the assessment that leads to or helps the students learn. According to Shuell, "It is helpful to remember that what the student does is actually more important in determining what is learned than what the teacher does" [10]. In this study, students were provided the opportunity to do activities more than once with feedback from the assessment of those activities.

Results indicated that students (in the online class) were able to take advantage of the feedback from assessments (grades on tests, and grades and rubric comments for papers) to decide if they needed (or wanted) to try again. This agrees with findings from Casey et al., who found that those students who "submitted much more than the minimum criteria typically reaped the most benefit in terms of academic performance" [11].

There is evidence in this study showing that providing students multiple attempts can benefit them. Those students who did multiple attempts showed increases in their scores on both quizzes and papers. As Jones and Harmon stated about assessment aiding student learning, it appears that students who took advantage of their feedback and decided to try again were aided by the feedback and made needed adjustments [3].

However, in this study there were some mixed results concerning the advantage of multiple attempts. While the results showed that the final quiz score was significantly higher than the initial quiz attempt, the results also showed that the number of quizzes re-taken or the total number of quizzes taken were not correlated with the final quiz grade nor the course grade. For papers, students were able to improve their scores if they wrote more than the minimum number of papers, and their scores were positively correlated to their grade in the course (better paper score – better course grade), but there was no evidence in this study that writing additional papers improved their course grade more than not writing additional papers. It did appear that writing the additional papers helped bring those students' scores up to where other students' scores were. Further study is certainly warranted.

Sims, Dobbs and Hand state that computer-based technology can "respond meaningfully to user actions and manipulations" yet this is often not discovered nor used [12]. Educators need to take advantage of the improving capabilities of the various learning management systems to assist in meaningful and helpful assessments for their students, and to find ways to do so without increasing their own time commitments.

This study was limited in that the classes measured were not randomly selected and had no control group for comparisons. Ideally, establishing more stringent divisions of students would allow statistical comparisons, but classes are rarely scheduled in such a manner to allow random groups to compare. There was also a limitation due to the format of the courses offered. One was scheduled during a shorter summer term and the other during a full 15-week semester. Some students may not have felt they had the time to write more than the minimum number of papers during the shorter term while they may have during the longer term. However, results showed that the actual number of papers written in these two formats was not significantly different, so having more or less time did not seem to influence students' decision to write additional papers.

The approach allowed more student choice or control of their learning path. Future research should also gather student perceptions of multiple attempts at assignments and quizzes. Is it seen as being helpful or as simply additional work? Do students find this feedback helpful, too little or general, or do they even use this feedback for subsequent work?

This study was a step toward better understanding of how to use LMS tools and technology for better assessment of our students' learning. Particularly this study also involved a large class. "In large classes, lecturers find it difficult to provide this level of individual feedback quickly on practical reports or essays" [4]. Using the LMS for automatic grading of quizzes and the rubric tool allowed specific feedback to be provided to students.

This study assumed the assessments (the quiz questions) were good indicators of student learning or that the score on a quiz or paper was a valid measure of student learning. As stated earlier, this research did not focus on the problems related to development of quality assessments so much as the implementation of assessments using capabilities of the LMS. It provided ways that do not increase instructor workload. These results should help other educators, online or face-to-face, as they consider using technology for assessment approaches, whether final assessments or formative, developmental assessments to help students gauge their progress in the course and make decisions accordingly.

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