ABSTRACT
Motivation – The purpose of this paper is to analyse how students experience different modalities in online ICT learning. The general aim is to develop a system that maps learning activities within their own context to different modalities.
Research approach – A first study was conducted in which about 30 students were asked to view three online presentations on three different topics and presented in three different modalities. After each presentation they were asked to evaluate the experience in a questionnaire.
Findings/Design – Despite the fact that no significant differences were found on how students experience different modalities, there are indications that the results would be different with a larger control group.
Research limitations/Implications – Only Italian university students whose native language is not English participate in the study. This might influence the results. We intend to repeat this study with other student populations and for other learning domains.
Originality/Value – E-learning today comes in different modalities. The choice for a certain modality nowadays is often technology or teacher driven. In this research we want to investigate e-learning from a user-centred perspective to discover in what situations what modalities enhance the learning experience of students most.
Keywords
E-learning, Multimodality, User-centred design
INTRODUCTION
Today, adults have to keep up with new knowledge and developments during their whole working life and even after retirement. This need will even increase in the future. (Rosenberg, 2001)
E-learning is an important way of learning in this ongoing education of adults as it provides several benefits. Students can learn when and where they like, they can learn at their own pace and select the learning materials that meet their own level of knowledge and interest. Nevertheless there are also disadvantages to e-learning. E-learners can feel isolated and unsupported. Furthermore, adult distance education students have to be highly motivated and responsible to do all the learning work on their own within the time frame they have available.
Today more and more multimedia is used in e-learning. E-learning courses have not only plain text but also pictures, video, multimedia, audio records, interactive examples... Some course are made in video format, other in plain text with pictures, however does a teacher actually know why one certain multimedia format is used instead of another? And what is the best format to use for your students?
Current design approaches are often either technology driven or teacher centred. A technology driven approach does not primarily serve the user needs or learner context, while a teacher centred approach often takes the individual learner goals and learner situation for granted. Hence an approach focusing on the individual student needs, context and goals is needed.
User centred design methods start from the needs and situation of multiple users and other stakeholders. New insights in the concept of experience as a view on the user’s stake in interaction with artefacts will increase the value of these methods, especially when applied to the domain of self-initiated learning and the support for life long learning.
Design patterns can be used to propagate how designers can make user centred design decisions. In a design pattern a design problem and the context in which the problem appears, is described. Possible solutions for this problem are explained by giving a rationale and by pointing out when a solution is considered to be a good solution.
We believe that design patterns are a good way to represent how you can design user centred e-learning. Design patterns allow you to explain the context of a design decision and why and when this applicable. This is important if you want to design an e-learning environment that is adapted to the needs of your specific users.
AIMS AND OBJECTIVES OF THE RESEARCH
The aim of this research is to investigate how we can develop distance learning material and techniques for adults through user centred design. We will limit
ourselves to the domain of academic level ICT and design education. We want to develop a conceptual framework and ontology for designing multi-modal e-learning for the this domain.

**Modality versus media**

Modality refers to the way information is represented while media is the actual channel through which the information is delivered. A moving picture, whether movie or video, is an example of a modality, by contrast the television or the computer with where the video is played upon is the media.

Bernsen, the founder of Modality theory and address the following problem: (Bernsen, 2001):

> Given any particular set of information which needs to be exchanged between user and system during task performance in context, identify the input/output modalities which constitute an optimal solution to the representation and exchange of that information

Recent research (Babadoğan, 2010) found that there is a positive correlation between the learning style, visual, auditory or tactile and academic procrastination of students. This means that a course based upon learning activity the student is performing.

**User-centred e-learning**

There are different aspects that we believe to be important in user centred e-learning.

Firstly each student has its own individual goals. One student wants to get a degree, another student needs to pass a course to get a promotion at work and another student is just following a course for fun and out of personal interest

Secondly each student is working within a certain context. For example one student studies when travelling on the train and has only a limited bandwidth available, another student follows a course that is not in his native language and finds it difficult to keep up with fast spoken audio.

Thirdly students do many different learning activities when studying a course. Some examples of learning activities are: acquiring definitions, understanding examples, reading literature, applying the theory to the practice, making exercises…

All these different aspects can make a difference on how the student is supported best on the learning trajectory.

We want to look what modality gives the best experience for a student based upon the personal goals of the student, the student’s learning context and the learning activity the student is performing.

**EXPERIMENTAL STUDY**

Several different aspects might influence the experience of a student when e-learning. At this stage it is difficult to predict what modalities will be good in what situation. Because of this we think it is a good idea to start our experimental study by investigating how students react to different modalities. In this phase we do not look at the personal goals of the student or at the context they are in. Two learning activities, acquiring a definition and understanding an example, will be briefly investigated in the experiment.

In our first experiment we question students how they experience new learning material presented in different modalities. Three different topics were chosen, where each topic explained a usability technique to the student. The topics were personas, scenarios and cognitive walkthrough. Each topic was presented in three different modalities: a video, a PowerPoint presentation with voice over and a text with pictures.

The content in each topic was the same for each modality. The voice in the video was the same as the voice that accompanied the PowerPoint presentation. For the text modality a transcript of the audio in the video was written down. The transcript was slightly adapted to change it from spoken English to written English, without changing the content or adding extra text.

