LEARNING DESIGN APPROACHES FOR PERSONALISED AND NON-PERSONALISED E-LEARNING SYSTEMS

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Abstract

Recognizing the powerful role that technology plays in the lives of people, researchers are increasingly focusing on the most effective uses of technology to support learning and teaching. Technology enhanced learning (TEL) has the potential to support and transform students' learning and allows them to choose when, where and how to learn. This paper describes two different approaches for the design of personalised and non-personalised online learning environments, which have been developed to investigate whether personalised e-learning is more efficient than non-personalised e-learning, and discuss some of the student's experiences and assessment test results based on experiments conducted so far.

1. Introduction

The ubiquitous availability of information and communication technologies (ICT) and multimedia tools have altered the landscape of learning and teaching. In this digital age, traditional learning habits have been reshaped; students demand learning environments that can be accessed via their personal choice of tools as wireless technologies and high-tech devices become widely available (JISC, 2009) and easy to use. The benefits of e-learning

include 24/7 connectivity to information sources and people, use of multimedia resources and activity tools. These enhancements have made many educational institutions wish to integrate technology into their educational practices.

At the same time, e-learning promises to be a very efficient and effective educational method (Wei & Yan, 2009) and one of the hottest topics in technology enhanced learning is providing real personalisation (Mylonas, Tzouveli, & Kollias, 2004). Future plans of the British Government include teaching strategies to support personalised learning, utilising new technologies to realise personalised learning, and finding methods to use the curriculum flexibly for increasing personalised learning opportunities (Baker, 2008). Today, with the ability of advanced technologies to capture, store and use individual data to deliver personalised learning based on students' preferences, it is possible to address this agenda (Mylonas, Tzouveli, & Kollias, 2004). Existing learning style models in the literature are widely utilised to achieve different levels of personalisation in learning materials and provide a pathway through a set of learning materials (Cemal Nat, Bacon, & Dastbaz, 2009).

Different pedagogical approaches can be applied to the design of an online course (Teo & Gay, 2006), however, "technology does not in itself bring about successful learning" (JISC, 2009), and students will still need support and guidance. The designs of a course needs particular consideration if, for example, it is to improve retention rates and enable successful progression and completion. Technology facilitates students' learning by allowing them to find a better way of learning, however, it does not guarantee that they will learn (Cemal Nat, 2010).

In traditional classroom instruction, teachers use various strategies and activities to create their learning designs as part of their lesson plan. In any learning design, sequencing and organizing of course contents and the selection of support activities are key concerns. In contrast to a focus on the organization of content, support activities need special attention (Dalsgaard, 2005). Various online support activities that can be included in the learning design of a course can help students to reinforce their understanding of contents and, acquire knowledge and skills (JISC, 2009).

"Learning Design is a descriptive framework for activity structures that can describe many different pedagogical methods." (Dalziel, 2009) and every learning practice has its own underlying learning design (Koper, 2005). It is possible to develop hundreds of different learning practices depending on the course objectives (Koper, 2005). Different perspectives and associated pedagogies or combination of perspectives can be involved in a learning

design. According to JISC (2009), it could also be argued that successful learning may depends on integrating different approaches.

In this paper we describe two different learning designs which have been designed to investigate whether personalised e-learning systems are more efficient than non-personalised e-learning systems in the context of assessing particular outcomes (e.g. recalling). The Felder & Silverman Learning Style Model (FSLSM) (1988) was selected as the preferred model to profile students and create personalised e-learning environment. The model was formulated by Richard Felder and Linda Silverman in 1988, and an instrument of the model was developed by Richard Felder and Barbara Soloman in 1997. Approaches for providing personalised learning through a process of profiling students using FSLSM and free-use of e-learning environment will be discussed.

In both designs, individual student's learning styles are tested. The first design aims to provide a personalised learning environment based on a student's predetermined learning styles. In this case their learning 'journey' is predetermined. The student, therefore, needs to answer a list of questions before accessing the learning materials and activities. The second design, non-personalised e-learning system, provides a free choice of learning materials and activities that allow students to find what they believe is their best way to study the subject. Both of them include exactly the same instructions, learning materials and activities, and both aim to test the student's learning style using the Felder and Solomon questionnaire. During the experiment, students were provided with e-mail support regarding the learning materials and technical problems as needed.

These two learning designs have evolved as two different e-learning systems, which aim to provide complete, and classroom independent, e-learning environments. The Learning Activity Management System (LAMS), which was integrated into the Moodle VLE, was used to develop the e-learning systems. For the experiment a group of university students from 'Multimedia Games Design and Development' course were randomly divided into two groups and invited to use one of the two e-learning systems to study the subject of "how to import music and sound in flash files, and publishing a flash game" which was divided into six sub-sections in both systems.

