IWEPLET 2013

The EuroPLOT project and the IWEPLET 2013 workshop are funded by the Education, Audiovisual and Culture Executive Agency (EACEA) of the European Commission through the Lifelong Learning Programme (LLL) by grant #511633 from 2010 – 2013.

The EuroPLOT Project Partners:

Aalborg University (Denmark) hosts the Centre for Persuasive Design, is the originator of the EMDROS database and the 3ET tool. Aalborg University also provides target groups of teachers in archival work, language learning and environmental science.

DHI (Denmark) is an international consulting and research organisation, and brings expertise in the development of technical guidance and courses for vocational training, including the application of e-learning resources and tools, and represents the target group on environmental science.

The University of Hradec Králové (Czech Republic) has led several European projects on learning objects, particularly on their creation and distribution through repositories (for example e-dilema), and is experienced in using e-learning in teaching business computing.

Danube University Krems (Austria) has a large interest in Open Educational Repositories (OER), the development of e-learning taxonomies and learner-centred design approaches related to learning environments, and has significant experience of evaluating educational projects and expertise in learning design and pedagogic frameworks.

Leeds Metropolitan University (UK) is the lead partner on this project and has expertise in developing learning objects (participation in 2 European projects), practical experience in Open Educational Repositories (OER) (institutional OER and repository projects), expertise in learning design patterns (led a national project), and in natural language processing and artificial intelligence applied to education (national project).

London Metropolitan University (UK) brings experience from the Learning Technology Research Institute with an international reputation in research on learning objects and learning design, and they are developers of GLOmaker, a generative learning object authoring tool.

Proceedings of the

International Workshop on EuroPLOT Persuasive Technology for Learning, Education, and Teaching

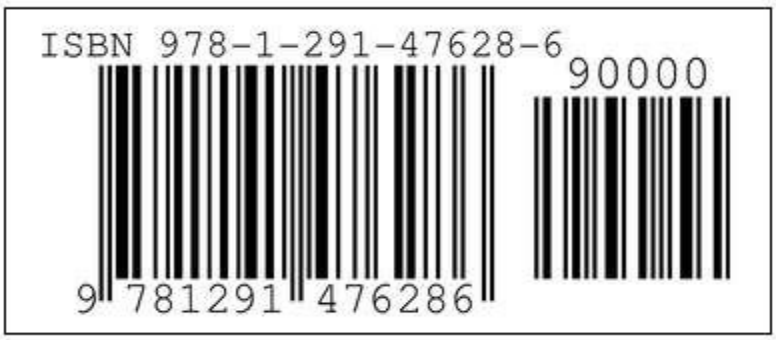
(IWEPLET 2013)

16-17 September 2013
Paphos (Cyprus)

Editors: Reinhold Behringer and Georgina Sinclair (Leeds Metropolitan University)

IWEPLET 2013 is held in conjunction with the **EC-TEL 2013 conference**

The papers in this book comprise the proceedings of the meeting mentioned on the cover and title page. They reflect the authors' opinion and, in the interest of timely dissemination, are published as presented and without change. Their inclusion in this publication does not necessarily constitute endorsement by the editors.



(2nd edition, with ninor revisions)

Preface

This book contains the proceedings of the **International Workshop on EuroPLOT Persuasive Technology for Learning, Education and Teaching (IWEPLET) 2013** which was held on 16-17 September 2013 in Paphos (Cyprus) in conjunction with the EC-TEL conference. The workshop and hence the proceedings are divided in two parts: on Day 1 the EuroPLOT project and its results are introduced, with papers about the specific case studies and their evaluation. On Day 2, peer-reviewed papers are presented which address specific topics and issues going beyond the EuroPLOT scope.

This workshop is one of the deliverables (D 2.6) of the EuroPLOT project, which has been funded from November 2010 – October 2013 by the Education, Audiovisual and Culture Executive Agency (EACEA) of the European Commission through the Lifelong Learning Programme (LLL) by grant #511633. The purpose of this project was to develop and evaluate **P**ersuasive **L**earning **O**bjects and **T**echnologies (PLOTS), based on the ideas of BJ Fogg. The purpose of this workshop is to summarize the findings obtained during this project and disseminate them to an interested audience. Furthermore, it shall foster discussions about the future of persuasive technology and design in the context of learning, education and teaching.

The international community working in this area of research is relatively small. Nevertheless, we have received a number of high-quality submissions submitted to a peer-review process before being selected for presentation and publication. We hope that the information found in this book is useful to the reader and that more interest in this novel approach of persuasive design for teaching/education/learning is stimulated.

We are very grateful to the organisers of EC-TEL 2013 for allowing us to host IWEPLET 2013 within their organisational facility which was a great help in preparing this event.

I am also very grateful to everyone in the EuroPLOT team for collaborating so effectively during the three years towards creating excellent outputs, and for being such a nice group with a very positive spirit also beyond work.

And finally I would like to thank the EACEA for providing the financial resources for the EuroPLOT project and for being very helpful when needed. This funding made it possible to organise the IWEPLET workshop without charging a fee from the participants.

Reinhold Behringer
Chair of IWEPLET 2013

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Part A: The EuroPLOT Project

Persuasive Technology for Learning and Teaching - The EuroPLOT Project

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The concept of persuasive design has demonstrated its benefits by changing human behavior in certain situations, but in the area of education and learning, this approach has rarely been used. To change this and to study the feasibility of persuasive technology in teaching and learning, the EuroPLOT project (PLOT = Persuasive Learning Objects and Technologies) has been funded 2010-2013 by the Education, Audiovisual and Culture Executive Agency (EACEA) in the Life-long Learning (LLL) programme. In this program two tools have been developed (PLOTMaker and PLOTLearner) which allow the creation of learning objects with inherently persuasive concepts embedded. These tools and the learning objects have been evaluated in four case studies: Language Learning (Ancient Hebrew), Museum Learning (Kaj Munk Museum, Denmark), Chemical Handling, and Academic Business Computing. These case studies cover a wide range of different learning styles and learning groups, and the results obtained through the evaluation of these case studies show the range of successes of persuasive learning. They also indicate the limitations and areas where improvements are required.

Keywords: Persuasive Design, persuasive technology, eLearning, learning objects, case studies

Background

In his seminal introduction of the concept of Persuasive Technology (PT), BJ Fogg [1] has identified several core principles of persuasive design of interaction systems. These principles have been shown to be able to change human behavior through indirect and informal learning. The question arose as to whether these principles could also be put to use in more formal learning. In 2010 the EuroPLOT consortium [2] was formed to address this problem and to investigate the use of these persuasive principles in learning and teaching. In this project, which is funded by the Education, Audiovisual and Culture Executive Agency (EACEA) of the European Commission in the Lifelong Learning Programme from 2010-2013, we have developed a framework for developing persuasive learning designs [6]. This framework was used to inform the development of two tools which allow the creation of persuasive learning objects based on persuasive learning designs: PLOTMaker and PLOTLearner. These two tools have been developed from existing software which has been extended with the persuasive elements and design options. These tools and the learning objects created with them have been applied and evaluated in four different case studies with groups of teachers and learners from realms with distinctly different teaching and learning practices: Academic business computing, language learning, museum learning, and chemical substance handling. Altogether, these case studies have involved the following wide range of learner target groups: school children, university students, tertiary students, vocational learners and adult learners. With regards to the learning context, they address archive-based learning, industrial training, and academic teaching. The participants in these case studies are from Sweden, Africa (Madagascar), Denmark, Czech Republic, and the UK.

Main elements of Persuasive Design

The main idea of the EuroPLOT project is to develop technologies which would allow the designers of learning objects to create such objects with inherently built-in "persuasiveness". The seven persuasive design principles identified by BJ Fogg are:

1 **Reduction** refers to the design strategy of simplifying what would otherwise be a complex process. For example, Amazon's 1-click purchase which allows you to skip a lot of time consuming navigations and tedious form filling, in order to make an instant purchase.

2 **Tunneling** is a design strategy which places the user inside a process that has a pre-determined direction. E.g. most installation processes require that the user completes several steps before the installations process is completed.

3 **Tailoring** is the degree to which a site or a program presents relevant content to individual users or user groups. Navigational options, filtering mechanisms and labelling systems can all be adapted to reflect user demographics.

4 **Suggestion** is the persuasive design strategy of delivering a message at the opportune moment. E.g. when Amazon suggests extra books which are closely related to the one you were just about to buy. - It is very important that suggestions are made at the right time, ***Kairos***. This idea stems from ideas of Greek philosophers, in particular Aristotle. It may be defined as the opportune moment to perform a persuasive action. It is a quite powerful concept which is not easily formalised, but its use in technology applications can significantly contribute to persuasiveness by the just-in-time and just-in-place paradigms

5 **Self-monitoring** is the design strategy which allows you to monitor progress. E.g. sites which require a log-in and then enables the user to monitor the progress of weight loss.

6 **Surveillance** is closely related to self-monitoring; however the monitoring is not done by the user but by the system or the owners of the system. E.g. when using a weight loss website, users may be motivated not only by monitoring their own progress, but also by sharing experience and receiving feedback from other users who are struggling with similar issues. By sharing statistics, diet-plans etc. users feel more related to each other and may be inspired by actions taken by others.

7 **Conditioning** refers to the strategy of embedding emotional feedback into a design. It is often expressed as praise and rewards, but in a slightly more subtle manner than the case with Persuasive Social Actors. E.g. when forums reward users with increasingly lofty titles (or user rights) in correlation to the number of posts made by the user.

Tool development and case studies

Tools

Two tools were developed in the course of the EuroPLOT project for creating such persuasive learning objects: PLOTMaker stems from the software tool GLOMaker [3] which allows the creation of self-contained digital learning objects and which has already been in use and development for several years before the EuroPLOT project. The additions to convert GLOMaker into PLOTMaker during the EuroPLOT project include several elements that refer to the persuasive principles, which can be put into the learning objects created with PLOTMaker. In particular the Augmented Reality component in PLOTMaker demonstrates the Kairos principle of just-in-place for location-based learning.

The tool PLOTLearner has been derived from the tool 3ET [5] and uses a large corpus of data in which language tests are stored, based on the database EMDROS [4]. This database is annotated and allows retrieval of text, broken into components of the language structure (words, phrases, clauses etc.). This very specific capability makes PLOTLearner suitable for learning where a large corpus of text is available.

Case studies

These two tools have been used to create learning objects in four case studies for demonstrating the viability of the persuasive learning approach. Altogether, these case studies cover several different learning styles, learner and teacher groups, countries and cultures. As target learners they address school children, university students, tertiary students, vocational learners and adult learners. With regard to the learning context, they address archive-based learning, industrial training, and academic teaching. Internationally these case studies include participants from Sweden, Africa (Madagascar), Denmark, Czech Republic, and UK. These case studies do not claim to give a comprehensive answer to the question of persuasive learning which does have a deeper positive impact than traditional learning, but show that this approach does have benefits for learning success. The reason for involving such a breadth of topics, learners, and learning styles was to demonstrate the applicability of persuasive learning across a wide range.

Academic Business Computing

This case study is undertaken in the framework of database teaching in academic computer courses which are taught at two universities. The learning objects in these courses are developed with the tool PLOTMaker and focus on teaching basic SQL. The goal of this case study is to demonstrate the applicability of this approach in two different countries and languages (English in UK, Czech in Czech Republic). The specific topic of these learning objects is database normalization and SQL querying, and the main persuasive principles used in the PLOT's design are **reduction** and **interactivity**.

Language Learning
This case study investigated the learning of language with the help of a large corpus of text. The learning tool PLOTLearner was specifically developed for this type of learning with a large text repository (data-driven learning) from annotated texts. The language to be taught is Ancient Hebrew. Due to the difficulty of this language, this provides a valuable example of how a language with a different visual writing system can be taught effectively to students through the engagement with a large structured text corpus.

Mediating Kaj Munk
The Danish writer and vicar Kaj Munk (1898-1944) has produced a significant oeuvre of plays and other texts, all of which are archived in the Kaj Munk Archive at Aalborg University. In addition, there is a Kaj Munk Museum in his old Vicarage in Vedersø (Denmark). Learners who want to inform themselves about life and work of this writer can do so through several methods developed in the EuroPLOT project: they can explore the writings through an online Kaj Munk Study Edition that allows structured access through the EMDROS database of Kaj Munk's works. Furthermore, a tool has been developed which makes it possible to virtually visit the Kaj Munk Museum using mobile devices, thereby using computers as persuasive media with Augmented Reality (AR) technology.

Chemical Substance Handling
In an industrial context, employees often need training in how to implement and handle new regulatory demands. This is especially important in the case of using chemical substances which may be harmful. In the EuroPLOT project, DHI has used PLOTMaker to develop learning objects which teach adult learners in an industrial context how to handle such dangerous chemicals. This considers health and safety aspects, and the persuasion of the learning objects is implemented through tailoring and simulation.

Results

The evaluation is in its final phase, and the results will be available and presented at EC-TEL in September 2013. A common set of evaluation criteria was used for all case studies, although this could not be consequentially maintained due to the fundamental differences of the case scenarios.

The **Business Computing** case study uses an outcome-based learning design paradigm for creating the courses, hosted on the virtual learning environment *Blackboard Learn*. Student feedback was evaluated and overall positive attitude and reception was noted. Constructive alignment has been found in the context of this case to be a key principle for which learning objects can be perceived as persuasive and effective for learning.

The **Language Learning** case study for Ancient Hebrew has involved learners in Denmark, Sweden and Madagascar. The tool PLOTLearner was successfully evaluated with 91 learners. Instructional strategies that embed self-reflective learning activities and challenging interactive exercises have been detected as particularly valuable components of a persuasive design approach for learning the language.

The **Kaj Munk** case study has involved teachers and students in classroom and outdoors (AR). One novel contribution was the *Conceptual Pond* in which personal reflections can be collected in a simple and intuitive way.

The **Environmental Science** case study for teaching handling of harmful chemicals has involved 22 participants. The process of creating learning objects did lead to further improvements in the tool capabilities. In the context of this case study for adult education we

found that the use of explorative learning designs has shown potential towards creating an awareness of the practical relevance of what was learned.

Future work

The EuroPLOT project will conclude in October 2013. Workshops will be held to disseminate the results of this project, including lessons-learned and the general persuasive concepts for teaching and learning. Further work will be to conduct an actual study on the true effectiveness of persuasive principles in teaching and learning, as these case studies only provide an indication of the effectiveness of persuasive learning.

Acknowledgements. The EuroPLOT project was funded by the Education, Audiovisual and Culture Executive Agency (EACEA) of the European Commission through the Lifelong Learning Program with grant #511633.

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Persuasive Learning Design through Context Engineering

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EuroPlot has focused on extending PLOTMaker by adding new components, persuasive learning patterns, a mobile player and learner journey manager. This new authoring environment enables teachers, trainers and students in industry and educational institutions to rapidly create pedagogically based contextual mobile learning apps. The authoring environment structures these apps methodologically to allow for the exploration of the inherent relationships between the learning content and the context of that content.

Keywords: Mobile Learning, Persuasive Learning, PLOTMaker, Learning Context.

Introduction

PLOTMaker is designed to support the aims of the EuroPlot project by giving teachers, trainers and students the tools necessary to create and adapt effective learning resources. PLOTMaker has been extended on the basis that the persuasiveness of a learning design is not dependent on the technology itself, but on how the technology is applied within a given context:

1. PLOTMaker as context engineering tool: Recent research is beginning to show that fluidity of thinking and learning relates to fluidity of movement. As a result of this persuasive principle the new version of PLOTMaker enables teachers, trainers and students to dynamically manipulate elements of the learning context. This is achieved by exploring the generation of 'meaning' in the physical environment and the inherent relationship between learning content and the context of that content.

2. PLOTMaker as mobile app maker: The new version of PLOTMaker enables teachers, trainers and students to rapidly create pedagogically based mobile learning apps in an intuitive and easy way. The persuasive power of this development will be explored with an example from the Kai Munk case study (figure 1+2) where students will capture their learning experience in situ using the mobile PLOTMaker player and then feed that content back into the PLOTMaker environment for novel reflection and interrogation of their learning.

Background

PLOTMaker has a wide international user base with 18,198 visitors having made 27,331 visits to the website in 2012 alone and from 129 different countries. There have also been 5,024 PLOTMaker downloads in the same time period.

The WYSIWYG authoring tool provides powerful features with an easy-to-use interface. It is open source and free for educational use. The PLOTMaker tool currently works on computers, tablets and mobile phones and allows users to overlay digital sight, sounds and interactions onto the physical world in order to create rich immersive and interactive experiences. Users equipped with a mobile device running the PLOTMaker mobile player can move through the physical world and trigger digital media interventions in response to physical events such as location, proximity, time and movement.

In addition to being used to create and then repurpose learning resources in four subject areas within the EuroPlot project (archival studies, language learning, environmental science and business computing) it has been used to develop and deliver a wide range of learning resources in a number of projects funded by bodies such as JISC, FDF (Foundation Degrees Forward) and many UK Universities.

Case Studies

1. Kai Munk

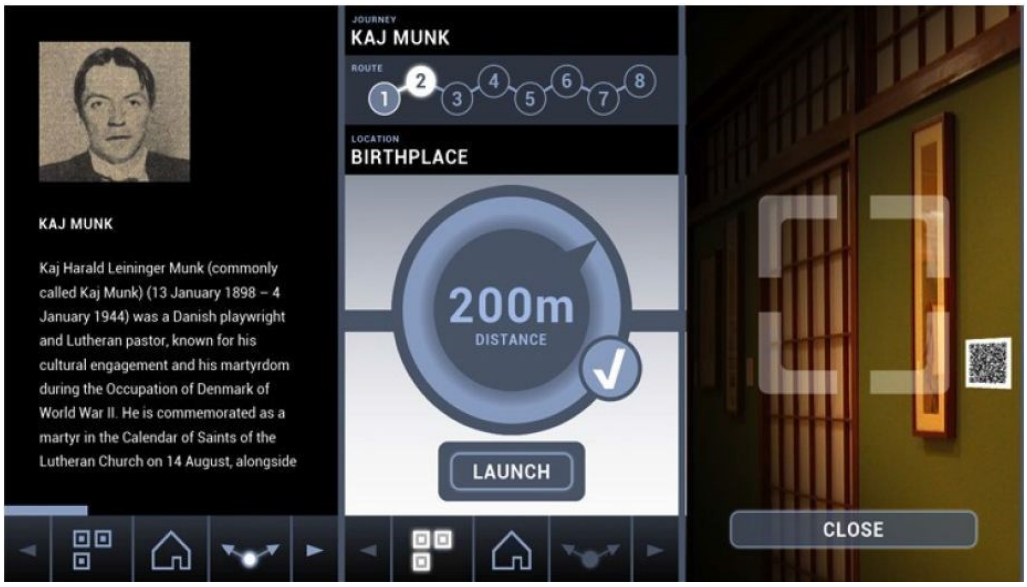

Figure 1: EuroPlot Kai Munk case study

PLOTMaker is being used to develop resources for problem-based learning for adult learners and school children around the Kaj Munk archive and will work with the Kaj Munk Research Center and the Kaj Munk Museum in Vedersø.