**METHODS**

**Participants**

The participants in the research were 27 students who study Design at the university of Alghero in Italy. The students did this experiment as part of an exercise in a course on service design. We omitted the results of students that did not complete the whole exercise, which left us with 18 student results.

**Design**

Every participant viewed three presentations, each of them explaining a different usability technique: personas, scenarios and cognitive walkthrough. The three presentations were each shown in a different modality, one was a video presentation, one was a PowerPoint accompanied by audio and one was a textual file with static pictures in it.

To avoid a preference based upon viewing the presentation in a specific order, we randomised the sequence in which the presentations were shown. The randomisation was done by using a Latin square design that took both the topic of the presentation and the modality into account.

After each presentation the students filled in a questionnaire to assess how they experienced the presentation. To measure this experience we looked at different metrics. How easy was it to understand the material in the presentation? How attractive is the presentation? How much did they liked or disliked the
modality the presentation was presented in? Was the presentation engaging?

The questionnaire was the same after each of the presentations. In the questionnaire the majority of the questions had a 5-point scaling answer. In other questions the participants could select several options at the same time. Finally there were questions where you could select only one single answer.

RESULTS

The results of the 5-point scaling were calculated with a single factor analysis of variance (ANOVA). Three different results groups were compared based upon the modality the presentation was shown in: the video group, the PowerPoint group and the textual group. There was no split up in presentation topic to eliminate bias.

We received 54 results on the questions, evenly spread over the three modality groups. Therefore we can calculate the degrees of freedom (df1) as 2 and df2=51. The critical F-value results in 3.179.

The F-values that were calculated all were in a range between 0.028 and 1.197. This means that there were no 5-point scaling questions were the F-value was higher than the critical F of 3.179. Therefore the differences between the groups were not significant.

The results of the single answer questions were calculated with a chi square test. The results were between 0.746 and 0.834, which is a lot lower than the 9.49 critical values for df=4, meaning that there is no significant difference found.

At this stage the answers of the multiple answer questions are not yet calculated.

DISCUSSION

No significant differences were found in how the participants experienced different modalities. We will present different possible theories why the measured results differ from our expectations.

Firstly all the participants in the study were students at an Italian university. The study was conducted in English, which was not the native language of the students. The English language level can influence the way a presentation was received by them. When a presentation has textual input a participant can read slower and re-read the difficult parts of the text. The participant can even take a dictionary and look up words that are not understood. With an audio tape you are forced to follow the speed of the speaker, which might be too fast for some non-native speakers. The audio could be replayed, but it is much more difficult to look up a word you don’t understand well, maybe the participant doesn’t even know how to write the word correctly.

Secondly in this study we did not look at the specific context of the participant. Did they have a place were they could quietly listen to the audio or watch the video? The video presentation was much larger to download than the PowerPoint and the text version respectively. Maybe participants with a low bandwidth internet connection had to wait longer before they could watch the video presentation.

Thirdly we did not ask or tested the students in advance to know what their preferred learning style was. Maybe this could influence the results on how they experience the different presentations.

Fourthly the number of participants in the experiment was maybe too low to actually see a significant difference. We have verified this possibility with a power test. The results of the ANOVA power test is that the chance to find a large effect when there actually is a large effect present is 72.6 percent. The chance to find a small effect between the values when the effect is (actually present however is only 9 percent. To have a 95 percent chance of finding large effects, we need to have 27 participants, while we need 423 participants to find the small effects present. Our experiment therefore did not have enough participants to reliably detect small differences in the data. We did see that some of the F-values were much higher than others, since the values were between 0.028 and 1.197 with a critical value of 3.179. This might indicate that there actually is a significant difference but that we were not able to statistically detect it, because our sample space was rather small. The largest F and Chi square values were found on the following questions:

- How easy it was to understand the presentation? 5-Point scaling answer from very easy to very difficult.
- How serious or casual do you find this presentation? 5-Point scaling answer from very easy to very difficult.
- How effective would you rate this media to transfer knowledge? 5-Point scaling answer from very effective to not very effective.
- What would have been your preferred way to see the example explained? Choose one option out of Video, PowerPoint with audio, Text with pictures.
- What would have been your preferred way to see the definitions explained? Choose one option out of Video, PowerPoint with audio, Text with pictures.

Finally the participants did not spend the same time on each modality. Watching a video explanation might take more of your time than reading the explanation textually. We are not sure if and how this influences the user experience.
FUTURE RESEARCH PLANS
This first study showed us that in future experiments we should have a larger number of participants in order to raise the chance of detecting significant differences in the data we collect.

We want to continue the current research where participants view learning material in different modalities. Step by step we will introduce other elements like user goals, context and learning activities.

In the following experiment we will look at how people experience multiple modalities within a single presentation. For example the definition is explained in a video, then it continues with an example in a PowerPoint and additional information is presented textually. Does adding different modalities in one presentation that takes only a limited time span influence the experience positively?

We want to elaborate the study by adding an assessment to the presentation to test the knowledge the student has gained from watching the presentation. Will the student gain more knowledge from different modalities? Are there other factors that influence the student?

REFERENCES