2. A concept for identifying learning styles and providing personalised learning

Owing to the rapid development of internet technologies and the shortcomings of traditional classroom learning, the way of learning is continuing to shift from the physical classroom to online supported learning although the vast majority of students themselves still value face to

face teaching environments (JISC, 2006). Providing effective learning in an online environment has become a significant issue (Lin & Chen, 2008). Personalisation in e-learning is the process of tailoring the learning environment according to students' learning styles, profile, interest, previous knowledge level, goals and pedagogical method in order to maximize the effectiveness of learning (Jing & Quan, 2008). Students' individual differences such as prior knowledge, learning goals and styles have been considered as the principal elements of personalisation. Notably, learning style is seen as one of the most significant factors to support personalisation (Liu, 2007). It is widely accepted and reported that the learning preferences of each student tend to be different (Liu, Gomez, Khan and Yen, 2007; Uden and Damiani, 2007); some students may learn best by watching and listening, other by reading, and others by doing (Zapalska and Brozik, 2006; Cantoni, Cellario and Porta, 2004).
In our study, a personalised e-learning system was designed based on FSLSM which is considered as the most appropriate and feasible learning style theory with respect to web-based learning system design and development (Carver, Howard, & Lane, 1999). The main aim of this learning style model is to describe the most significant learning styles of engineering students and help instructors to match their teaching strategies with students' learning needs (Felder & Silverman, 1988). It characterises students in four dimensions according to their preferred way of processing, perceiving, getting and understanding of information. In parallel, it classifies instructional methods to address proposed learning styles and distinguishes preferences in four dimensions.

Active/Reflective dimension

This dimension categorises learners according to their way of processing information. *Active learners* are categorised as retaining and understanding information better by doing something with the learned material such as; discussing, applying or explaining it to others. By contrast, *reflective learners* tend to think about the concepts quietly first and they like work alone. Also, in order to retain the material more effectively they prefer to stop periodically to review and think what they have read, and write short summaries of their reading. In our system different types of learning support tools were included for the provision of pedagogical support and encouraging students' information processing.

Sensing/Intuitive dimension

Learners in this group are distinguished according to their perceptions of the learning materials. *Sensing learners* prefer to learn facts and study concrete learning materials,

whereas *intuitive learners* are more comfortable with abstract materials. Moreover, in order to learn from concrete material *sensing learners* tend to like solving problems with standard approaches and dislike complicated problems. They also remember and understand information best if they see how it connects to the real world and they tend to be more practical.

Intuitive learners like discovering possibilities and relationships. Moreover, learners in this category tend to be more innovative and like challenges than *sensing learners*. Imaginative and practical types of examples were used for each section of the subject being studied in order to facilitate students' perception on learning materials in our system.

Visual/Verbal dimension

In this dimension learners differentiate according to the way that they prefer to get the information. While *visual learners* remember best what they see, such as pictures, diagrams and movies, *verbal learners* learn better from written and spoken explanations. Furthermore, *visual learners* may use techniques such as highlighting to colour-code their notes to remember better. Video, audio, picture-based and text-based content presentations of each section were provided to facilitate the students' in learning the information.

Sequential/Global dimension

Learners are characterised according to their understanding of information in this dimension. *Sequential learners* prefer to learn in a linear way and in order to find solutions they tend to follow logical stepwise learning paths. By contrast, *global learners* tend to learn in large jumps and absorbing learning materials randomly. They can put things together once they see the 'big picture'. They are interested in overviews and find connections between different areas, whereas *sequential learners* are more interested in the details. In order to encourage understanding of the subject, a sequential or free selection of learning path was developed for these learners.

Table 1: Felder and Silverman Learning Style Model

Felder and Silverman Learning Style Model								
Dimension	*Processing*		*Perception*		*Input*		*Understanding*	
Learning Style Preference	**Active**	**Reflective**	**Sensing**	**Intuitive**	**Visual**	**Verbal**	**Sequential**	**Global**
Description	Discussing, applying, explaining	Thinking, taking notes	Facts, concrete materials	Creative, abstract materials	Pictures, diagrams, movies	Written spoken	Linear steps	Large jumps, random steps

Corresponding teaching styles of instructors in a classroom with the learning styles of students have also been suggested by Felder and Silverman (1988). However, as e-learning was not common in 1988, corresponding e-learning system features with the learning style preferences have been constructed by the authors and are summarized in Table 2.