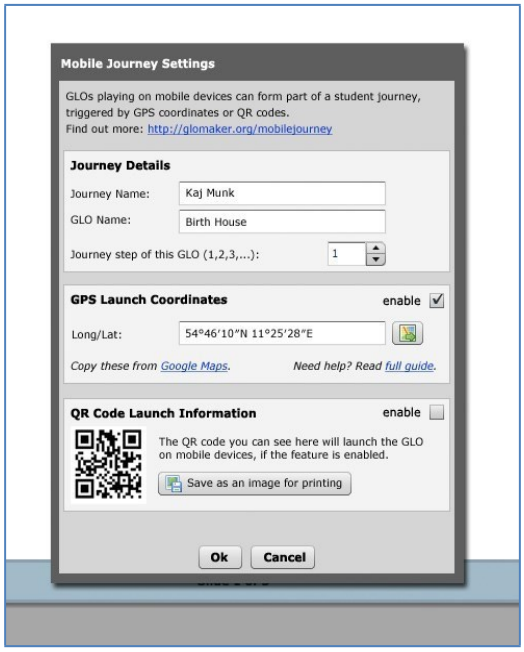

Figure 2: The Kai Munk Learner Journey Interface

2. Rylands Greek papyrus

(http://www.glomaker.org/samples/Papyrus12/GLO_Player.html) This example PLOT focuses on Rylands Greek papyrus and uses the PLOT access views component (see figure 3). The access views component is effectively a tool within a tool that is used (in this instance) to explore a variety of interpretations of a single artefact from three different disciplinary perspectives (History, Papyrology - study of papyrus documents, and Museum Studies). The objective is to promote an appreciation of the insights about the item and its wider historical context by considering an object from more than one disciplinary perspective.

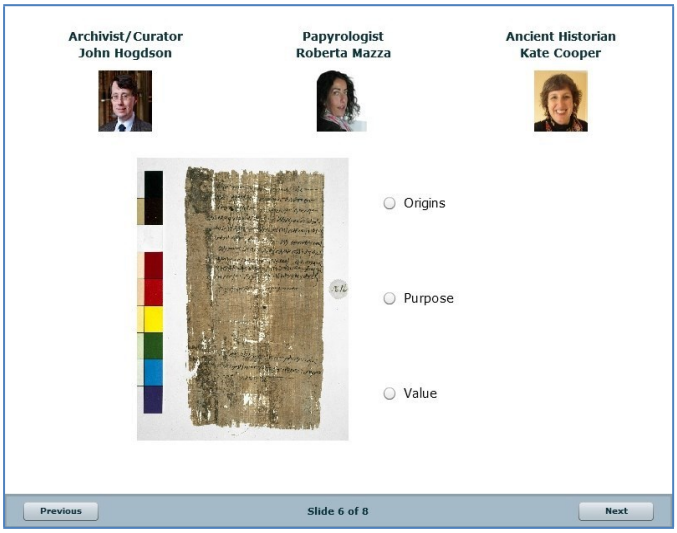

Figure 3: Rylands Greek papyrus Access views component.

3. Ravensbourne Induction Trail

The Ravensbourne Induction Trail is an interactive location-based media experience designed by students for (the new intake of) students at Ravensbourne University. This process of co-creation was encouraged through the PLOTMaker architecture - ice-breakering and team building activities were triggered via the PLOTs in order to combine personal with environmental experiences.

Using the PLOTMaker tool, and consequently the PLOTmaker player, the learners and their teams are guided into different reflective challenges and are asked to re-conceptualize them by recording short videos expressing their point of view, their strengths as a team, and show their decision making and problem solving skills. The Induction Trail consists of six PLOTs, each of which is connected to an area of the building and specific topic and activity.

The learners have to discover the environment and become an active part in the process of knowledge construction. The entire experience is learner-centered. As a result the members of this "Community of Practice" (Wenger, 2006) actually (co)produce the resources which can in turn usefully be shared with other communities (Ryberg, 2008)

According to pedagogical constructivism the students enhance their personal potential developmental level through their independent problem solving activities. Rather than taking place under adult guidance these activities are actually mentored by the tasks suggested by the PLOT, and supported through collaboration with each other (Vygotsky, 1978).

Following the simple activities designed for the learner, this process of technology-based learning becomes a social process of *collaborative knowledge building* (Brown & Campione, 1994; Lave, 1991; Pea, 1993a; Scardamalia & Bereiter, 1996)[1] for the creation of cultural artefacts (Stahl, 2005) and learner creativity. During the induction trail the learners will use not only the PLOTmaker player, but they will be encouraged to use other "social" platform, such as Instagram and Twitter to generate their personal content and challenge other teams.

1. **Scavenger hunt: photo challenge**
   The "Scavenger hunt: photo challenge" (see figure 4) is an ice-breaker and team building activity which uses the PLOT as a guide for understanding the different courses offered at Ravensbourne University. Instead of the traditional "scavenger hunt" they have to use their devices socially, tagging their content via Twitter.

   All the content is then available not only for the team that created it, but also for all the other members of the other teams and in general for all the Twitter and Instagram users. The objective is to create a new form of knowledge based on the personal experience of different learners, that spreads over the social networks through creative activities, in a collaborative social environment.

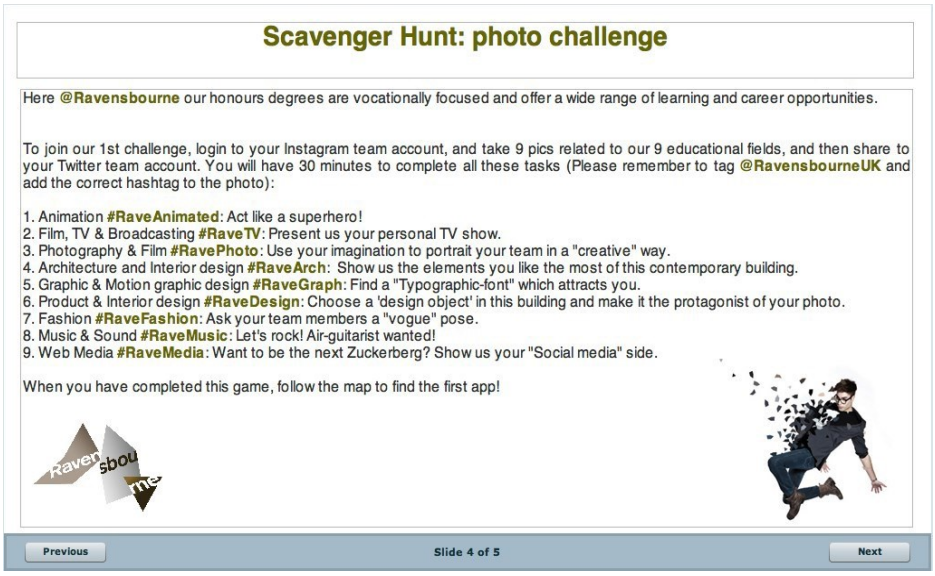

Figure 4: Scavenger Hunt: photo challenge

2. Central Loan Resources

The "Central Loan Resources" is the place where the equipment of Ravensbourne university is borrowed. In this case we have created a memory game (see figure 5) to let the students familiarise with all distinctive equipment from different fields of study. In order to create a more interactive experience we have used the 360 degrees panorama feature. The students could be able to interact actively with the environment and discover the equipment moving into the room (see figure 6). For this activity the social use of Instagram and Twitter is required.

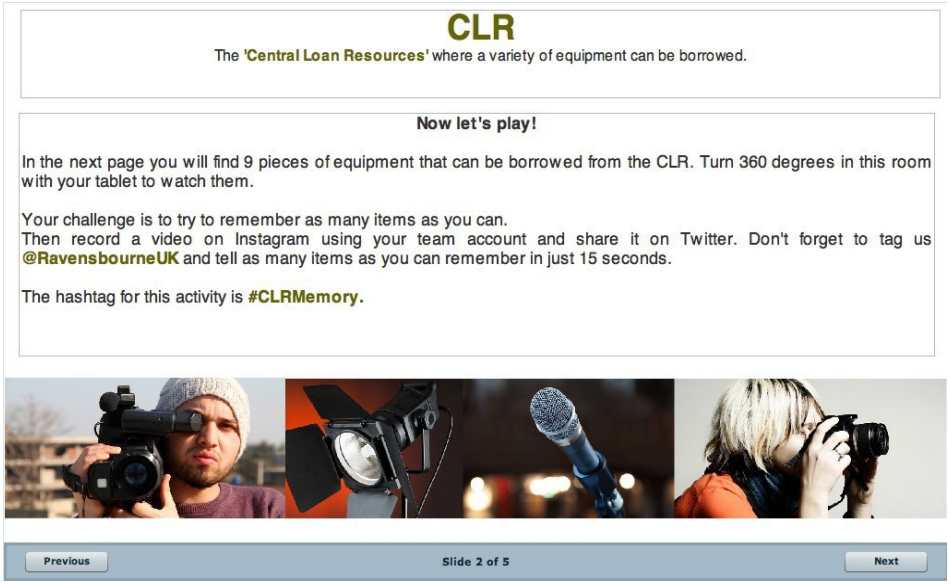

Figure 5: CLR activity explained

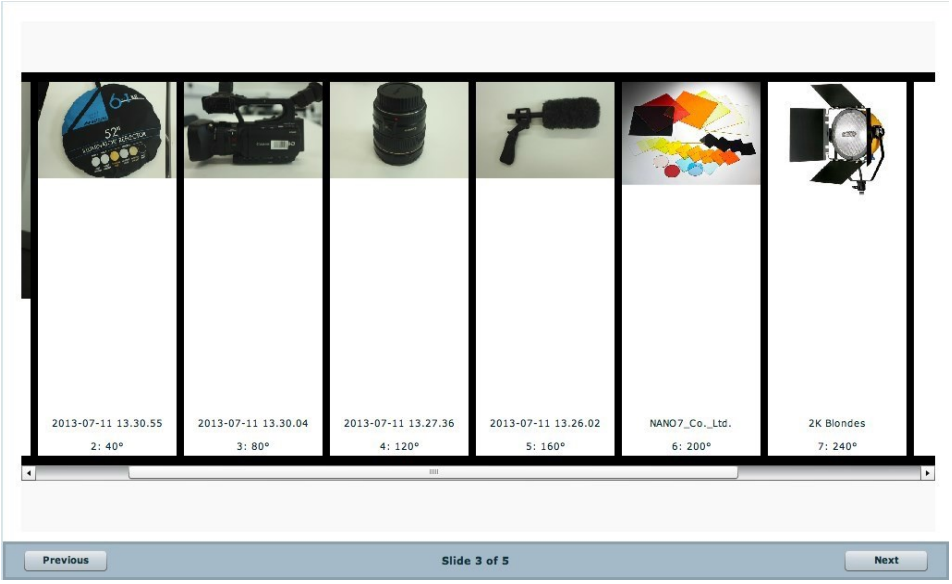

Figure 6: CLR 360 degrees panorama

4. Urban Education and Language Learning.

The final case study focuses on the design, implementation and evaluation of a location based, context aware system for urban education. The initial design was iteratively adapted using evolutionary prototyping for language learning.

The Urban Education tour is based on a small area known as Eden Grove close to London Metropolitan University and it explores how schools from 1850 to the present day are signifiers of both urban change and continuity of educational policy and practice. The theoretical perspective was to allow collaborating learners to interact: with each other, with the mobile phones and with the physical environment in order to generate their own context for development within a Zone of Proximal Development.

Iteration 1: Urban Education

The tour was developed using the initial design outlined above in conjunction with a complex interplay between mobile learning technologies, iconic physical infrastructures and educational discourses. The aim was to visualise urban education through various collective images and representations (cf: Durkheim's notion of the *social imaginaire*). This was intended to enable researchers in both formal and informal learning contexts, when combined with the real, to examine past and present representations of urban form, and relate these to a contemporary Iteration of urban education (Pratt-Adams, Maguire and Burn, 2010). The overall intention was to create a digital 'technoscape' (Appadurai, 1996; Urry, 2006) to represent urban land, space, and subjects using a combination of social and cultural scripts. These included oral histories, local historical stories, and material elements that detail changes in the urban form, such as old photographs of pupils, school buildings and historical maps. The aim was for the researcher to move through the re-constructed landscape and thus "perform that landscape" (Sheller and Urry 2006, p. 9).

The development and production process involved the following elements:

- Initial field work and documentation of the site;
- Capture and digitisation of oral histories, Pathe news clips and local historical stories;
- Capture and digitisation of material elements that detail changes in the urban form, such as photographs depicting the evolution of school buildings and historical maps;
- PLOT production to support the underlying pedagogy of the tour.

The cameras on the smart phones were used to allow students to produce video podcasts of themselves and take photos. This instant capture of report writing and note making in situ was designed to promote real time reflection. Images captured with the phones were automatically geo-spatially tagged with their location information using GPS. These smart phones are also capable of instant upload of data to sites like Flickr. Finally QTVR (quicktime VR) movies of the interiors of the structures under investigation can be viewed and manipulated in real time on location (as access to the interiors was not available during the fieldwork).

Users running the PLOTMaker player on a mobile device can move through the physical world and trigger digital media with GPS via an invisible interactive map. Zones are initially set up on a map which has been geo-referenced to the physical site. The training starts with minimal instruction for the user. The intention is that whilst the technology (GPS) is working behind the scenes the content is very much at the forefront in order to minimise any technical concerns. Once they have entered a zone, audio and textual instructions are automatically triggered to the mobile device.

Some examples of the varied learning activities involved in the application include a section where the user is asked to examine both the physical architecture and the virtual architecture in the same physical location. The virtual architecture in this instance includes areas which were not available to view on the day of the tour and visualizations of the building as it was in the late 19th century. The user is then asked to examine what the building was originally used for when it was established in 1870. The user also has the opportunity to listen to the oral history of a former pupil at the school and adopt their point of view whilst in the same physical space where the events took place. *The user can reinvest the insight gained back into the context and augment the space.*

In another section the user is asked to look at a newsreel of a religious procession from the 1930s that was filmed in Eden Grove whilst they are standing in the same location where the film was shot. The students can reflect on the significance of religion (in this case Roman Catholicism) on the locale and its influence on schooling.

In the 1920s this area was known as the Ring Cross Estate and was in the second highest criterion for overcrowding and squalor, with people living in some of the worst slums. During the middle of the 20th Century, the area was part of a slum clearance programme. Conditions improved throughout the 1970s. The user is shown these street scenes and asked to approximate by physically sketching out how much of the area in the archive footage still remains and how much of it has been redesigned. The student is encouraged to reflect on the impact of the social conditions on educational standards.

The final section exposes the user to the differing architectural styles of the buildings. The user is introduced to a traditional Victorian 3-decker style school design (where the hall is located at the centre with classrooms coming off a central point) and asked to compare it to the more recent open style designs where each classroom is given some access to the playground. The central activity is to examine what the architecture suggests about the educational approaches of the time.

Iteration 2: Language Learning

The aim of this iteration of the design was the realisation from the previous instances shown above that the way information is spatially represented directly impacts on our cognition. "In the everyday world, humans organise and manipulate objects in space to facilitate thinking. We are constantly organising and reorganising space to enhance performance" (Kirsch, 1995). All forms of media use some level of spatial arrangement to organise information.

Computer-assisted language learning (CALL) has embraced virtual learning environments such as Second Life but using actual physical structures as a means of scaffolding language learning has not yet been explored. The method of loci was adopted by ancient orators in order to remember and organise speeches using a combination of visual memory and location (Yates, 92).

> "The problem of seeing and retaining complex information is older than print…. The principle ancient mnemonic device was called 'The Method of Loci' and places its emphasis on memorability (via intelligibility and transparency) through visual structures such as concept maps. It is very much concerned with the acquisition of new knowledge. It plays upon methods that we use informally, and it is a tradition that survives today …..Visualization was in itself an important method of theory building. It may have been more important than text." (Won, J. Storkerson, P. 1996)

So would our pre-existing spatial design act as a catalyst and activate the abilities of language learners if carried out in situ? The tour was translated into four languages: German, Spanish, Italian and French but the content remained exactly the same. The users were tested in the classroom using this content as text only and then in situ using our design.

Although we accept that our description above is brief, we point out that reusing another iteration of our design here for language learning was very easy and quick to achieve, something that we see as a pointer to the generality of our approach. In the future research section we will explore ideas for extending the Language Learning design.

Social Media

A potential way of extending the urban education project is to incorporate the dynamic use of real time social data. We become part of a larger social identity through passing around ideas. We spread ideas around through dialogue and other forms of interaction. They become 'contagious patterns of cultural information that pass from meme to meme which in turn have the ability to change the actions of a group' (Dawkins, 1976). A meme is a basic unit of cultural ideas, social semiotic symbols or practices, which can be transmitted from one mind to another via texts or speech, etc.

Learning interventions can now harness the power and potential utility of the wider social network. If we can spread ideas bi-directionally through these cultural networks in real time then we can harness instant feedback and reuse. This will help create what can be termed mobile meme machines (http://mememachine.com/). Application Program Interfaces (APIs) exist for Twitter and Facebook which will make it easy to talk to Augmented Reality (AR) browsers in real time. Students should be able to share and critique their ideas on urban or school design both in situ and in reflection. Metadata could then potentially be gathered in real time via these social networks and used to capture the meaning and sense-making process in learning. All kinds of annotations, classifications, discussions, usage information,

and references can then be added as an extra layer on top of the content information. This metadata can be used to enable users to find all kinds of new media for instruction and learning (and potentially keep their Zone of Proximal Development on display). Metadata in this sense is closely related and can be fed into the core processes of learning as reflection, guidance, and feedback (Specht, 2009).

During the urban planning studies students learnt that the physical design of any educational institution has a direct impact on the delivery of the education that takes place within that context. Learning space design shapes our behaviour and influences our thinking. As a result, a way of extending that understanding is to get the learner to participate in the design of that context in order to control how their learning environment operates.

The idea of this application of the system is for urban designers working in pairs to use simple open source 3D software (i.e Google sketch up http://sketchup.google.com/ or blender http://www.blender.org/) to create basic additions or revisions to current school designs (in the form of 3D sketches). This is a useful way to give students the opportunity to highlight the areas of their institutions that in their opinion lead to negative effects on their learning.

In order to test the validity of the findings a virtual version of the application will be created which will be used by individuals only. This will involve individuals using the recently available Google Earth API (http://code.google.com/apis/earth/). In essence, instead of placing their 3D models and annotations into real space they will enter them into virtual space, via the AR application. This data will then be compared to examine how significant the world as a platform is in this scenario.

Augmented Reality

Another way of extending the project is to build an Augmented Reality (AR) version of the tour. AR specifically generates composite views using the real scene viewed by the user and a virtual scene generated by the computer. The key aspect of AR is that the virtual elements enhance the person's perception of the world by supplying relevant information that is not contained in the real world.

AR is more powerful than VR as its influence is bi directional. “If we consider AR as a visualisation technique, the relationship of real and virtual objects is one of focus and context: Either we want to provide additional virtual context to an important object in the real world or we want the user to focus on a virtual object embedded in a real context” (Kalkofen et al, 2009). The learner in an AR environment can locate points of interest (POI) which have been pre-embedded into the scene or they can place (and eventually activate) their own POI into the scene in real-time.

The construction of psychological and physical space is one of the constituent parts in the generation of context. MAR (Mobile Augmented Reality) systems have been referred to as “intelligence amplifying systems to enhance human cognitive activities, such as attention, planning, and decision making” (Brooks, 1995).

AR crucially provides both the direct primary experience (the real world scene) and the mediated representation (the digital augmentation). As a result Augmented Reality (AR) provides significant support for real time situated learning. Practice and theory can now feed

off each other in the same space. A good example of this is an engineer working on an engine whilst wearing glasses that provide a digital overlay showing the potential areas which could be responsible for a known problem. The theory informs the practice in the same space.

Extending the Language Learning project

A lot of virtual media is often accused of isolating learners from reality but augmented-reality has the opportunity to draw learners further into reality by amplifying the already existing authentic context. The inherent high resolution nature of real life must be taken advantage of in order to enhance learning. Language is fundamentally about the local context. As a result the classroom is arguably not the most efficient environment for enhancing and assessing language performance. Through acquiring a language in context you acquire a culture. Authentic cultural language should directly mesh with authentic cultural situations.

As highlighted by Vygotsky's Zone of Proximal Development (ZPD), maintaining successful immersion in language learning depends on working at a level just above the comprehensible level of the student. An average teacher has many students with differing levels of ability in their language skills, and as a result, personalized immersion instruction is almost impossible to apply.

Augmented Reality in this context provides an excellent vehicle for immersive and dynamic language learning. Adding extra information onto the surrounding environment is the core function of Augmented Reality. A language learner is supplied with the ability to acquire a language whilst being augmented within their authentic environments. Learners can see local people having conversations in the target language and real objects being labeled dynamically. Preference settings could easily tailor the method to the individual level of ability ensuring the learners remain within their ZPD.

Conclusion

The PLOTMaker is a versatile pedagogical tool where generated digital learning content can be customised, adapted and edited for different learning purposes across a big range of topics and disciplines.

Not only can teachers create content for students but also students can create content for other students. This digital mentorship becomes a playful tool in the learning process. PLOTs can be used alongside any other app running on the device to create effective 'context augmentation' within a wide range of learner-centered experiences and possibilities. The students can, for instance, create their own educational journey with the additional support of Augmented Reality apps. Students can also create PLOTs dedicated to documenting the process of creation of their projects.

Students can create engaging activities using their own original content based on the topics they are interested in and instantly share them with their peers for iterative feedback. The PLOTMaker authoring tool gives teachers and students a different approach to knowledge construction. The pedagogical tasks can be chosen by the students, in an immersive

ubiquitous environment that can be discussed and enhanced through the use of social media (i.e. Twitter or Facebook).

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PLOTLearner as Persuasive Technology: Tool, Simulation and Virtual World for Language Learning

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The Lifelong learning project EuroPLOT (www.eplot.eu) has developed PLOTLearner as a new learning technology that uses a text database to drive persuasive language learning. In terms of B. J. Fogg's theory of Persuasive Technology from 2003, the function of PLOTLearner can be characterized as a tool to use for the practice of language skills, but also as a simulation of the interaction with the grammar of a text. It automatically scaffolds the text with a virtual world consisting of pictures, videos, and documents. PLOTLearner is furthermore developed according to Diana Laurillard's model from 2012 of how to learn a practice capability from an external environment, which in this case is a corpus for training and exploration.

A particular database of the Hebrew Bible from Amsterdam is used in this project, but both the database management system and the PLOTLearner application are developed as open source. The approach illustrated in this project could work for learning language and culture from any text and for any language. This persuasive technology and its learning objects is an example of a completely repurposable sustainability in learning technology.

Keywords: Persuasive Technology, Learning technology, Design for learning, Corpus-driven language learning, Hebrew Bible database.

1 Introduction

"Let the Hebrew Bible be your tutor!" This is the sales pitch used for a new learning environment where a text drives the motivation and enablement of learners. This new brand of learning technology, PLOTLearner, is one of two technologies developed by the lifelong learning project EuroPLOT 2010-2013 (www.eplot.eu).

EuroPLOT has developed this technology for the small and manageable pilot case of learning from the ancient corpus of the Hebrew Bible (Winther-Nielsen ms). However, the technology could scale to any open project for learning to read from texts in any ancient or modern language. The project has already experimented with texts in New Testament Greek, Danish texts from the Kaj Munk collection and Frankfurter Rundschau texts from the German Tiger database. Other papers from the project, and especially Behringer et al (2013), explain how EuroPLOT has developed learning design and patterns for other areas of learning. This paper will illustrate the principles of persuasive language learning that were developed for PLOTLearner as a tool, medium, and virtual world for learning.

The acronym PLOT is short for Persuasive Learning Objects and Technologies. However, it also hints at several senses of the verb 'to plot', such as planning projects, mapping progress, generating processes, and constructing plots in texts. These different usages capture the structure of this discussion of PLOTLearner, explaining how

- the project planned a new kind of persuasive interface for an EU project (section 2)
- the tool maps a journey of learning through statistics and graphs (section 3)
- a learner plans self-directed learning from texts (section 4)

- a learning environment supports scaffolding for a better understanding of the plot of the text (section 5)

2 Plotting a persuasive technology

When EuroPLOT in 2010 proposed persuasive technology for language learning, we already knew that quiz technology provided by the program 3ET can solve many basic needs of beginners learning to read in a new language (Winther-Nielsen 2011). Understood in terms of B.J. Fogg's (2003) theory of Persuasive Technology, we already had a tool that could 'motivate people to exercise' (2003:32), but we lacked a stronger persuasive capability in the technology to change the behaviour and motivation of users. We were persuaded by Fogg that when a learning technology takes on the roles of pedagogical persuaders like teachers, instructors or coaches, it may have great potential for education:

> From the classroom to the workplace, educational designers will create computing applications that deeply motivate people to initiate a learning process, to stay on task, and then to review material as needed. ... As sophistication increases, we'll see adaptive education and training products that tailor motivational approaches to match each individual learner – motivating 'accommodators' to learn through cause-and-effect simulators, or providing 'convergers' with rewards for performance on interactive problem sets and quizzes. (Fogg 2003:246).

Principles of persuasive technology are now finding their way into digital design. At the same time edutainment and gamification are emerging as big industry in the marketplace, culture, and entertainment. However, it is equally clear that sophisticated technology per se does not guarantee effective learning or widespread use. The goal of our project was therefore to explore how current work in design for learning, interaction design, and computer-assisted language learning could inform our development of an application we called PLOTLearner, with the aim of deployment and evaluation in a pilot project on a corpus of the Hebrew Bible.

Fogg (2003) characterizes the three core functions of a persuasive technology as tool, simulation, and social actor. The following will explain how we are implementing those functions in language learning, guiding learners to

- practice skills in reading, writing, and parsing for proficiency *with a tool* for practice
- explore the structure of a text for engagement *in a simulation* of the grammar of the text
- exploit resources activated by the text *for a virtual world* which functions as a learning environment

In light of this, the aim of EuroPLOT is to develop a learning technology that empowers and motivates self-directed learning driven by a database. Learners can use this technology to explore the text through a text corpus interface. They can practice skills of reading and vocabulary memorization and gain proficiency in morphology and in analysis of syntax and text. PLOTlearner supports the construction, reuse, and repurposing of exercises which are loaded, edited or created through a Windows interface. It generates activities for learning of language or culture from a database storing a text corpus.

The programming of PLOTlearner has been structured as an agile development, with new releases produced by Claus Tøndering for testing by Nicolai Winther-Nielsen about every second to third month from April 2011 to December 2012. From April 2013 Claus Tøndering is developing an online version without funding from EuroPLOT (http://pltest.3bmoodle.dk/). The plan is to continue open source development after the end of the EuroPLOT project in

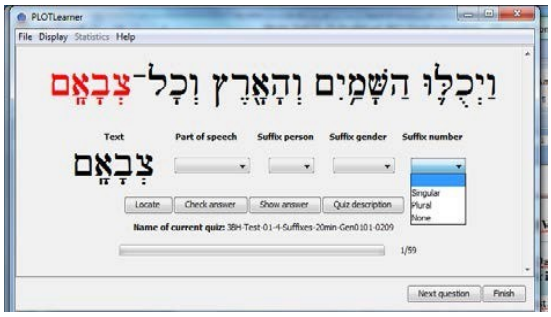
October 2013. Furthermore, we are now working on support for online display of the progress of learners in a "Learning Journey Online" (Gottschalk and Winther-Nielsen ms).

The persuasion envisioned through PLOTLearner focuses on conditioning through certificates, surveillance by teachers and peers, self-monitoring by self-directed learners, and persuasive suggestions directed at autonomous language learners (Winther-Nielsen submitted). The technology can be characterized in different ways due to its support for language drilling, text display, reading, and vocabulary learning: PLOTLeaner is

- a tool to simplify the practice involved in acquisition of morphology (drills)
- a tutor that simulates the study of grammar in text (interactive display)
- an interlinear guide with transliteration (pronunciation support)
- a reading helper that checks typing, reading, and spelling skills (self-corrective reading)
- a translation assistant with glosses and ranking of word frequency (vocabulary training)
- a virtual world with display of cultural background material (interpretation)

The following section will explain how PLOTLearner uses the three functions of tool, tutor, and virtual environment for practice and exploration into a corpus-driven learning scenario, and how the interface is designed to enhance the persuasive effects during active learning of a language and its texts and culture. The core of the present technology is explained from Laurillard's (2012) model of learning from an external environment.

3 Learning from a plotted practice environment



The step we first have to take is to plot how the tool marks a course for skill training and displays learner progress through statistics and graphs. This tool aspect was already developed for the technical quiz solutions in 3ET, but the goal now was to develop a persuasive framework for practicing mastery of forms in a language. In Fogg's terms, the focus here was how to initiate, continue, and complete the practice of a skill by review.

The best way to explain the role of practice is to use the robust theory of design for learning developed by Diane Laurillard. Her figure is reproduced with minor changes in Figure 1:

> It shows the learner learning by using their personal goals and current conceptual organization to select from their current practice to generate actions on the external environment. The learner can use an action modeled by the teacher, or use results from their own action to modulate and build their practice capability. What they get from the teacher or the environment may modulate their concept, their personal goals, or current practice capability, and so generate new actions in continual iterative process. (Laurillard 2012)

Laurillard's mapping of learning from an external environment explains how a persuasive skill practice can emerge, and especially how, "the shading identifies the internal cognitive components the learner deploys during the process, which the teacher is trying to influence" (Laurillard 2012: 61). The figure clearly illustrates how the learners' practice capability depends on action modelled by the environment (B_E). Crucially, in PLOTLearner the learners interact with the external environment (E) through an interface to the database. However this

content is generated from concepts provided by the computational linguists who created the database as well as by the course developers through conceptual organization (C_T). In this sense the learners' action to achieve the desired practice skills ($D_{E)}$ is embedded within a larger environment of facilitation. The persuasive effectivity is afforded by a simplification of practice and by the enablement of a pleasant training environment that encourages learners to improve performance to the level they want to achieve through their efforts.

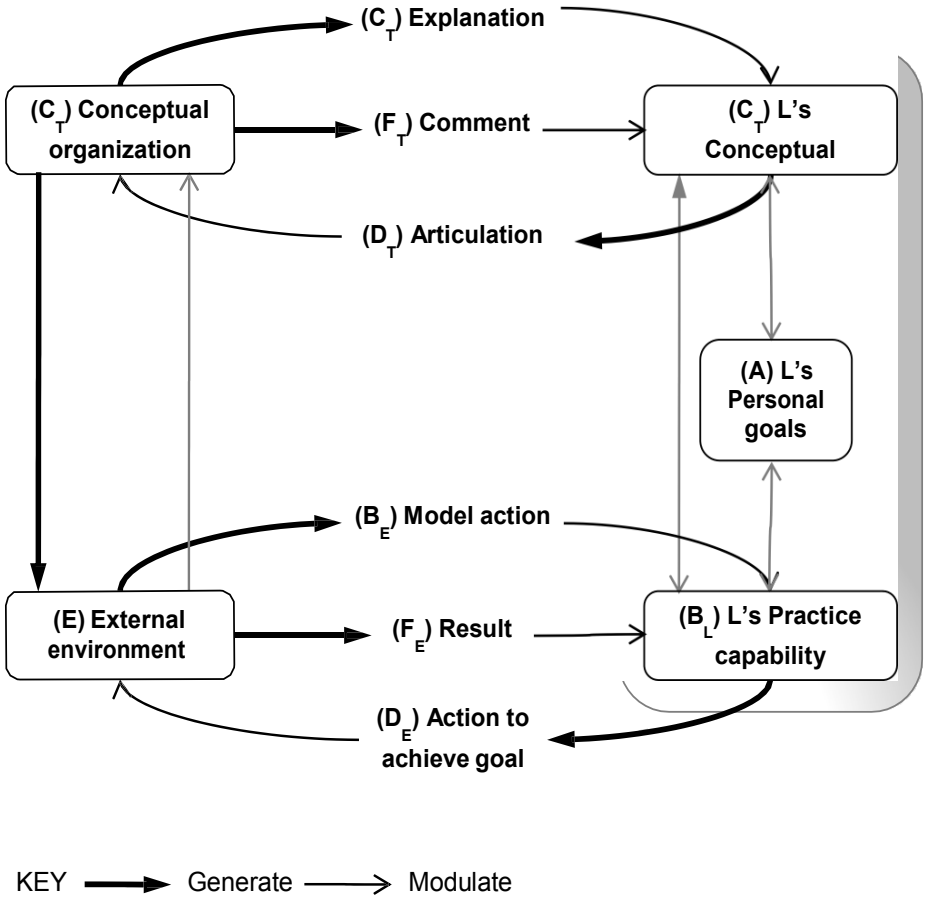


Figure 1: Learning from an environment and a teacher (Laurillard, Fig 4.1)[1]

PLOTLearner was developed and tested as a Windows program with two entry modes: learners activate the program in the "PLOTLearner" mode and they are instantly brought to exercises to train in a skill. Learning designers, teachers, and advanced learners can choose to activate the program in its "PLOTLearner – Facilitator Mode", which will allow them to edit exercises or create new ones. They can provide descriptions of learning content or hints addressing potential frequently-repeated mistakes and supply links to external content (see http://www.ezer.dk/3ETusersguide/PL-2.0.1/en/intro.php). Each time the learner clicks on a load exercise button, he or she is presented with a screen that enables him or her to study information on the practice task in the "Exercise description" field, or else begin to practice right away by pressing the "Run this exercise" button. The content of this description can be

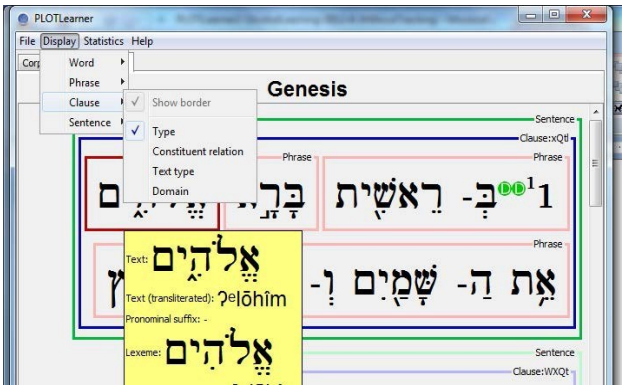
[1] Used by permission from Laurillard, including changes of her siglas: (C_C), (F_C) (D_C), replaces (C_T), (F_T) (D_T), because (C_T) explanation can be confused with (C_T) conceptual organization. Subscript letters ({C, D, F}$_C$) are functions of the conceptual organization, hence by analogy ({C, D, F}$_E$).

repurposed by any facilitator for any learner. In this way the facilitator can repurpose practice to provide the exact amount of persuasive motivation to encourage engagement as well as explain how learning routines can be simplified. Crucially, the description should define the learning outcome and give easy access to whatever additional content with which the facilitator wants the learner to engage.

For any language learning immediate feedback is crucial. PLOTLearner handles the Result (F_E) function by checking answers in the database and generates feedback. While the facilitator does not have the ability to supply hints to address every possible wrong answer, he or she can supply pedagogical advice on potential problems in the exercise description. Learners receive instant feedback on their knowledge by directly checking answers or getting feedback through the Result (F_E) function. During the practice of a specific exercise for language learning, the learner will always be able to press a "Check answer" button to improve on the fly until the right answer is matched in the database. The learner can at all times go back to the description and study some more, but this will have an impact on performance speed. Another button will allow the learner to have an answer shown, but this will count as a mistake. Otherwise, the learner can skip ahead to subsequent questions or end the exercise. Throughout the process, a bar visualizes progress, showing unanswered questions remaining.

Other sophisticated displays support the tracking of the learner's journey, displaying the duration and results of exercises and listing mistakes in a statistics files called "Complete local report" (http://www.ezer.dk/3ETusersguide/PL-2.0.1/en/statistics.php). The learning journey can be tracked in an "Exercise graph", which graphically plots how many right answers were given per minute. In this way there are several options available for display of crucial feedback (F_E). The value of these statistics and their use in tests and exams is discussed in Winther-Nielsen (ms).

4 Self-directed learning plotted in a motivating interface



A further step on our path into this new learning technology leads to the new functionality offered in the second prototype, PLOTLearner 2. Our route of agile development has taken us far beyond 3ET, which only supported exercises on morphology and writing.

Earlier analyses of persuasive functions had indicated that we should support learning through active exploration. Learners must begin with an overall understanding of the form of the before they can be persuaded to learn actual forms. This enables the learner to gradually acquire a higher level of mastery because the learner is in complete control of planning the content, pace, and range of his or her learning journey through the interface. It clearly indicates that PLOTLearner is not only a tool for practice, but also an adaptive technology that implements Fogg's category of persuasive media. It places the learner within a simulation of the objects of the text, empowering the learner to gain full control of all active exploration.

In practice this implies that technology supports the learner's interest in engaging interactively with the text. This is the part where the learner will engage with PLOTLearner to activate the conceptual learning process (C_L). For this stage, the model action (B_E) has to be prepared through the teacher's conceptual input for explanation of concepts (C_T). In this

regard, PLOTLearner also offers what is available in more traditional teaching scenarios and classrooms, However, it redefines the role of the teacher's conceptual instruction as supervision and coaching on how to use the content and structure of the database.