Table 2. Reflections of the FSLSM in classroom and on the system.

Learning style preference		***Corresponding teaching styles in a classroom***		***Corresponding e-learning system features***
Active	**Processing**	Active	**Student Participation**	**Learning Support Tools** (discussion forum, chat, mind map, note taking)
Reflective		Passive		
Sensing	**Perception**	Concrete	**Content**	**Subject Examples** (imaginative, practical)
Intuitive		Abstract		
Visual	**Input**	Visual	**Presentation**	**Content Presentation** (text, audio, picture, video)
Verbal		Verbal		
Sequential	**Understanding**	Sequential	**Perspective**	**Learning pathway** (sequential, random)
Global		Global		

Significant elements such as learning goals, expected outcomes, learning activities, learning pathways and/or learning materials are considered by instructional designers in learning designs used to develop contextual and domain knowledge (Jing & Quan, 2008). However, in traditional classroom education, it is difficult for instructors to use multiple design experiences due to time, material and environmental constraints (Vattam & Kolodne, 2006).

3. Personalised learning design

This design employs the intervention of the system to support students who have been assessed with particular learning styles and needs. At the beginning of the learning 'journey' students were required to complete the FSLSM questionnaire to identify their learning styles

before they could start. In order to avoid asking too many questions at once and to enhance students' participation, questions were presented in four stages. The student was then automatically presented with an appropriate personalised e-learning environment containing the individualised learning pathway, a set of learning materials and learning support tools according to the results of the questionnaire. Before starting to study the subject in order to prepare the students, they were provided with a page explaining the goals of the session.

A personalised learning pathway for each student was created to help the processing of the presented information. For example, as *sequential learners* gain understanding by working through the learning materials step by step, with each step following logically from the previous one, they are provided with a sequential pathway. This design presents appropriate learning content and then provides examples for each section. After completing these two steps, the system suggests the use of particular learning support tools to reinforce understanding. However, *global learners* in a personalized system are allowed to choose their path freely as they can absorb materials with random steps. Additionally, in order to help them to see the 'big picture' they are given access to general subject overview page. In such case, students could visit examples first and learn contents later or directly use support tools.

Four different presentation types for content were used to support visual and verbal type students in order to enhance their way of receiving information. Students who can receive information easily from demonstrations and pictures were provided with learning content, which are explained using video and pictures, whereas *verbal learners* are provided with audio and text contents, as they are better at learning from spoken or written words. *Visual learners* could choose video content, picture-based content, or both: *verbal learners* students could choose audio content, written content, or both.

Two types of examples (i.e. imaginative and practical) for each section were used to support *sensing and intuitive learners.* Students in the sensing category were provided with practical-type examples for helping them find connections with the real world and learnt facts. In addition, supplementary practical examples were made available for these students, since they tend to learn from examples rather than listening or reading course content. They enjoy solving practical problems. In contrast to *sensing learners*, imaginative-type examples are provided to *intuitive learners* to encourage their creativity and discover relationships between concepts. In this system, *sensing learners* did not have access to imaginative-type examples and vice versa.

Learning activities that were presented to the student were based on the first dimension of FSLSM, which identifies active and reflective students. For example, *active*

learners were encouraged to use chat and discussion forum tools that allow them to discuss and/or explain the studied materials with their peers. Furthermore, multi-user mind mapping tools were also provided for this type of students to support their information processing. In order to allow this type of students to try things out and help their understanding, additional exercises and code samples were made available. By contrast, *reflective learners* were encouraged to take time for thinking and use a note-taking tool for writing summaries. In addition, generating a single user mind map tool to work alone or for reflecting on the information presented was also made available for *reflective learners*. Moreover, self-assessment tests were provided to give them an opportunity to reflect on the materials and check their acquired knowledge.

Towards to the end of learning session, students were given a chance to upload and submit their solutions to any of the practical exercises. Afterwards, to finish their learning session they were asked to answer several multiple-choice questions about the studied subject for assessment purposes. The assessment test could be attempted only once.

4. Non-personalised learning design

In this design, our aim was to create a learning environment that does not provide any personalisation. Therefore, all learning materials including contents and examples, and support tools were made freely available to all students. They were allowed to choose their pathway to study the subject with the restriction of visiting at least six learning materials as the subject has six sections. To provide additional data on learning styles, students were still required to answer the FSLSM questionnaire at the start of the learning session and take the assessment test at the end.