This implies that in PLOTLearner the learning of concepts is primarily structured as how to learn the content of the main source of the corpus-driven learning and hence also how to use the rich conceptual content stored in the database. Moreover, this part of the system is very persuasive from a user experience point of view because the learner can point to language features he or she wants to have visually highlighted. The relevant content from the database is readily available as pop-up displays in a user-friendly mouse-over fashion. To study the database content of a selected text segment is therefore very pleasant for the learner and the interactive environment fulfills learners' desire to have interactive information available at the tip of their fingers. In terms of the analysis of the functionality of a Persuasive Technology, this is the ultimate function of persuasive suggestion (Winther-Nielsen submitted, and briefly summarized by Gottschalk and Winther-Nielsen ms).

However, the shift to a corpus-driven environment for the study of grammar has even more profound implications. When we researched our new approach to language learning, we discovered that persuasive language learning must start with engagement with the interface into the grammatical categories stored in the database. PLOTLearner therefore radically changes the curriculum and topics of language learning by enabling interactive access to the text through the hierarchical levels of word, phrase, clause, and sentence and the features and values stored at each level (http://www.ezer.dk/3ETusersguide/PL-2.0.1/en/firstex.php?lang=he).

- At word level: "spacing" is added to display individual lexical morphemes within words, as well as transliteration to help beginners learn to read much faster. (Transliteration also gives access for those who are not able to read the Hebrew script, but still want to learn aspects of the grammar).
- Form in text lists the form of the root and affixes for easier display with the text.
- Lexeme offers access to dictionary words and vocabulary learning based on gloss(es) in English, their frequency, and their part of speech.
- Morphology displays stem and tense of verbs, state of nouns, and person, number, gender
- At phrase level: phrase types in terms of part of speech and functions like predicate, subject, and object are shown with labels.
- At clause level: clause type labels and text type are given.

Thanks to this new potential in corpus-driven self-directed learning, the next generation of learners can now begin to learn lexical and grammatical categories through the interface. They can get a first-hand interactive and visual feel for the hierarchal structure of the text, and all language data supports the pursuit of personal interests and goals. Evaluation data supports our assumption that engagement with the text through an interface motivates learners to initiate skill training for acquisition of forms, vocabulary, and syntax.

5 Corpus-solutions enabling language learning plots

The last step on our tour is to examine how this new kind of database-driven persuasive technology can support even more effective and efficient learning in and around a database by triggering the engagement of learners. Fogg (2003) has pointed to the crucial role of khairos, or the opportune moment for learning, and the challenged is how this kind of timing can be triggered for persuasive language learning from a database.

Current language learning theory has moved away from communicative language teaching and is heading towards task-based language teaching. The focus in this approach is on learner defined tasks that support the understanding of the form of the text rather than memorization of rare forms (Robinson 2011). The theory of Task-based Language Teaching has for long focused only on development of a curriculum for the classroom and not paid attention to learning technology. However, PLOTLearner joins a new trend of applying computer-assisted language learning to task-based language teaching, such as seen in the studies published by Thomas and Reinders (2010). The ultimate goal is of course to let the learning technology generate scaffolding that activate content for the Vygotskyan zone of proximal development

PLOTLearner does not support this ultimate goal yet, but we have made a start by creating a flexible database system that can store pictures, videos, and documents for use in problem-based learning. Whenever PLOTLearner is opened, the program will automatically connect to the internet and activate the database EuroPLOT Resources (http://resources.3bmoodle.dk/img.php). This database is developed as a kind of open source learning repository that allows learning designers to construct their own content for the text collections they want to include. In the EuroPLOT project, PLOTLearner is set up to automatically search in the metadata for any resource that is linked to a text or to a geographical reference mentioned in this particular text, but the pictures additionally contain information on archaeological periods and cultural customs. A developer of learning content can create any kind of new sub-topics and add any kind of content for this kind of intelligent scaffolding of the text by multimedia. The filenames refer to the name of the creator of the content, the category of the learning material and resolution types. It creates a visual world that triggers a pedagogical visualization for persuasive learning and can be used for problem-based learning activities. PLOTLearner automatically scaffolds this for the texts and displays the metadata that are provided for learning objects.

For the present test of the learning environment, the bulk of the content in the database is some 5000 pictures with metadata primarily in Danish. However, this database will be used for ongoing experimentation with persuasive learning objects offered as open educational resources for scaffolding with PLOTLearner and content provided in English.

Ultimately we want to go beyond suggestions generated by the text database and move towards an intelligent tutoring system with tailored triggers. Our ultimate dream is to construct a learning environment that scaffolds a deeper understanding of the world of the text. Through further open source development of PLOTLearner, we aspire to support reading for the plot from the beginning of a text through its unfolding in dramatic turns and peaks and all the way to the resolution of the problem and the end of the story.

Conclusion

This concludes the tour of the learning environment of PLOTLearner, with the introduction to an entirely new way of learning a language from a text database. The journey included the story of the birth of the project as well as a description of the crucial hallmarks of PLOTLearner as a Persuasive Technology. In terms of the theory of Fogg (2003), it started as a tool for practice of language skills and was developed into a simulation for the study of language in texts. The social world is so far only included as part of pedagogical texts, images, and videos automatically displayed by the program.

This sophisticated learning technology is developed as a highly adaptable and repurposable open educational software. PLOTLearner is constructed to allow for inclusion of any kind of text in any kind of language that has been stored in an Emdros database. It is our firm conviction that this novel kind of persuasive technology has great potential for future persuasive corpus-driven learning.

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Chemical Handling – PLOTMaker for Training in Exposure Scenarios under REACH

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Persuasive design of e-learning is a relatively new area and not widely applied in training directed at industry and business. The Lifelong Learning project EuroPLOT has developed an e-learning resource on how to handle exposure scenarios for chemical mixtures according to the EU chemical legislation REACH. Eight sessions were developed applying persuasive principles. Each session consists of several persuasive learning objects. The course was uploaded on a Moodle website and offered to the industry as a stand-alone course. Sessions of the course were pre-tested in a focus group at DHI and a pilot-test was initiated in July 2013. Employees from industries, branch organisations and consultants were invited to the pilot-testing. The conclusion based on the first pilot-testing results was that training in a challenging topic such as the practical implementation of new chemical regulation by industries may be better understood through simplification by reduction, tunnelling, tailoring and application of animated interactive exercises. The possibility for learners to explore a topic at their own pace was found motivating. It was, however, obvious that some learners may benefit from a blended learning course or an online learning environment supporting discussions and contact with a teacher.

Keywords: Persuasive design of e-learning, formulating industry, exposure scenarios, case study

1 Introduction

In 2007 the European Union radically changed its chemical regulation with the introduction of REACH. The responsibility for management of the risk of substances was now placed on the industry, and this new strategy for the EU chemical policy introduced entirely new obligations for the industry. As a result, manufactures and importers must register and make a chemical safety assessment, depending on the tonnage of a chemical substance they are producing or importing. As part of the chemical safety assessment they may develop the so called exposure scenarios, which we are dealing with in our case.

Different roles are assigned to the industrial companies and the professional users of chemicals. The most important role for our case is the formulator, who is the downstream user of chemicals producing chemical mixtures, such as paints, cleaning agents and glues. The formulators must deliver information on the safe use of their products to their customers, applying the information in the exposure scenarios annexed to safety data sheets received from their suppliers of chemicals. Not only is it a challenge for the formulators to work with the huge amount of information embedded in exposure scenarios, but scenarios are often delivered in formats varying from supplier to supplier.

The main objective of our work was to create persuasive learning objects that addressed the health and safety specialists within the formulating industries or consultants working with these industries. Persuasion is of course not a new competence in teaching, but there have only been few attempts to combine persuasion with e-learning for education of the staff in business and industry applying the basic principles of persuasive technology defined by Fogg (1998 and 2003).

Fogg argued that a persuasive technology may function as a tool for making behavior easier, a medium for simulation or as a social actor. For each of these roles he designated a list of persuasive principles (Fogg 2003; Gram-Hansen 2012). While the principles of Fogg primarily are directed to persuasive technology, Oinas-Kukkonen and Harjumaa (2009) extended these principles to a description of 28 different persuasion technics in their model of Persuasive System Design (PSD). Oinas-Kukkonen (2010) combined this model with analysis of the context of persuasion focusing on the designer and the usability of the user.

Persuasion is defined as the attempt to change attitudes or behaviours (Fogg 2003). By using persuasive design in an e-learning resource on exposure scenarios, related to the chemical legislation REACH, we attempted to engage and motivate the learner to actively apply the information on safe use of chemicals included in exposure scenarios delivered to him from his suppliers.

In this paper we present our work on developing the e-learning course, starting with course planning, continuing with design of learning sequences and persuasive learning objects and concluding with the first results of our pilot testing.

2 Materials and methods applied in the case study

Tools for developing persuasive learning objects

PLOTMaker was the main tool applied in the development of our learning objects. The tool was developed within the EuroPLOT project and based on the software tool GLOMaker developed by the Learning Technology Research Institute at London Metropolitan University (http://www.glomaker.org/index.html). Both the Freestyle and the EASA pedagogical patterns of the planner part of the software were used in the creation of our learning objects.

The PLOTMaker provides a teacher oriented authoring tool for creating persuasive learning objects. By incorporating new layouts and interactive components it has become a suitable tool for designing more engaging e-learning resources. Some of the components of the tool are in themselves interactive while other components allow importing of interactive flash animations and sounds created outside PLOTMaker. These resources are integrated into the Learning Object (LO) in its final shape.

We created several interactive learning objects in our sessions applying Microsoft PowerPoint in combination with iSpring Suite or Camtasia Studio. All sessions were assembled as a guided learning tour in how to handle exposure scenarios for chemical mixtures. The entire course was delivered in a Moodle website.

Persuasiveness in the design

We started designing learning objects applying the persuasive principles defined by Fogg (2003) and exploring how PLOTMaker could support interactive e-learning. Our primary goal was to design LOs, which motivated the learner to continue learning all the way to the end of the e-learning course. Furthermore, the learning content should inspire to further studying of the subject. It should provide employees from the formulating industry with a more comprehensive way to learn the basic principles of working with exposure scenarios for mixtures. The persuasive principles applied were: tunnelling, tailoring, reduction, simulation, self-assessment, suggestion, and to some extent social signals.

Testing by learners

A focus group at DHI tested selected sessions of the course in a pre-pilot test. Their experience of learning with the LOs was gathered in interviews directed by Herber (2012). Invitations to take part in pilot-testing of the whole course were sent to formulating industries,

branch organisations and consultants in Europe. When completed the online course each participant was asked to file in an online evaluation questionnaire anonymously. The questionnaire was developed by Erich Herber in 2013.

3 Results and discussion

Planning the course

Selection of target group, overall topic and learning outcome are of course essential parts of the planning of a course. These tasks should all be defined prior to the detailed planning and design of the course. For our specific case, a need expressed by industries was our basic for the selection of the particular topic and target group. The typical target of the learning is often one or two employees in each formulating company. We suggested that it would be beneficial to them to have access to an online course covering the whole topic.

A team of three teachers at DHI selected the course content and took part in the design of the course. The selection of content was based on our existing experience gained in several face-to-face courses and workshops within the area. Additionally, two other teachers were involved in evaluation and quality assurance of content and design.

The steps for the planning and design of the course were:

1. Selection of other software tools besides PLOTMaker which was preselected for our case in EuroPLOT and a suitable learning management system (LMS)
2. Selection of course content, number of sessions and topic for each session
3. Learning sequence, including pedagogical pattern within each session
4. Design and selection of materials for each LO
5. Internal evaluation and quality assurance of content and functionality of LOs

As already mentioned we chose to apply tools to supplement PLOTMaker in order to obtain a more varied and engaging learning. Knowing safety data sheets and classification rules for chemicals substances and mixtures were set up as a prerequisite for taking the course. However, the new terminology and methods introduced in the chemical legislation in 2007 were not assumed to be known in advance.

Before starting the design of LOs we decided on the sequences of learning activities for a session, applying the planner in PLOTMaker. We found both the EASA and Freestyle patterns in the new version of the software tool well suited for our purposes.

In total eight separate sessions were created, each consisting of a range of LOs. The content of the LOs was mostly developed from scratch and only few objects were reused or repurposed from LOs of others. Each session was packaged and uploaded on the Moodle website with a link to the GloWebPlayer.swf file. The uploaded course was discussed and evaluated systematically by the team and at least by one teacher outside the core team, and the course was adjusted before release for testing.

Persuasive learning objects

The front page of the course was inspired by the Learning Journeys (http://hermes.uwl.ac.uk/learnerjourney/), guiding the learner through the different sessions of the course (Figure 1), and providing an overview of the entire course. A learner without any prior knowledge of the subject may follow the suggested route from session one to eight while more experienced learners may jump to the sessions needed and thus plan a tailored learning tour.

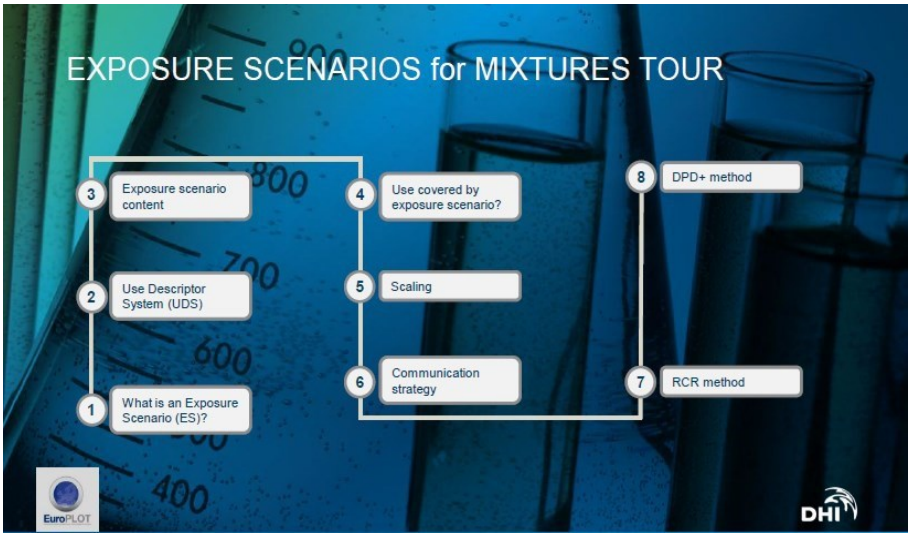

Figure 1: The front page of the online course

The topic of exposure scenarios is in general considered quite complex learning content. The learning has so far been achieved through reading of technical guidances and face-to-face workshops and seminars. To our knowledge this is the first attempt to make an online course on this particular topic. When transferring the teaching to the PLOTMaker software we were able to reduce the big amount of guidance text to be read by presenting new terms and core knowledge in simplified illustrations and animations. One example is the LO in Session 2 of the course shown in Figure 2. By persuading learners to press the play button in this LO they will be presented with text and pictures related to a specific term or descriptor, e.g. the SU9. However, by linking to the original guidance in other LOs, the learners will still be able to study this in details.

According to Fogg (2003) we are likely to be persuaded by something which appears to be easy, and one important step towards making something easy is to make sure that everything seems familiar to the users (Gram-Hansen 2012). Selection of situations, illustrations, language, pictograms and other material that are known to the target group is a simple way to make a LO familiar to the learner.

The illustration at the front page of the learning resource (Figure 1) appeals to the target group, illustrating entities from their world. When entering the sessions you meet illustrations of situations where people are using chemical mixtures or products, such as professionals spray painting a car and technicians handling chemicals in a laboratory. Interviews of colleagues from other formulating companies who express their opinion on a topic is another way of making the LO familiar and the topic relevant to the learner. Besides including opinions of colleagues in LOs, social signals were introduced by using pictures of people in familiar situations.

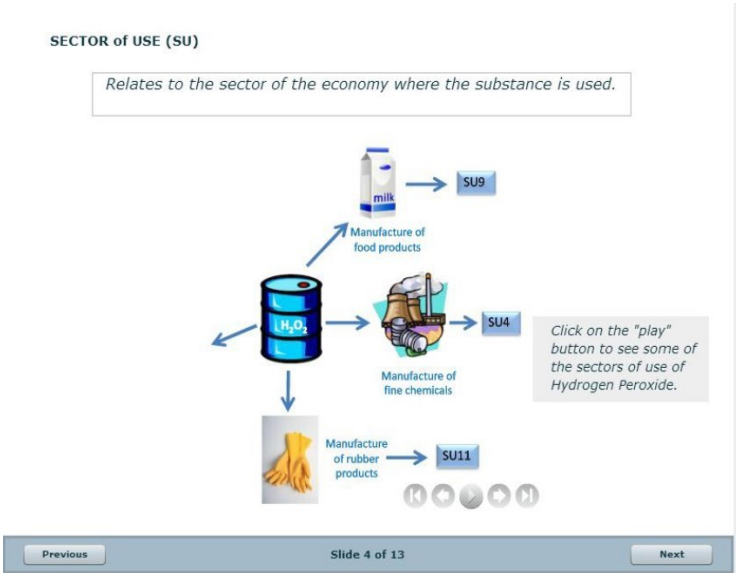

Figure 2: Example on simplified presentation of new terms in an animation

Self-assessment and simulation take up large part of the learning sessions, allowing the learner to learn through interaction. The Multiply Choice Questions, Matching Quiz and Drag and Drop components of PLOTMaker have been used several times throughout the course to encourage learners to test their knowledge. Animations have been produced without programming, creating sequences of pictures in PowerPoint which were converted to flash files using the iSpring Suite. Use of animation in quizzes allowed inclusion of unexpected effects, like a simulated explosion when the learner chooses the wrong answer (Figure 3).

Figure 3: Animation used in a quiz to make a special effect when the answer is wrong

Simulation in our case means working with examples of exposure scenarios for chemical substances, going through exactly the same steps that health and safety specialists in the formulating industry have to perform when they receive real exposure scenarios from a chemical supplier. Before learners enter into a situation of simulation, they are offered the option to go through an example presented in a video. The simulations in the last part of the course (Sessions 7 and 8) allow learners to do a calculation using an interactive calculator (http://glomaker.wikifoundry.com/page/Links+to+free+resources?t=anon) and to type results directly into the LO. Having completed the steps needed for preparing an exposure scenario for a chemical mixture, learners in the end obtain the exposure scenario of the mixture.

Testing and interview of focus group

The focus group participating in the pre-testing was asked to think back on how they learned with the digital learning resources and how they benefited from them. The learners commented on individual LOs and gave suggestions for improvement. They used the feedback given in LOs repeatedly during the test to reflect on their individual learning success. However, the feedback was not in itself considered motivating for the learning.

The application of video-based interactive exercises was considered useful by learners and helped them to understand the exercise. Keeping simplicity in the LOs was recommended, although exercises should remain challenging and demanding. In some LOs, text and image were not synchronized and this caused irritation. The learner had to press a button for changing the text in the right part of the screen as the animation went on to the left. Unfortunately, automated synchronisation was not supported by PLOTMaker. The general lesson learned from this is perhaps that one should not try to push a system or tool beyond its capability, but keep it simple and functional.

The pilot testing of the course was still ongoing while this paper was prepared (August 2013). Examples of the first preliminary results from six questionnaires indicated that the majority (83%) enjoyed training with the online course, that the course helped them to better understanding the practical relevance of the subject (100% i.e. strongly agree / rather agree), that training with the online course can be useful for learning the subject (83%), that they could find effective ways to learn with the online course (83%), and that the online course motivated them to study the subject in more depth (67%). Furthermore, 67% of the testers disagreed on the question “I believe that I can better learn from teacher instruction than from online course”.

Four out of the six testers found that the online course was more motivating than other forms of teaching and training, as expressed by their answers and comments (Table 1). They appreciated the possibility to explore the topic at their own pace and without interference from other people. However, a drawback of online learning could be the lack of feedback and possibility to ask questions.

One of the testers pointed out that he or she experienced some technical problems during testing, because the connection slowed down during browsing in the online course. It was also annoying that a session started from the very beginning when he or she attempted to refresh the connection. Furthermore, comments on some of the soundtracks pointed out that it could be difficult to hear the content.

The pilot testing is anticipated to include at least 15 vocational learners from the industry. But we are still waiting for the remaining replies. However, from the answers presented above it is indisputable that learning through the online course motivated the majority more than face-to-face teaching. The first step in fulfilling our overall goal of the online course - “to engage and motivate the learner to actively apply the information on safe use for chemicals included in exposure scenarios…” - is achieved because testers so far has found that the course has helped them to a better understanding of the practical relevance of the subject.

Table 1: Answers and comments from six testers in the pilot testing of the online course

Question to the testers: *Was training with the online course more motivating than other forms of teaching & training (e.g. classroom teaching / face to face training)?*		
Answer	**Number of testers**	**Explanation / comment of testers**
Absolutely	1	No disturbance and not 100 people asking questions about all and nothing.
Rather yes	3	1. Can keep my own pace, can jump back and forth as needed, can test myself w/o risk of being embarrassed. 2. Own pace 3. You can choose when to go in depth with a question and when to go lightly on a subject.
Rather no	0	
Not at all	1	No feedback, no possibility to ask questions
Indecisive	1	The training I received earlier was rather poor (in a workshop) this did not inspire me to attend more courses. But courses/classroom teaching is ok, but if things are very complicated, much time is spent on the poorest participants. The way I learn is to have some background (like this program or to read the theory), then ask questions and listen (face to face training or classroom training).

4 Conclusions

This paper demonstrates that the principles of persuasive design can be applied in e-learning directed at industry and business. We have shown that training in a challenging topic, such as the practical implementation of the new chemical legislation by industries, may be better understood through simplification by reduction, tunnelling and tailoring of the subject.

The application of video-based or animated interactive exercises support learners and keep them engaged in their learning. The possibility for learners to explore a topic at their own pace was found motivating. However, it was obvious that some learners may benefit from a blended learning course or an online learning environment supporting discussions and contact with a teacher.

Acknowledgements

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Applying persuasive principles to influence students in adopting deeper learning approaches

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The current generation of students are exposed to an increased use and familiarity with communication, media and digital technologies. In line with this capability, universities are offering an arena for engagement and discovery, making use of the Virtual Learning Environment (VLE) to provide a blend of online and face-to-face curriculum. Persuasive design is a relatively new framework for influencing behaviour, made prominent by BJ Fogg (2003) where he proposes a set of persuasive principles on how to think about creating designs that are more persuasive. This paper articulates the development, evaluation and sharing of PLOTs in teaching database concepts to students at Leeds Metropolitan University (Leeds Met) and the University of Hradec Králové (UHK). Students of undergraduate Computing and Business Computing studies face challenges in understanding fundamental database concepts. In order to develop competency, we have applied selected persuasive principles in the design of blended learning using persuasive learning objects (PLOTs), self-assessment and discussion boards within the institutional VLE. Students participated in the evaluation of the PLOTs, engaging in discussions with peers and tutor, and self-assessing their understanding of concepts. Results indicate a degree of behaviour change towards becoming more self-regulated learners.

Keywords: persuasive design principles, persuasive learning objects, self-regulation, blended learning.

Introduction

This paper discusses the development, evaluation and sharing of Persuasive Learning Objects (PLOTs) in teaching database concepts for Computing and Business Computing students at Leeds Metropolitan University (Leeds Met) and the University of Hradec Králové (UHK). The initiative forms part of the EuroPLOT project, contributing to the understanding of the cross field between persuasion and didactics. Persuasion is not a new concept in education; tutors have used it in various forms to influence students' learning behaviour in the classroom, and the challenge is to apply the concepts effectively through digital e-learning technologies. BJ Fogg (2003) paves the way in providing the structure around which people understand and apply persuasive design, mediated through computer technology.

A digital learning object is defined as an online interactive chunk of e-learning designed to achieve a stand-alone learning outcome, which can be reused in different contexts. When persuasive design principles are applied to the creation and deployment of the learning objects, they are referred to as PLOTs (persuasive learning objects) with the main objective of achieving active engagement. At both universities, an outcome-based learning design paradigm is used for creating the courses, hosted on the Blackboard Virtual Learning Environment (VLE) and delivered as a blended learning context. Garrison and Kanuka (2004) posit that when blended learning is thoughtfully integrated into face-to-face (F2F) learning, the strengths of

synchronous (F2F) and asynchronous (text-based Internet) learning activities can be harnessed to support meaningful learning outcomes. Gram-Hansen (2010) points out that there are shared commonalities between key persuasive design concepts and outcome-based learning design (Table 1), which we have incorporated in the development of our PLOTs.

Table 1. Mapping of key Persuasive Design concepts to Outcome-based Education (OBE) learning design

Persuasive Design	OBE Learning Design (Biggs & Tang, 2007)
▪ Originates from a persuasive intention ▪ Considers the requisites of the users ▪ Requires that the users is aware of the persuasive intention ▪ The persuasive intention is met through use of one of more persuasive strategies ▪ Is dependent on timing and contextual awareness	▪ Originates from an intended learning outcome ▪ Considers the requisite of the students ▪ Requires that the students are aware of the intended outcome of individual lectures and courses ▪ The intended learning outcome is achieved by use of rhetorical and didactic strategies. ▪ Is dependent on timing and contextual awareness.

The application of such principles raises the concern whether these can enhance the learning experience of students accessing and using the learning objects within the VLE, specifically instigating a change in attitude, understanding, or behaviour (Fogg, 2003). Within Higher Education (HE) curricula, this translates as an opportunity to promote self-regulation through independence and personal ownership of learning, increasing students' ability to self-assess and self-correct, skills which form the hallmarks of undergraduate education. These elements also point towards self-efficacy, a quality which the prominent psychologist Albert Bandura (1997) refers to as "beliefs in one's capabilities to organise and execute the courses of action required to produce given attainments" affecting students' motivation and learning, and self-efficacy forms an important aspect of contemporary educational psychology (van Dinther, Dochy & Segers, 2011).

Teaching of databases is integral to all Computer Science and Information Technology-related courses. Graduates should be self-efficacious in solving real-world problems, which require combining the knowledge of fundamental database concepts with the ability to recognise when a particular problem could benefit from the application of specific concepts. This process enables students to gain database skills that are valued in the workplace. The Teaching, Learning and Assessment in Databases (TLAD) which is an UK annual event that brings together database teachers and researchers in all academic institutions globally to share good learning, teaching and assessment practice, acknowledges that teaching concepts such as normalisation and Structured Query Language (SQL) are problematic. Hence we have chosen to develop PLOTs supporting the understanding of normalisation at Leeds Met and SQL at UHK.

Pedagogic and Persuasive Underpinnings in a Blended Context

Knight's longitudinal study (2010) which evaluates the different learning strategies adopted by students when accessing VLE-hosted resources, reveals students who adopt a deep learning approach, in which online resources are accessed consistently throughout the study programme, perform markedly better than surface learners who focus their online activity either at the beginning or end of the programme's duration. When analysing the behaviour of our students in the VLE, it was apparent that they adopt a 'grab-and-go' strategy. The challenge was to enhance the course with PLOTs, designed to afford students to engage with learning actively throughout the semester. We believe that in order for the PLOTs to suitably change students' behaviour towards adopting a deeper learning approach, an appropriate activity blend ought to be designed embedding persuasive principles, besides incorporating these principles into the design of the PLOTs themselves.

Persuasive Design Principles viable in VLEs

Fogg (1999) proposes a framework for persuasion, which he refers to as the Functional Triad (Table 2), in which the computer as a tool can increase capabilities by enabling persuasive affordances that develop self-efficacy. This is in line with Bandura's (1997) pioneering theory where self-efficacy is a perceived quality; that even if individuals sense that their actions are more effective and productive (through using a specific computing technology), they are more likely to perform a particular behaviour, suggested as persuasive affordances below (Fogg, Cuellar & Danielson, 2003). We will adopt the Functional Triad as a starting point in designing our PLOTs.

Table 2. Specific Persuasive Affordances arising from the use of computer technology, adapted from Fogg (1999)

Function	Specific Media within the VLE	Specific Persuasive Affordances
Computer as tool or instrument	PLOT	Reduces barriers (time, effort, cost) Increases self-efficacy Provides information for better decision making Changes mental models
Computer as medium	PLOT	Provides first-hand learning, insight, visualisation, resolve Promotes understanding of cause-and-effect relationships Motivates through experience, sensation
Computer as social actor	Discussion Boards	Establish social norms Invoke social rules and dynamics Provide social support or sanction

The intended change of students' behaviour is classified according to the Fogg and Hreha's (2010) behaviour wizard as BlueSpan, whereby we expect students to do a familiar behaviour

over a period of time. The behaviour wizard suggests that designing span behaviours requires special consideration where a span intervention might pay close attention to the strategic use of regular triggers which have to be activated when the person has sufficient motivation and ability to perform the behaviour. The VLE allows for announcements and notifications that can be used to prompt students to undertake learning activities at appropriate points. As the VLE keeps track of the individual student's access of activities, timely triggers can be issued when most students are online to get them to engage in the learning activities. The activity blend, which includes the PLOTs is designed with the aim of allowing students a chance to quickly review a topic, engage in collaborative discussions with the tutor and peers, and embark on formative assessment designed to improve self-efficacy. Sadler (1998) refers to formative assessment as assessment that is specifically intended to generate feedback on performance to improve and accelerate learning. Nicol and Macfarlane-Dick (2006) take this further in revealing the positive implications of using formative assessment for students to proactively generate and use feedback in supporting the development of self-regulation.

The four persuasive principles (Fogg, 2003) adapted and applied to the design of our PLOTs and VLE activity blend are:

- Reduction - simplifying a complex concept through PLOTs.
- Suggestion - intervening with a trigger, as compelling suggestions at the opportune moment through the discussion board and emails.
- Self-monitoring - regulate progress of engagement and learning with PLOTs through the self-assessed quizzes.
- Social signals - rewarding users with positive feedback and providing support through the self-assessment and the discussion board.

We have applied a pedagogical approach of scaffolding learning to support achievement of the learning outcomes as advocated by McLoughlin and Lee (2010), provoked by triggers at appropriate points of learning guide students in a step-by-step manner, allowing them to independently construct their learning in a way most suited to the individual needs. The PLOT content is structured to be gradually absorbed by the learner using scaffolded delivery of concepts in increasing complexity (McLoughlin and Lee, 2010). We used different forms of media for motivating learner engagement in terms of capturing and focusing attention such as audio, images and video. Researchers and cognitive psychologists believe that technology can deliver more sensory data than we can process, to the extent that audio and visual effects can interfere with learning (Clark and Mayer, 2011). Care is taken to avoid the redundancy effect, where animation is combined with supporting narrative, but not with corresponding text that can hinder associating words with corresponding graphics. On the same note, extraneous use of text and graphical images are also avoided, which are in line with persuasive principles.

This is followed by short formative assessments in the form of quizzes for students to self-assess, so that they can ascertain if indeed learning has taken place. The premise is that students self-monitor their learning, capitalising on the flexibility of the medium that allows for iterative any time, any place exploration until they have understood the database concepts delivered through the PLOTs by self-assessing their knowledge gained.

The PLOTs are hosted on the institutional Blackboard VLE to facilitate a constructive blend of learning designed to inculcate self-regulation in students. The VLE also affords asynchronous discussions as threads that are necessary in depicting interaction and presence. Garrison and Kanuka (2004) find that these elements are alluded to by students as important aspects of online course design especially in instilling a sense of community. The proposed activity blend involving a persuasive pedagogical model for delivering learning via PLOTs are as follows:

1. Understand the guidelines and procedures for using the activity blend,
2. Work through the PLOTs,
3. Discuss tasks and issues in the discussion board with tutors and peers, and
4. Undertake the formative assessments.

Case Study Description

The PLOTs are designed to be used independent of tutor guidance, supporting the F2F teaching and learning of the relational database design and the database query language SQL in 2 modules:

- Introduction to Database (IDB) - first year undergraduate module offered to BSc. Computing and BSc. Computer Forensics students at Leeds Met, and
- Database Systems 1- second year undergraduate module offered to Information Management and Applied Informatics students at UHK.

The main aim of PLOTs are to persuade students to revise or recall topics as the bite-sized stand-alone learning objects, whereby the main concepts are embedded into an appropriate curriculum and taught F2F. Topics correspond closely with the course learning modules, and each topic has clearly defined learning outcomes, which are assessed within the PLOT and the VLE.

Evaluation Findings

Findings arising from the 3 focus group questions posed to students at Leeds Met are summarised as follows:

1. What is your favourite / most useful learning feature or exercise in the learning object?

Students remarked that the videos afforded interactivity that enabled understanding of complex normalisation concepts, allowing them to control the effectiveness of learning and reinforce understanding deeper, and the much-needed rehearsal for learning (Clark & Mayer, 2011). They felt that the videos condensed F2F teaching materials into concise chunks of learning, and allowed for more inclusive learning – both online and during F2F lab sessions.

Students pointed out that the audio narrative clarified and simplified understanding of concepts, and the voice humanised the PLOT, motivating them to engage with the content. The audio also strengthened trustworthiness and credibility (Fogg & Tseng, 1999) which supported the portrayal of a good teaching presence online (Garrison, Anderson & Archer, 2000). Students found the quizzes within the PLOT useful as it allowed them to self-assess the extent of understanding the database concepts

2. Which problems (technical/didactical/organisational) did you have? What caused them?

Students felt that the PLOT was easy to navigate and use. They did not experience any pedagogical issues in terms of understanding the concepts explained in the PLOT, which is designed to expose concepts in a progressive and scaffolded manner. Students did face technical problems in accessing the learning object from the VLE which was eventually resolved by downloading the Flash plug-in.

3. If you could add any new feature or exercise to the learning objects, what would it be?

Students highlighted the need for more interactivity in the assessment, whereby they could complete exercises that will drag and drop attributes to build normalised tables interactively. They also expressed the desire to have clues/tips to help when incorrect choices are made under the quiz section in the PLOT.

Similar findings were noted with UHK students using the same three focus group questions.

Question 1 - Most students agreed that the favourite/most useful learning feature in the learning objects were the quizzes, which they have used as many times they wished, thus helping them to increase self-efficacy (Bandura, 1997). They found that the practical examples and the scaffolded delivery of learning in small chunks clarified their understanding of concepts.

Question 2 - Students experienced technical issues in displaying the study materials and quizzes in low resolution when viewed with a laptop, as well as issues with JavaScript that prevented the VLE from functioning properly. Consistent with the findings from Leeds Met, students suggested that the feedback on quizzes ought to indicate why the choice(s) made were incorrect to improve learnability.

Question 3 - As new features/exercises in PLOTs students requested for more quiz questions and they also expressed the desire to be able to compare results with peers.

Besides the focus group open questions, students also filled an on-line survey, summarised in

Figure 1. The survey consisted of following 12 Likert-scale positive statements, which received favourable responses:

Q1: The learning objects referred very well to the topic of the course.

Q2: The learning objects explained the topic in different contexts or situations.

Q3: The learning objects offered learning content beyond my usual e-learning expectations.

Q4: The content of learning objects provided appropriate examples to illustrate key points or concepts.

Q5: I never wasted time with irrelevant details.

Q6: The learning content was easy to understand and concise.

Q7: Quizzes were at appropriate difficulty level.

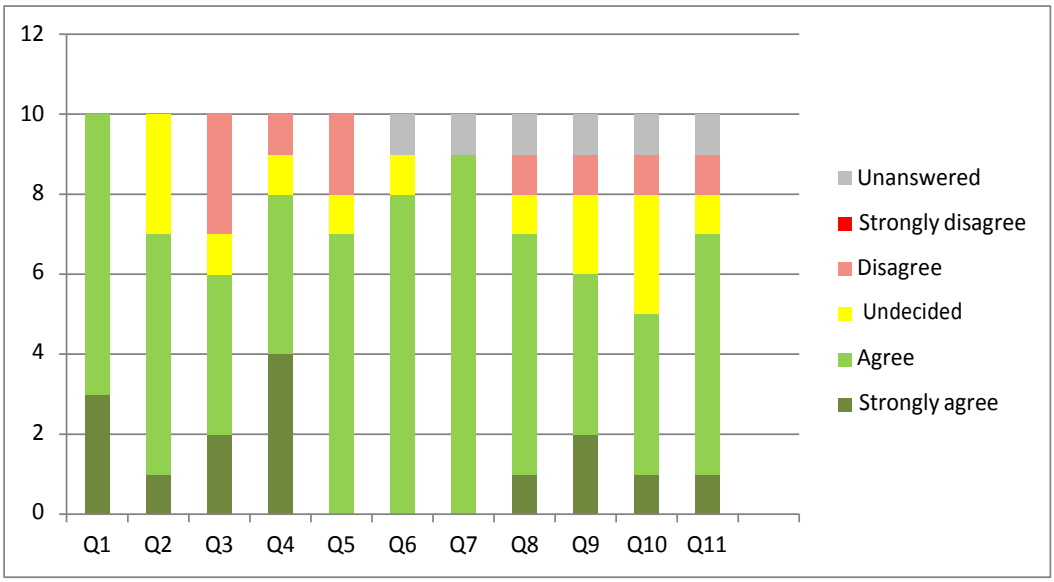
Q8: The learning objects were easy to use.

Q9: The learning objects helped me identify my lack of knowledge.

Q10: The feedback I received for correct or wrong answers in quizzes helped me learn.