The students were presented with all available contents in four different formats: video, audio, text and picture-based. At the same time, they had access to all existing examples of the subject in two different formats including practical and imaginative. Discussion forum, chat, note-taking and mind map tools were freely available in order to enhance students' learning. Moreover, students were allowed to use all supplementary materials such as extra practical examples and more information sections. As all learning materials and activities are available, students created their own pathways to work through the subject in their preferred way. They were allowed to revisit any material and activity as many times as they wished, however the system would not let them finish the learning session until they have tackled some learning materials. For example, students may prefer to visit examples first and then contents or only examples.

As in the personalised learning design, towards to the end of learning session, students in this group were also given a chance to upload their solutions and finish their learning session by answering multiple-choice questions about the studied subject without retaking the assessment test.

5. Results and discussion

This study was designed to investigate if personalised e-learning systems are more efficient than non-personalised systems in the context of assessing particular outcomes (e.g. recalling). Students were expected to study the subject and answer an 18-item multiple-choice assessment measuring their knowledge at the end of their learning session. Each question was worth 1 point and the system calculated the final grade for each student. In total 46 students from two different universities used the systems and successfully completed the learning sessions. 23 students studied the subject using the personalised e-learning environment and 23 students used the non-personalised e-learning environment.

Table 3. Subject assessment test results.

University	***Learning environment***	***Average of total grades***
University A	Personalised	9.7
	Non-personalised	9.1
University B	Personalised	6.9
	Non-personalised	7.6

As the results of the assessment test indicate, students from University A performed better in the personalised e-learning environment and achieved higher marks than students from university B. Most of them answered half of the questions correctly. Students made positive and constructive comments about the systems after completing their learning. A student from university A made the following comment about the personalised learning environment:

> This was a very useful insight into the future of E-learning. Truth be told, I didn't try my hardest to complete all the tasks but I believe, if this system was fully integrated into our learning schedule, it would be very useful particularly because it offers tailored learning.

On the other hand, about the non-personalised learning environment they said:

> It’s very easy to use, pretty fun. I wouldn’t mind using it again. Videos were awesome.
>
> It is very educational. Please implement this in the future course.

The comments above show that students are willing to use an integrated e-learning system in their course. In particular, they liked the idea of having course content presented in different

formats. As students are now quite familiar with technology, they did not have problems using the systems. Nevertheless, user manuals for each system were provided in order to minimise any difficulties.

In contrast to University A students, University B students performed better in the environment that they had free access to all learning materials and support tools. Although, they got lower marks than University A students, they made optimistic and encouraging comments. Their opinions about personalised system are:

> I found it easy to use. I would like to use it again also there are good tutorials and I could get helpful information. It's a very good system which will help our generation and future generation.
>
> The system is good and distinct. I want to use it again because I want to improve my flash knowledge. I like the videos which are explaining every steps. I think some 'action scripts' are long. Thank you for this thing, I hope we will use it again.

Similarly, positive comments were expressed by students using the non-personalised system:

> "Well, I have learned some useful things in this session because of there was things which I haven't seen before and then I tried to figure my experience by practicing step by step to get the right result and I'm so so thankful to who the set this e-learing session up for us :)."
>
> "If given chance and opportunity I might use this system again. It was user-friendly plus convenient as we can do it while sitting at home."
>
> "I found it easy to use and would like to use it again. I liked the tutorial part where I was able to learn and I liked the assessment part as well. There is no part of the system I did not like. A good point of the system is the ability to track my progress."
>
> "At first I found the e-learning hard to use but later on I was conversant with it. I would like to use the system again. I liked the chat application and profile pages."

Students from University B provided opinions from different perspectives. In addition to system usage and accessibility, they shared ideas about their learning. They reported learning different techniques and improved of their knowledge about the subject. Moreover, they were able to analyse the content. For example, comments such as "I think some 'action scripts' are long", demonstrates the ability of this student to evaluate how to improve the system. Others remarked that it is good to be able to track their progress and use chat application.

In general, results and comments indicates that Learning Activity Management System (LAMS) as a standalone learning environment is accepted positively by students and that they would like to have it integrated into their usual learning programme.

6. Conclusion

The current study was intended as a preliminary study exploring the efficacy of personalised

e-learning systems. The proposed learning designs are applicable to LAMS and students appreciated using the e-learning systems. However, the findings do not definitively support the conclusion that personalized e-learning systems are more efficient than non-personalised e-learning systems or vice versa. These findings warrant further research, particularly with larger sample sizes and in-depth analysis of students' data such as, time spent on contents and assessment test, number of content visits etc.

Note

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