Q11: The amount of interactivity in the learning objects was appropriate.

Figure 1: Frequencies of answers in Likert-scale questions in pilot survey.



Discussion and Conclusion

In this paper we explored how persuasive learning designs can be effectively applied to the design of PLOTs within a blended context capitalising the affordances of the VLE, with the aim of changing students´ behaviour towards adopting a deeper learning approach. Filtering key concepts into concise chunks, in clear and unambiguous language can provide more targeted learning content with the persuasive principle of reduction. Students can clarify assumptions and articulate knowledge interactively via the asynchronous discussions (the principle of suggestion and social signals), and this in turn encourages students to take on a deeper approach.

The findings evidenced that the PLOTs were well received by students and persuaded them to engage with the learning and assessment activities independently. In summary, the content, media, visual design allowed for persuasion to occur. The resultant PLOTs will be refined and shared with the project's partner institutions. Up until the time of writing, the study of development of online learning incorporating persuasive design principles has yet to be undertaken in Europe. Tashakkori and Teddlie (2010) state that studies involving human behaviour change over time and are complex, therefore necessitating a sound understanding of the social/behavioural phenomena that takes place. This merits further exploration and study with a larger set of students to derive more conclusive explanations of the change in learning behaviours instigated by the application of appropriate persuasive design principles specifically through digital technologies.

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Mediating Kaj Munk
Using Persuasive Learning

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Abstract. As part of the EuroPLOT project (PLOT = Persuasive Learning Objects and Technologies) the Kaj Munk Case is focused on disseminating knowledge of the person, the works and the ideas of Danish vicar and playwright Kaj Munk. Due to the complexity of the content to be disseminated this requires a multifaceted learning approach as well as support for existential reflection. Technologies used are The Kaj Munk Study Edition, geocaching and mobile persuasive learning objects, and The Conceptual Pond. Combining these approaches in the Munk Case provides a framework for technology enhanced learning in the field of cultural mediation.

Keywords: Persuasive Design, persuasive technology, Kaj Munk, case studies

1 Background

In the course of developing the overall EuroPLOT-project the Kaj Munk Case was suggested as an interesting and challenging case for the development and implementation of principles and techniques for technology enhanced learning using ideas from persuasive technology. The Kaj Munk Case is developed by Aalborg University in cooperation with The Kaj Munk Research Center, Aalborg, The Kaj Munk Vicarage Museum, Vedersø, and several other institutions related to primary school, secondary school, church education, folk high school and university.

Danish theologian, playwright, journalist and novelist Kaj Munk (1898-1944) displayed a comprehensive and widespread cultural impact in Denmark.

First, he is well known for a number of theatrical plays dealing with important religious, political and ethical questions. Being originally attracted to fascist ideas and Moussolini's ability to get the trains to run on time, Munk gradually rejected fascism in general and the German Nazi regime in particular. He wrote several plays treating these issues, acknowledging the importance of the strong character – yet reacting on the progroms of the thirties. Other plays treated modernity, Christianity, faith, and love.

Second, as a novelist Munk elaborated some of his existential thoughts in fiction,

but in journalistic work for Danish newspaper Jyllands Posten he proved ardent and sharp in rejecting the laissez faire approach to the rise of the Nazi regime and the subsequent occupation of Denmark in 1944.

Third, as a clergyman and a preacher Munk sought to encapsulate his rather consistent Christian reflections with ideas of war and resistance.

This being said, the fate of Kaj Munk is also decisive for the impact history of his works and ideas. He was executed by German authorities in 1944, creating a myth as one of the few Danish resistance martyrs. His (partially) nonviolent approach to resistance and his respect for the common soldier amongst the enemy made him an inspirational person for the post-apartheid peace and reconciliation process in South Africa. So Kaj Munk was evidently a multifaceted personality with a vast range of ideas and well-argued opinions adding to a notable life course.

It has been argued that Persuasive Technology as presented in (B.J. Fogg 2003) should be seen together with elements of classical rhetoric (Hasle 2006). This is also very much the idea on which the Kaj Munk case in EuroPLOT is based. One ambition in the project has been to develop software which could on support the work of various rhetors who want to guide the user. Another important ambition has been to make it possible for the users to explore Kaj Munk's conceptual universe by themselves. The Emdros-based Kaj Munk Study Edition has as a software product been design to function in both ways, being a tool for the rhetor who wants to guide the user and at the same time being a media for the users who what to explore Munk's ideas.

2 The complexity of the Kaj Munk Case

Each of the different cases in the EuroPLOT-project present different challenges to the understanding of technology enhanced learning and the facilitation of multimedia learning. Each case study displays a certain degree of complexity in the learning environment, the subject matter, and the intended learning outcomes. Recognizing this, it may be argued that in several ways the Munk Case does present an even higher level of complexity than is expected in many generic learning situations.

It has thus been important to address the issues around this enhanced complexity in order to achieve a thorough understanding of:

- The communicative agent.
- The intended learning outcomes or the intended persuasive impact.
- The learning environment and recipients.
- The material and subject to be mediated.

Obviously, these questions do apply in the process of designing most technology enhanced learning systems. Nevertheless, inherent qualities in the material and the agenda of the Munk Case prove considerations in this area to be of a most decisive nature.

2.1 The communicative agent

In the Munk Case the potential transmitters of content and learning material are legion. Such are also the intentions and the intended learning outcomes or intended persuasive impact. In classic rhetorical theory the *rhetor* defines the agenda and the arguments and, doing this, he enters into an act of *rhetoric agency*.

In the Munk Case there are many stakeholders and interests in the mediation and learning situation. It has therefore been necessary to adopt an open approach to mediating Munk offering tools and media for the users own, individual learning rather than supporting a very fixed curriculum or a predestined route of digital immersion. Communicative agents in the mediation of Munk could be teachers at different levels of the school system. It could be University teachers, researchers, public opinion makers. But it could also be the Kaj Munk Vicarage Museum or another cultural intuition, or the Evangelical Lutheran Church. This diversity of potential *rhetors* obviously differs from much technology enhanced learning in a more restricted or structured learning environment.

In some cases the concept of a single communicative agent must be abandoned as the learning environment is shaped by a multitude of users. This is for instance the case where annotations or user generated content establishes any user as a potential content provider.

2.2 The intended learning outcomes or the intended persuasive impact

Following the argument that multiple potential communicative agents are into play in the Munk Case it is obvious that that a considerable degree of diversity will also be present in the learning environment. Since *rhetors* have different agendas, motivation, and intentions their focus in mediating Munk may be quite diverse.

Nevertheless, this diversity is not only a matter of intention; it is also a matter of style and the role of persuasion. Thus, the communicative agent could aim at one (or both) of these categories of recipient impact:

- Intended learning outcomes – which should focus on knowledge dissemination and cognition.
- Intended persuasive impact – which should focus on bringing inspiration and even suggesting attitude and/or behavior change.

In a habermasian understanding of learning obviously the intended persuasive impact approach is ethically dubious. Nevertheless it is in cultural, political, or religious mediation often the case, that mediation contains some kind of value transfer. It is the strength of the Persuasive Technology framework (B.J.Fogg 2003) that it recognizes these intentions and offer a theoretical framework for the discourse.

2.3 The learning environment and recipients

Just as the *rhetors* are diverse so are the receivers. Given that the learning environments may be at any part of the school system, at University, in Church or in cultural institutions of different natures it is obvious that learning environments differ vastly.

2.4 The Kaj Munk Study Edition

Researchers at the Kaj Munk Research Center at Aalborg University have developed an Emdros based system which integrates archive-based learning resources (pictures and texts), called the Kaj Munk Study Edition (Sandborg-Petersen, U. 2013). This system exists presently in a Danish version. In addition, a German version and an English version of this Study Edition are being developed based on the available translations of Kaj Munk's texts. This system makes it possible to search for patterns and expressions in the text corpus. In this way the system offers an opportunity to explore Kaj Munk's universe as it is represented in terms of the texts.

The ambition is that The Kaj Munk Study Edition should include all parts of Kaj Munk's journalism, dramas, poetry, prose, sermons, and letters. In this way the work with the development of the system may be taken as an illustration of how the complete works of a writer of cultural significance may be represented using an Emdros based tool and how such a tool may be helpful in order to solve tasks in a teaching context, particularly the demands for problem-based learning. The ambition is also that the system should be persuasive in the sense that the use of it should stimulate the wish to learn more about the life and works of Kaj Munk.

2.5 Geocaching and mobile persuasive learning objects

In addition to the more traditional use of technology employed in the Kaj Munk Study Edition, EuroPLOT has also made use of geocaching which may be seen as special kind of so-called mobile persuasion. Within the project a system of four geocaches related to Kaj Munk has been established in co-operation with the Kaj Munk Museum in Vedersø, which is located in Kaj Munks former vicarage. Two of the four caches have been presented in both Danish and German. The four caches were installed in June 2011 and the use of the system has been studied over a period of two years. There is strong evidence to support the claim that geocaching can in fact serve as an effective persuasive technology.

Promising feedback from the Geocaching system in Vedersø, has lead to the development of multimodal persuasive learning design, which was implemented and tested in the small village Vester Hassing in Northern Jutland in June 2013. Building upon the notion that the presence at a specific location, influences the users perception of the learning material, students at Vester Hassing school were introduced to WWII and Kaj Munk, through a combination of traditional and mobile persuasive learning objects. The learning design included a tour of the village, during which the

students received learning material and challenges at specific locations. For instance, the students learned about the time when the railway in Vester Hassing was blown up by the resistance during WWII, and challenged to capture a picture of the station in the same angle as a picture taken when the station was still active.

Technologically, the learning design was based on the persuasive learning technology PLOTMaker, which enables teachers to develop interactive and engaging learning objects that are executable either on computers or mobile devices. The mobile GLOs hold particular potential compared to other similar systems, as learning material is not pushed from servers, but placed on the mobile device and activated at the appropriate moment. Thereby, learning institutions are enabled to apply mobile learning material, without having to consider the cost of data streaming.

Observations from Vester Hassing showed that the learning design in general, and the mobile learning design in particular, motivated the students to engage in the learning material in a highly collaborative manner. As the student walked between the different locations in Vester Hassing, they would discuss the material they has just been presented with, and "translate" it so that it was understood by all members of the group. Furthermore, the evaluation of the learning experience, showed that the constructive approach to learning which forms the pedagogical foundation of the persuasive learning design framework (Gram-Hansen, 2012), resulted in all students meeting the intended learning outcomes of the event. Finally, a majority of the students responded that the learning experience had motivated their interest to learn more about Danish and local history.

2.6 The material and subject to be mediated

As mentioned above the works of Kaj Munk contain much written material in the shape of novels, sermons, plays and newspaper articles. Also a number of other sources for the mediation are relevant: Contemporary photographs, records, discussions of the subjects treated by Munk, extending the scope of Munk by interpreting his beliefs and implementing them in a post-modern paradigm.

Accepting this means that the challenge of the Munk Case is to mediate a narrative that is still in the making. This differs from the mere mediation of knowledge and skill most akin to the general educational systems.

2.7 Complexity indesigned

In the Munk Case it has been a main concern to facilitate an approach to learning that accepts the luhmanian *autopoiesis* and *self-referentiality* of the different *subsystems* that are intended to make use of the learning tools and strategies of Europlot. In order for this to be achieved an open strategy has been adopted in the Munk Case offering ample freedom for the user to utilize the tools in an undetermined logic thus, conceptually, developing an individual narrative in learning.

Having this focus on the different aspects of complexity in mind a number of technology enhanced learning applications have been implemented and tested.

3 Further research

In the course of development and testing in the Munk Case it has become obvious that cultural mediation and the dissemination of ideas and relevant discussion is aided by the establishment of multifaceted learning system. This system may consist of several different applications and tools that may be implemented at the relevant time, place and manner as suggested in the classic theory of *kairos*.

Two

3.1 The Conceptual Pond

In the course of the Kaj Munk Case an application was designed for representing "snapshots" of the reception and understanding of a text, the so-called Conceptual Pond (Sørensen & Sørensen 2013). The Conceptual Pond has been implemented for the evaluation of the reception of Kaj Munks writings. So far mainly plays have been used:

A. Kaj Munk's play "The Word" in the version of renowned filmmaker Carl.Th.Dreyer presented to confirmation class students at 13/14 years of age and
B. Kaj Munk's play "Love" presented to university students of applied philosophy at Aalborg University.

In case A) the findings of The Conceptual Pond assessment system secured unique knowledge revealing the reception and intuitive response to an unfamiliar style of content related to complex existential and metaphysical questions. This is groundbreaking as such research has not previously been performed for recipients of this age. It may be argued that the intuitive and interactive assessment design of The Conceptual Pond was of considerable help in A) acquiring the student's responses and B) in the process of providing statistical material for further research.

Though The Conceptual Pond offers valuable insights the concept could benefit from further testing and development – especially in the field of enhancing the intuitive interface design and supporting expressions of opinion.

3.2 Immersive Layers Design

In the development of the different learning tools it has become clear that the learning processes in the Munk Case could benefit from an enhanced categorization and navigation system for the handling of the complexity of the subject.

The Immersive Layers Design consists of three separate layers in the interface that function as different portals to a variety of digital learning materials. The three layers are a geographical layer, a temporal layer, and a conceptual layer. The term immersion is inspired by Murray (Murray 1997), pointing to deeper level of reflection.

Working with the conceptual approach is inspired by The Conceptual Pond (Sørensen & Sørensen 2013). The design is expected to be generalizable and applicable in a number of technology enhanced learning environments of some similarity with the Munk Case.

The threefold structure of the Immersive Layers Design is inspired by the rhetorical concept of kairos. Acknowledging three aspects of kairos:

1. The opportune moment: Content is mediated at the contextually appropriate time.
2. The opportune location: Content is presented in suitable (virtual) geographical surroundings.
3. The opportune manner: Content is mediated through the appropriate technology (or the omission of technology).

Table 1. Immersive layers overview

Immersive layers design	**Layer 1**	**Layer 2**	**Layer 3**
Description	Geographical	Temporal chronological	Conceptual
General properties	Visual, maps, pictures	Timeline, time shudder	Colour/picture based
Persuasive properties	Explorability, virtual locationbased, reducing level of abstraction,	Explorability, simulation, interaction,	Intuitive access, overview, reduction, handling of complexity
Learning value	Reducing level of abstraction, acquiring understanding of geographical context and real-life events	Recognizing causal events, exploring timelines, reference to world outside the Munk-universe	Acquiring overview, supporting reflection, facilitating deep access to knowledge systems, linking content to other layers

The Immersive Layers Design needs prototyping and testing for assessing the potential in relation to especially the complex cultural mediation of the Munk Case.

4 Conclusion

In the Kaj Munk Case several applications have been implemented and tested. At the same time the process has revealed that the complexity of the case seems to require an equally complex approach to facilitating technology enhanced learning.

Accordingly the different applications related to the Munk case should be understood as parts of a comprehensive digital learning environment facilitating persuasive, interactive learning in a manner relevant to the complexity og the case.

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PLOTLearner for a Corpus of the Hebrew Bible: The Case for Repurposing in Language Learning

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The Lifelong learning project EuroPLOT (www.eplot.eu) has developed a learning technology called PLOTLearner that applies principles formulated in the theory of Persuasive Technology. This new persuasive technology uses a text database to drive a new kind of language learning that focuses on enhancing motivation and enablement through persuasive principles. It also focuses on repurposing learning objects in a persuasive context. The database is the corpus of the Hebrew Bible from the Eep Talstra Centre for Bible and Computer at the Vrije Universiteit in Amsterdam. The interface to this learning technology and the content and structure of learning objects were tested in Gothenburg and Copenhagen and then repurposed as a sustainable technology in Madagascar. The Hebrew test case demonstrates how the technology scales persuasively from small test groups to 500 students in a situation where a national institution in Africa sought to apply the technology in a way that complies with the Bologna process.

Keywords: Learning technology, Design for sustainable language learning. Corpus-driven language learning, Hebrew Bible database. Madagascar.

1 Introduction

EuroPLOT develops Persuasive Learning Objects and Technologies, or PLOTs for short, for reuse and repurposing in several learning contexts of language, culture, environment, and business IT. This case study for language learning uses the corpus of the Hebrew Bible in a persuasive technology called PLOTLearner to demonstrate transnational repurposing for tertiary students at the university in Gothenburg and at a college in Copenhagen and then scaling up to vocational and tertiary learners in Madagascar.

Implementing learning technology in Madagascar is a challenge because it ranks as one of the poorest countries in the world, and the use of computers is not common. Nevertheless, focus interviews fortunately indicated how motivational this learning technology is, as in the following excerpt of an interview with a teacher training to repurpose the technology for his own teaching:

> When we have PLOT Learner, it is like as we have seen a light, because it is very clear how to teach Hebrew with PLOT Learner. Also, the way to persuade the students to learn Hebrew through using the computer is very interesting. In the area where we are, 70% of the students have never used a computer. But PLOTLearner has helped them … learn how to use a computer, and they are motivated to do so in order not stay computer-illiterate. The lessons in the PLOT Learner are very simple and organized. They didn't like Hebrew classes before, and many students gave up. But now they compete in doing exercises with the software. (Pastor TSANGAMILA Fils, Hebrew teacher from STPL Vangaindrano, http://bh.3bmoodle.dk/mod/resource/view.php?id=221, 1:40-4:44.).

This paper will discuss the implementation of persuasive learning technology and especially focus on the goal of the project to effectively use "principles for designing technologies that

change behaviour or attitude, for example, by using fun, simulation, competition, cooperation, or peer influence" (www.eplot.eu). After an introduction to the history and vision of the case for Hebrew language learning, the presentation explains results from the initial pilot testing of the tool for Hebrew in Gothenburg and the creation of content for classroom teaching in Copenhagen. The main focus is to explain how the scaling up for Madagascar has succeeded in repurposing the technology and training facilitators who will teach some 500 students annually. This is followed by a section explaining how data was collected.

2 PLOTLearner - technology for a corpus of the Hebrew Bible

The EuroPLOT application in 2010 formulated the novel idea that a database application PLOTLearner could turn a linguistic corpus like the Hebrew Bible into a pedagogical tutor of the learner. Using the core concepts of reusable and repurposable learning objects, the project envisioned effective learning through interactive and pedagogical engagement with digital learning objects generated by the Hebrew texts. Learners would gradually be persuaded to improve their learning attitudes and activities, while being gently guided by the technology to learn from the texts and practice language skills.

The story that informs this novel idea began with experimental use of technology in the Hebrew classroom back in 2003 (Winther-Nielsen 2011). In the classroom there were good results with a simple program, Paradigms Master Pro (http://paradigmsmasterpro.com/), which generated quizzes on nouns, verbs, suffixes, and prepositions. Not only did drills help students learn much faster and often with fun in competition, but some would even develop an ability to recognize structure in a fashion similar to a parser. Students in this classroom would use text, grammar, and dictionary resources produced by the commercial Bible software company Logos (https://www.logos.com/). Among those resources was a rich linguistic database of the Hebrew Bible developed since 1977 by the Werkgroep Informatica at the Vrije Universiteit in Amsterdam (WIVU, now renamed as the Eep Talstra Centre for Bible and Computer).

This data is stored in an Emdros datatabase management system (www.emdros.org). The principles embedded in this database were developed by Ulrik Sandborg-Petersen (2011) of Aalborg University into a database for storage and retrieval of data from text databases. This database system was in turn used for linguistic projects on Role and Reference Grammar, and it led Winther-Nielsen (2011) to formulate the vision that the linguistic corpus of Biblical Hebrew could be used for persuasive language learning. From 2008 we experimented with combining the effects of drills observed in the classroom with database technology. Then in 2010 Claus Tøndering wrote and released the Windows application 3ET, short for Ezer Emdros-based Exercise Tool, which generated quizzes from the Hebrew corpus. The next step was to develop the idea of a PLOTLearner, which would add persuasive learning functions to 3ET in the way described in Winther-Nielsen (submitted; ms b) and Skovenborg (2011).

EuroPLOT disseminates PLOTLearner for open global educational use in Hebrew language learning. The leading publisher of academic editions of the Hebrew Bible, the German Bible Society in Stuttgart, has granted EuroPLOT a license to offer 20 % of the Hebrew database for free. Therefore, there are no obstacles to widespread distribution of PLOTLearner due to cost or quality of content. The challenge of the project is rather to substantiate the claim that this new approach to Hebrew language learning is superior to other alternatives, which is the aim for this discussion of PLOTLearner in terms of pilot testing, scaling and solid statistical data.

3 Piloting PLOTLearner in Gothenburg and Copenhagen

PLOTLearner has from the outset been developed through participatory design focusing on feedback from user experience.

The first main prototype of the Windows program, PLOTLearner 1, was released in October 2012 and had enhanced support for transliteration and user-friendly presentation of exercises. This version was tested by 6 students of EuroPLOT associate partner Nava Bergman from Gothenburg University in February 2012 through quantitative surveys. She invited some of her former Hebrew students to participate. 9 students began the test. 6 students completed it (Winther-Nielsen 2012). Even if this group was small and not randomly selected, it served well as a heuristic pilot testing group. Participants were asked to answer a pre-test questionnaire, then test the tool for 10 hours before doing a post-test questionnaire. The evaluation measured the attitudes of the respondents, supplemented by optional comments.

This evaluation focused on the exercise support of the program, which got the highest scores along with training of morphology. While respondents noted insufficient learning content, they clearly sensed the persuasive effect of the program. Among the helpful responses received were: it is brilliant to do text-based exercises; it is very helpful to have a virtual keyboard for typing Hebrew; it is very useful to have access to mouse-over popup information from the database. Crucially, 3 students found PLOTLearner clearly motivational, and only one disagreed. Respondents pointed out that the program was fun to use, increased desire to practice, and was effective when one got used to the tool and to learning at their own pace and at any time they liked.

However, this test group knew Hebrew and did not need a tool for beginners and therefore did not want to participate in further testing. Furthermore, the university discontinued teaching of Biblical Hebrew, and therefore Bergman could not scale up to the planned 40 students for the final test. Currently teaching assistant Christian Højgaard is using EuroPLOT's PLOTMaker to repurpose learning objects for the textbook of Bergman (2005), and hopefully this will attract students eventually.

Two students in Copenhagen participated in Think-Aloud Observations recorded on video in March. The protocols and recordings confirmed the positive evaluation from Sweden. Direct observation in a controlled environment enabled tracking of persuasive learning and the observer could gently guide the informant towards issues of interest (Rogers et al 2011: 256).

The second prototype, PLOTLearner 2, was developed into a simulation of a corpus-driven study of the Hebrew text and supported learner-friendly interaction. This version was released July 26, 2012. During the Autumn of 2012 EuroPLOT produced and tested 12 sessions for introductory teaching of Biblical Hebrew (http://bh.3bmoodle.dk/course/view.php?id=2 (login as quest)). The reporting on the tests results from this prototype is still in progress (Winther-Nielsen ms a).

The aim of this phase of the EuroPLOT project was to produce teaching material for experimentation with Hebrew language teaching as blended learning and to test persuasive learning objects. The 12 sessions were tested during the first two-and-a-half weeks of an 80-lessons-long course on Biblical Hebrew given at Fjellhaug International University College Denmark, a campus accredited by a Norwegian college. It was therefore possible to test the use of PLOTLearner by 5 students over a period of four months until their final exam.

Exercises and learning material was delivered in Moodle. The students primarily used short videos introducing grammatical topics as well as one-page pdf-sheets with condensed overviews on these topics. All material could be accessed through a text in PLOTLearner describing the exercise. Class sessions were recorded in Camtasia screen capture, and Skovgård

(2012) analyzed the relation between teaching and outcomes achieved in PLOTLearner, while Gottschalk (2012) explored the users' interest in support for collaboration.

Unfortunately, EuroPLOT had no clear immediate positive influence on the final exam performance for these students. They did not do as well as was expected in the language exam, although they performed well in translation. Their eventual performance was good: half a year later they all got A and B levels in a subsequent course on interpretation of texts from the Hebrew Bible. The lesson from this experience is that learners must be tested in accordance with the skills PLOTLearner builds in acquisition of morphology, vocabulary, and translation. In an ideal world the often superfluous final exam should be replaced by regular or at least weekly self-directed tests for documentation of individual progress. This can develop skills during a learning process in line with the new learning promoted by the European Union.

Our most important conclusion from this pilot evaluation of the two prototypes and the participatory development of learning content is that PLOTLearner integrates well into a classroom with blended learning, supporting skill acquisition in morphology, vocabulary, and translation. However, facilitators of PLOTLearner must repurpose learning material to match grading requirements, if they cannot change evaluation and testing mechanisms to match and support learning as a process.

4 Malagassy education and teacher training

Due to the discontinuation of Bergman's teaching of Biblical Hebrew at Gothenburg University, EuroPLOT has only had the opportunity to scale PLOTLearner for its final pilot testing in Madagascar in the first quarter of 2013.

The technology is implemented to change the teaching of the Hebrew Bible in an entire educational system for vocational training of pastors in the Malagasy Lutheran Church. This church has an estimated 3.2 million members and urgent needs for an increase in educational capacity. Many pastors in rural areas serve more than 10 churches, covering a large geographical area with poor infrastructure, and the churches are growing fast. An average of 400 students are enrolled in a 4 year pastors' training program at six rural pastoral training schools, and close to 100 students in a 3 year program at the Lutheran Graduate School of Theology, or in short SALT, which is involved in EuroPLOT as an associate partner.

The Malagasy representative of the EuroPLOT associate partner, Dean of SALT, Dr Lotera Fabien, wanted PLOTLearner to enable students training at the vocational STPL schools to qualify for admission in the advanced bachelor education at SALT. After two years of study at the STPL, they apply for finishing the last two years of their four-year Bachelor's program and a three-year Master's program at SALT. Many of these candidates will get teaching jobs while others will go into administration or become lead pastors. This is part of the plan to upgrade education under the Bologne process. EuroPLOT will provide the new kind of learning in demand locally.

On behalf of EuroPLOT, teaching assistant Andrianotahina Naivoson Hery directed the testing of PLOTLearner 1 with a group of 15 students beginning January 2012. From September to November 2012 he installed PLOTLearner 2 at each STPL in order to help Hebrew teachers to get a first personal experience with the technology. The fieldwork for pilot testing of PLOTlearner by this author was scheduled from January to March 2013.

The first job was to enhance the professional training for 5 out of 6 teachers of Hebrew at the rural STPL schools. They both needed to learn more Hebrew from the 12 EuroPLOT sessions and more advanced content. They also needed to learn how to run tests in PLOTLearner and

provide documentation of skills of their students. The challenge was to transform teaching experience documented in the classroom in Copenhagen into a contextualized training for a new facilitator role scaled to the needs in Madagascar. This teacher training was carried out in an intensive 8-day-long introductory course on PLOTLearner in January 2013. Six weeks later, after the 5 Hebrew teachers had experimented with self-directed learning, they returned for a final course week. In this phase, Malagasy teaching assistants gathered invaluable feedback in questionnaires and video recorded interviews.

Repurposing of educational material in Madagascar has to adjust to a situation without fast and affordable internet access. Delivery in Moodle is impossible, but one-page pdf-sheets with condensed grammar work well. All resources were now built around a Word97-2003 document integrating hyperlinks to PLOTLearner, videos, and pdf documents. Teaching assistant Tiana Andriamapandry (2013) used the 12 EuroPLOT sessions and existing material and repurposed it all into Malagasy for the first pdf-edition of *Boky Voalohany*. This teaching grammar integrates with PLOTLearner and will be used and tested at the STPLs and further developed in response to Malagasy learner feedback.

The fieldwork included an evaluation of the learning environment in which the new PLOTLearner was going to be used. It came as an unpleasant surprise that some 400 students at 6 STPLs only had access to 2 computers! We estimated that basic needs could be covered if they had 1 computer per 10 students. Thanks to donations to the amount of 3500 Euros, the project can now distribute 40 second-hand, well-functioning Windows computers and 6 laptops. This will provide access to learning content via USB-keys, but it will also promote collaborative learning in groups and pairs.

For this new leaning environment we explored a new approach that would foster self-directed learning, overcome one-way communication, and demotivate copying from the blackboard. These teachers are now contextualizing learning as a bonded fellowship, inspired by the local culture's core concept of collaboration across age groups, known as *fihavanana* (Dahl 1998:139-143). This kind of networking and collaboration does not only apply to the extended family, but can be used for any relationship based on respect, care, mutual favours, and trust, which can form the core for a new kind of Malagassy learning 2.0.

In a report from STPL Atsimoniavoko on June 19 2013, Hebrew teacher A. Pascal Ramahafadrahona describes how he has formed small groups for both his Hebrew classes, 19 groups for the junior class of 80 students and 5 groups for the senior class of 40 students. Even if some students are shy or resist collaboration, the majority of the students help each other, competing as a group and making good progress. He used the tool for the final Hebrew exam at his school, working for an entire week to complete the exams on a few laptops borrowed from students and friends in the nearest city. This teacher repurposed exercises from PLOTLearner for the final test, and forwarded examples show impressive results from these students.

In this way local teachers are now repurposing the technology into a truly sustainable learner-centered PLOTLearner Fihavanana learning environment. It will work without unaffordable textbooks from the West and it will support effective learning in the learners' mother-tongue. EuroPLOT's persuasive technology is thus already being implemented for teaching of 500 students annually at the end of the project in October 2013. The feedback from evaluations testifies to students having fun, completing their learning, and engaging in collaborative learning.

The intensive teacher training course gave invaluable data on the persuasive force of PLOTLearner for facilitators in a global setting. Whereas before students barely learned to read the Hebrew text, students can now practice language learning skills in morphology, vocabulary,

and translation, and teachers and their assistants can easily repurpose the technology to local demands. It enhances new persuasive learning 2.0 for sustainable effect.

5 Statistical data on learner progress

The claims for persuasive technology made so far do not stand alone, because the deployment of PLOTLearner in the Hebrew case study has focused on gathering solid statistical data on the persuasive effect of this new learning technology. The evaluation of the technology and the learning content in pilot groups and in a full scale implementation in Madagascar has provided learner data as evidence on how technology can motivate learners to track their own progress and improve their own learning journey. This illustrates also how teachers are able to survey the progress of students and facilitate students in their learning project and improve the learning outcomes for students.

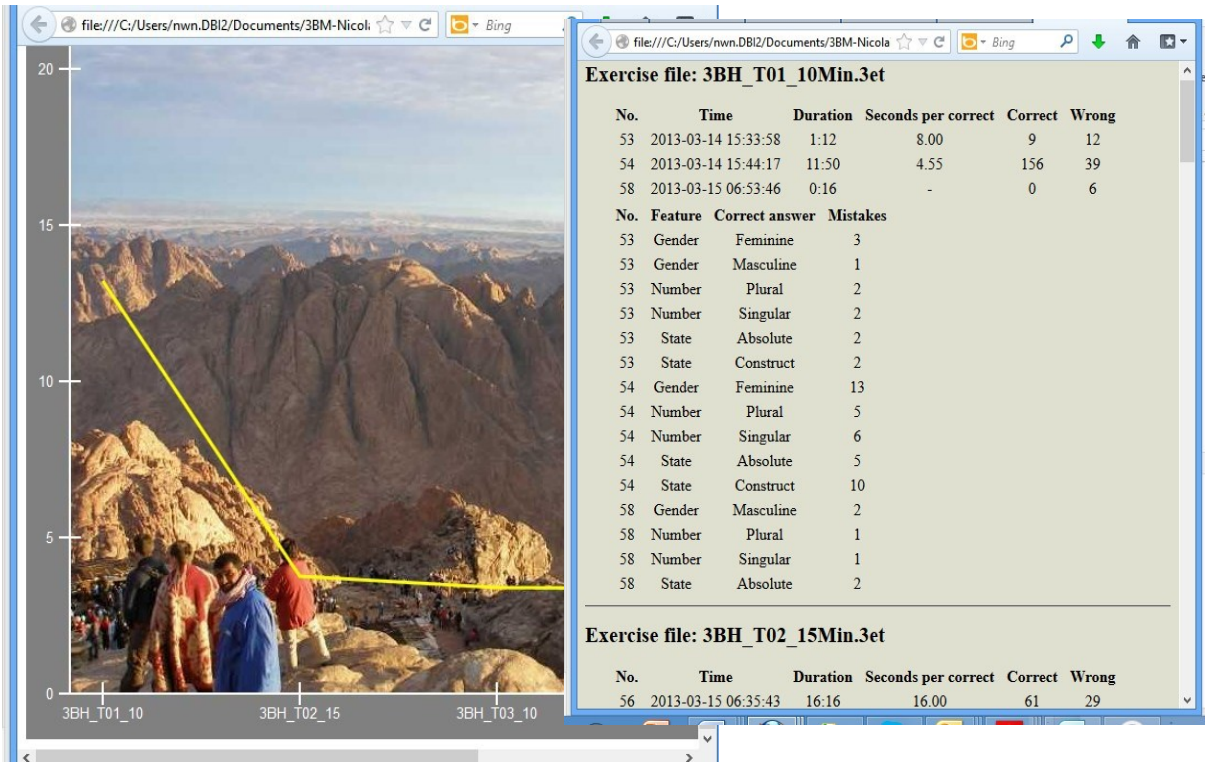


Figure 1. The graphical and statistical displays of test results in PLOTLearner

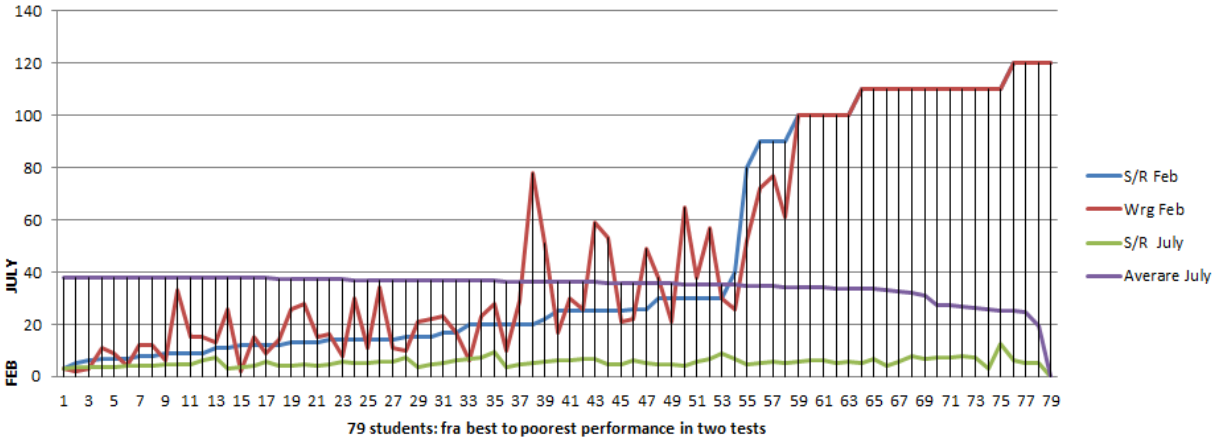
PLOTLearner provides feedback on persuasive effect in learning outcome by displaying statistics on learner performance. The evaluation has so far been based on the "Complete local report", which is shown in the right hand side of Figure 1, and the "Exercise graph" in the left hand side of the figure (See Tøndering 2012: http://www.ezer.dk/3ETusersguide/PL-2.0.1/en/statistics.php). These statistics files were used for manually gathering data on student performance related to duration of exercise, seconds elapsed per right answer, and how many right and wrong answers.

On February 8, 2013, a two-week course on the 12 sessions on introductory Hebrew was concluded with a 15 minute long test for 79 students at SALT. This test has 104 questions in four exercises covering the first five verses of Genesis chapter 1. In figure 2, the light blue graph from the left lower corner starts at the 3 seconds per right answer (S/R Feb) for the best student in this test. This graph slowly rises up to 30 seconds per right answer for the first 53 students, and then jumps steeply upwards, and 21 students, or every fourth student, failed to

complete the test. The red line also begins in the lower left corner at the 2 wrong answers (Wrg Feb) for the best student. The variation in this curve on wrong answers illustrates that the second per right value is not a perfect indication of best student score because some learners are fast but sloppy and make many mistakes, while the best learners will be both fast and accurate.

Figure 2: Results from Tests at SALT in February and July.

A series of experimentations with learner statistics therefore made us change the calculation of language proficiency when we had the Malagasy teaching assistants gather data for the same test a second time by the end of the school year in July. We still gather the second per right



value (S/R July) illustrated by the green graph which now is a more or less flat curve ranging from 3.19 to 7.32 seconds for 73 students out of 78 participants. These students had clearly learned to master PLOTLearner during the intervening 5 month of practice before the second test. We now used a new calculation of the average between right and wrong answers which has been introduced for the Learning Journey Online (Gottschalk and Winther-Nielsen ms). The average of the right answers is multiplied by three, and therefore this value begins with a high value of 38 points for the 13 best learners who had no mistakes at all in this test. 66 students had values over 33 point which is equal to 17 mistakes and the cline only falls for the last 12 students in this test ending at 26 wrong answers for the poorest student.

This data illustrates the progress among a statistically valid population, but it does not cover an advanced knowledge of Hebrew. However, our experiments with data gathering not only proves that we now have a very stable system, but also that we will be able to provide persuasive feedback and self-monitoring as we continue to develop this kind of corpus-driven learning. In our typical courses students would do this 15 minutes test after 12 sessions. A learner would then prepare for a one-hour test on exercises generated by the corpus of Genesis 1-3, testing knowledge on nouns for 10 minutes, verbs for 15 minutes, vocabulary for 10 minutes, and translation for 20 minutes. After these first 30 or so sessions on introductory Hebrew, a learner can pick any text and continue to explore and practice skills.

7 Conclusion

The presentation of the case for persuasive learning of Hebrew has focused on how learners and facilitators can use PLOTLearner for motivation and enablement. The first step was to explain how the technology was developed through pilot testing and improved in agile programming. In the next step we summarized repurposing as open and sustainable technology in Madagascar. The final step introduced our methods for gathering of statistical data that corroborate our claim that this technology is effective for language learning.

From the pilot testing in Gothenburg we realized how important it is that persuasive technology is user-friendly in its integration of learning content. The main result from Copenhagen is that corpus-generated practice and feedback works in blended learning, but it must match the requirements in the final exam. From scaling up to Madagascar we are able to plot PLOTLearner's potential for repurposing learning to an education by training teaching assistants who will repurpose resources to the local culture. Finally, the statistical data on learner progress and performance are helpful for tests and for monitoring of student progress.

This Hebrew case study presents a strong case for persuasive language learning driven by a text-database and it could work for any text and any language.

Acknowledgement

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Designing The Persuasive Learning Experience

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While the persuasive strength of a *digital learning object* will vary from learner to learner or from learning setting to learning setting, there are *persuasive design* strategies that are likely to apply to a larger number of educational settings. This paper discusses some of these design strategies and attempts (from the viewpoint of *persuasive learning*) as well as design considerations that shall help designers of digital learning objects to develop high-quality persuasive learning designs for their audiences.

The objective of this paper is to present key findings of research that has been made in *EuroPLOT*, a 3-years LLP project, as well as to propose overall design recommendations for persuasive learning objects. We are aiming at the involvement of persuasive strength as a new principle when designing digital learning objects.

Keywords: Learning Design, Persuasive Design, Persuasive Learning, Evaluation

Introduction

This is a paper resulting from the evaluation of the EuroPLOT project and explores the interrelations of the two disciplines *learning design* and *persuasive design*. It is based on research undertaken among a sample of learners in four pilot projects of different educational areas. The aim of this particular study was to gather evidence in relation to the following key question: *How should persuasive learning experiences be designed?*

We started to elaborate on this question by approaching the user of learning objects as a multiple character: The user is a learner (aspects of learning design) but also a user who interacts with an interactive learning system (aspects of usability design) and responds to emotional encouragement and involvement (persuasive abilities of design) throughout the process of learning. We are aiming at the involvement of persuasive strength as a new principle when designing and/or evaluating digital learning objects. We want to extend the current practice of learning designs by focusing not only on cognitive but also on persuasive considerations that relate to learning. Our approach goes beyond the functional usability paradigm of learning design and proposes persuasiveness as a new type of measurement.

Methodology

The underlying study of our paper was both quantitative and qualitative in approach and a mixture of focus group discussions and online surveys was used. The first stage of this was a series of in-depth discussions with learners who had worked with persuasive learning objects that designers of the project developed. In addition to these discussions, an analysis of data from an online questionnaire was conducted to gather further information about provision across the three different contextual sectors in the study. Also a review of prior studies in the disciplines of usability design, learning design and persuasive design was conducted to identify complementary design strategies. With respect to the later, we particularly looked at

Persuasive Design as a design strategy that enables designers of learning objects to respond more flexibly to motivational and effective needs of learners (Fogg 2003).

Key Findings

In practice, there is a positive attitude towards the overall appearance and instructional approach of the developed learning objects across all disciplines. The instructional designs of the piloted learning objects were felt (by the learners) to be both creative and comprehensible, with a high level of concern for active learner engagement and motivation. *Constructive alignment* has been found to be a key principle for which learners perceived learning objects as beneficial for their learning. However they expressed a need for more self-reflective forms of learning and more elaborated interactive content. Particularly challenging learning experiences with explorative learning activities were considered to be highly useful for their learning, as well as more established components such as quizzes, progress control and step-by-step guidance.

Both learners and designers of the EuroPLOT pilot projects generated debates about the complexity of learning resources and the appropriate level of detail that was necessary to present new concepts or ideas. They all agreed that there is a fine line between a too narrow and a too broad presentation of details. Learners from the Higher Education sector (e.g. the Hebrew learning case) critically questioned some of the exercises of the piloted learning resources in the light of different curriculum expectation levels (e.g. between beginners or advanced learners, lower or higher-grade levels) whereas learners from the Vocational Education sector rather felt persuaded when learning activities would prepare them sufficiently for practical work situations and related to practical contexts (e.g. in the Exposure scenario case). Instructional design strategies that set value more on a learner specific customization and/or reduction of the digital learning content will potentially lead to contribute to the point of persuasion (see *'Tailoring'* and *'Reduction'* by Fogg 2003).

The most consistent lack across all the three disciplines was identified with respect to an absence of self-monitoring activities as well as little stimulation towards immersion (see *'Self-Monitoring'* and *'Suggestion'* by Fogg 2003). Some learners also expressed concerns about the specific practices and relevancy of how feedback and response needs to be provided in the digital learning experience. In fact, not all learners were aware of the entire range of possibilities that the feedback options of the learning resources offered them to enhance their learning. Hence, important educational and/or motivational effects have been lost. In some cases, if feedback was of less immediate concern to a learner's own attitudes or concern, the feedback was not raised as utterly motivational or it was even ignored as such.

A key aspect of the designers' role in the whole learning experience is about negotiating commitments to learning as well as about assuming the positions and learning preferences of the targeted learners in advance. Typical questions that designers with an attempt to persuasive learning strategies should think about are: *"Who are the learners and what is their current opinion on the taught issue?", "What might be the motivation or purpose for their opinion or attitude?" or "What arguments or pedagogical strategies are most likely to persuade them?"* Despite the fact that knowing the audience is one of the key qualities of the expert learning designer, designers should be clear of the fact that they will not be able to persuade every single audience member with their learning designs!

While the persuasive tactics of learning designs will vary from occasion to occasion, there are tactics that are most likely to apply to a larger number of learning scenarios or settings. The following list presents a set of persuasive design consideration that may help designers to

embed persuasive tactics in their learning designs. These tactics (which are only exemplary at this point) will go beyond common instructional design guidelines, but do not necessarily compete with them:

- **Attention.** The first impression is important! The opening of learning objects therefore is a significant and opportune moment to capture attention of learners and/or to shape their opinion. Contradictory statements, questions or humor can increase attention quite easily.
- **Time.** Learners do not have time to waste with irrelevant details, clicks or links. If designers wait too long with explaining and/or demonstrating key issues and concepts, or if they are too importunate with too much repetition and immersion, the learning object can lose people's attention as well as their credibility.
- **Detail.** The designer of persuasive learning content should make sure that the main points are concise, clear and presented to the level of detail that is relevant to achieve the targeted learning outcomes.
- **Efficiency.** Smaller and less time consuming learning activities will make the performance of a learning object more practicable and motivating for learners than complex learning paths. The higher the complexity of a learning activity, the more time learners will have to invest to work efficiently through the learning experience.
- **Reinforcement.** Concluding statements or reflective tasks at the end of a learning object (e.g. quizzes), or at a crucial point during the learning experience, can help to repeat core concepts or positions without too much of redundancy or force.
- **Simplicity.** Designers should make sure that interactive tasks do not require too much time or efforts from the learner. Otherwise they may lose their attention, or distraction may occur. When learners lose attention they are not likely to be persuaded.
- **Guidance.** Designers of learning objects should also give unambiguous and specific instructions of what learners are asked to do.
- **Benefits.** When new opinions or positions are explained in the learning object, the benefits and motivation of the position should be clear to the learner. From the designer's point of view, the benefits that are given should respond to the very position of the targeted learners, their contexts, beliefs or attitudes.
- **Flexibility.** Didactic flexibility and diversification is the best tactic of designers to make that action request. If the target learner hesitates to accept a targeted learning activity, the learning object should offer an alternative activity (for example a less complex task, a different didactic approach, or a new learning journey).
- **Feedback.** Learners like to know if their actions have made a positive difference. They should be informed of the consequences of their commitment and/or action. Even if the intention of the feedback is not primarily intended to motivate learners, this is how the feedback is usually perceived by the learner.
- **Commitment.** Any kind of committed action (e.g. accepting a button to start a learning activity or to confirm or disagree with an opinion) will lead to attention and active engagement in the learning experience, and potentially result in higher persuasion.

Instructional designs that consider either of these tactics are more likely to answer to a high persuasive design attempt of a designer. However, designers must understand that persuasive learning objects are not persuasive simply for the fact that they embed persuasive strategies or apply persuasive design principles (Fogg 2003). A core aspect of persuasive learning design is

the building on the interests of learners. Persuasive learning design is expected to clearly identify benefits with the greatest appeal to the users of the learning objects. Designers are requested to respond to them most flexibly for the purpose of persuasion when developing the learning content. Also rethinking the channels and methodologies of self-regulated learning as well as increased learner involvement in the learning experience will respond to the specific demands of persuasive learning design.

With no doubt, learning motivation and attitudes are likely to benefit if flexible, personalised and learner-centred learning strategies are embedded in learning designs. Some learners stressed the fact that they benefited from the digital learning objects (as a complementary learning resource for their face-to-face teaching units) because they were able to deepen their knowledge and experience in a more explorative from, particularly when they studied new and/or more complex concepts. The learning activities helped them to see new aspects of a topic (or to reflect more thoroughly on them), or even lead to discover misconceptions. It was obvious that particularly the interactive aspects of self-regulated learning had an impact on learners' motivation to learn as well as that different forms of interactive learning enhanced their attraction and interest in the whole learning experience.

As regards the content and the intended learning experience of a persuasive design attempt, the following characteristics were identified as a result of the different design considerations that were raised in discussions with learners, designers as well as literature reviews (see Table 1).

Table 1. Evidence of Persuasive Learning Designs

Designing the Persuasive Learning Content	Designing the Persuasive Learning Experience
• The content offers benefits or rewards to the intended audience. • The content offers prompt, constructive and personalised feedback. • The content suggests that a learning benefit is particularly valuable or scarce. • The content is mediated at the contextually appropriate time. • The content appeals to the norms and/or learning preferences of the learners. • Key concepts of the content are repeated without too much force to support reasoning or to gain attention. • The content refers to other, more complex material (on request). • The content is mediated through appropriate technology, for example interactive and explorative tasks. • Content is delivered in an interactive and self-controlled learning pace.	• The learning experience is consistent with previous beliefs, actions or expectations of the audience. • The learning experience has a time limit and/or deadline associated with the experience. • Learners actively engage in the learning experience and have autonomy on how to complete learning activities. • The design elements, language, formatting, appearance, and functionality are used in a consistent form. • The design is simplified and sticks to basic principles of aesthetics. • Learning activities enhance the self-reflective skills of learners. • Feedback and control is part of the learning experience, not just summative. • Feedback is particularly useful for behavior that the learner can change. • The learning object strengthens visual relationships between concepts and beliefs.

Concluding points

We assume that some of these principles may be more prominent than others when it comes to develop *persuasive learning designs*, however, they are all considered important. Learners emphasized the effects of a flexible design approach and identified a need to encourage teachers and designers to use new media and differentiated learning scenarios for their teaching. It is particularly interesting, however, that the overall types of activities that the different pilot projects realised were quite similar, not least due to the same technologies (*PLOTMaker* and *PLOTLearner*) that were used for their development.

It can be assumed that the different sets of learning designs and/or learning objects that they had tested have been highly valuable for their learning and motivational throughout their learning experience. The strategy of learning designers for the future should be to allow for sufficient time during the learning experience to achieve persuasion.

Acknowledgements

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Part B: Beyond EuroPLOT

Persuasive Design

The concept of persuasive design has many aspects to be considered. Four research papers address some of these aspects. Gram-Hansen asks the question if persuasive design is a matter of context adaptation. Torning has investigated the persuasive design of learning experiences. Grund-Sørensen has developed a multi-modal interface for cultural exploration, and Wiafe has postulated a unified framework for analysis, design and evaluation of persuasive technologies.

Persuasive Design – A Matter of Context Adaptation?

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Abstract: Within the field of Persuasive Technology it is widely acknowledged that successful persuasion is dependent on timing and the ability to act within the opportune moment known as Kairos. Kairos constitutes the link between the opportune moment and the appropriate action, all in consideration of the specific context. This paper argues that the claim of persuasive design may not be the ability to change the user's attitude or behaviour towards a given subject, but rather on the ability to create designs, which adapt the context in a way, which facilitates the ability to act within the opportune moment.

Keywords: Persuasive Design, Kairos, Context, Context Adaptation, Context Awareness

Introduction

Based on findings within and beyond the EU funded e-PLOT project, this paper argues towards a wider and more nuanced understanding of Persuasive Design (PD). Methodological and theoretical research within the field of Persuasive Technology (PT) has so far primarily focused on a further development and deeper understanding of a list of design principles argued to hold persuasive potential(Fogg, 1998). However, once applied within more established research fields such as Technology Enhanced Learning (TEL), Information Architecture (IA) and Digital Mediation of Cultural Heritage (DMCH), these design principles appear to be already widely applied. This lack of originality challenges the unique claim of PD, and gives reason to look beyond specific design principles in order to clarify the potential of PD in relation to existing HCI areas. This paper suggests that the claim of PD may more reasonably be based on a wider understanding of the rhetorical notion of Kairos (Hansen, 2009), and more specifically the acknowledgement that in order for any technology to hold persuasive potential, there must be an appropriate and adaptive balance between the technology and the context in which is applied.

As our acceptance of technology has increased, so has the influencing potential of these devices. Amongst the newly established perspectives on technology application, which are being explored is the notion of applying interactive computer technologies when intentionally changing the attitude or behaviour of users. Most often, this approach to technology is referred to as persuasive or motivational design. The definition of Persuasive Technologies includes all types of interactive computer technologies designed with the intent to change attitudes and behaviour, however location based and context aware technologies are credited as holding a particular persuasive potential.

PD is most often described in continuance of work originally presented by Stanford University researcher, BJ Fogg, who in 1998 introduced the notion of PT, and in 2003 published the first book on the subject (Fogg, 1998, 2003). Approaching the notion of computers as persuaders from a social psychology perspective, Fogg suggests that computers hold a particularly strong potential to change the attitudes and behaviours of the users, but emphasizes that the designer cannot rely on coercion or deception when influencing the user. As such, Fogg defines a specific perspective on interactive computer technologies, which distinguishes itself from e.g. marketing technologies or technologies that somehow mislead the users. By this definition, Fogg not only highlights an important link between PT and classical rhetoric, he also emphasizes that ethical reflections must play a central role in relation to this particular type of interactive technology.

Persuasive Design – Potential and limitations

The acknowledgement that designers are able to greatly influence the way a given situation is perceived by the user, has encouraged researchers to explore and develop theoretical, methodological and practical aspects of applying computers as persuaders. In particular, much attention has been directed towards one aspect of Fogg's research, known as The Functional Triad. The triad constitutes a categorized framework in which Fogg has identified three different psychological roles in which a persuasive technology may function, namely:

- Tool (Technologies which ease the intended behaviour)
- Media (Technologies which enable users to explore and experience the consequences of given actions)
- Social Actor (Technologies which provide social support)

Fogg refers to the functional triad as a framework for evaluating and understanding the user's experience of applying a technology, and it is suggested that the reflections regarding the psychological role of the technology may be useful to researchers as they explore the notion of persuasive technologies further. Furthermore, the functional triad is argued to be of value to designers, as an inspiration to those who aim to develop persuasive technologies.

For each of the roles in the triad, Fogg lists a number of persuasive principles, which – through analysis of a large variety of persuasive technologies - he identifies as system design commonalities. In spite that these principles have been identified and categorized through careful exploration of already existing technologies (and as such do not constitute novel design solutions), they have become one of the primary points of interest for researchers who have sought to further develop Fogg's work.

Most renowned within the PT research community, is the Persuasive System Design model (PSD), which was introduced by Oinas-Kukkonen and Harjumaa in the acknowledgement that the functional triad lacked a design oriented perspective. The PSD model presents a categorization of the persuasive principles of the functional triad, which establishes a link between these principles and well-known features of requirement specifications, thereby making the categories more apprehensible for system developers. (Oinas-Kukkonen, 2008). Other principle based research approaches include, mapping the principles to areas such as classical rhetoric and information architecture (Lykke, 2009; Pertou & Iversen, 2009), and

investigating and formulating individual principles and triad related perspectives, such as credibility, praise and rewards (Bertelsen & Schärfe, 2010) (Anne Gerdes and Øhrstrøm, 2011).

Each of the theoretical and practical approaches to the further development of the PT framework constitutes important perspectives in relation to establishing a deeper understanding of the potential of PT. However, the focus on formalising the PD principles also comprises a significant challenge once these theories and methods are applied within other research areas. As the design principles have originally been identified through analysis of already existing technologies, they themselves do not contribute with new approaches to design. As a result, the unique claim and novelty of PT is questioned when the framework is applied within more established research areas.

Persuasive or simply enhanced?

Several researchers have addressed the challenges related to Fogg's original work, since the establishment of the PT research field. One of the first to point towards aspects which might be questionable, was Bernadine Atkins, who in 2006 published the paper "Captology: A Critical Review", in which she places a strong focus upon the ethics of PT and also argues towards a distinction between education, advocacy and persuasion (Atkinson, 2006).

Whilst Atkins approach may have motivated others to place a stronger focus on the ethics of PD, it can be argued that the PSD model exemplifies an attempt to not only develop and applicable method for persuasive system design, but to also meet some of the implied problems related to the applicability of Fogg's original framework. However, while the PSD model presents a more formalized understanding of the content of the functional triad, the focus remains on the individual principles, rather than on the different roles of the triad, and does as such differentiate itself from Fogg's original recommendations regarding the triad.

In the process of exploring the cross field between PD and IA, Marianne Lykke comes to the conclusion that whilst the persuasive principles can be related to IA components, the principles themselves do not lead to any extraordinary design ideas (Lykke, 2009). Thereby Lykke's conclusion exemplifies one of the fundamental challenges when applying the existing theoretical and methodological framework for PT to more established fields; namely that the framework does not provide argumentation towards a unique claim for PD, but merely comprises a reflective meta-layer to existing design approaches.

Similar conclusions were reached within the EU funded e-PLOT project, as steps were taken towards defining a theoretical and practical definition of persuasive learning designs. Several researchers, including Fogg and Atkins, have suggested that an overlap exists between learning and persuasion, but one of the challenges within the e- PLOT project has been to argue towards areas in which PD may in fact enhance existing learning technologies to an extent where the technologies may be defined as persuasive. The theoretical framework sought to define the cross field between the existing PD framework and a constructivist approach to learning, and in practice the two technologies which were included in the project were analysed from a PD perspective in order to determine areas in which PD might

contribute to the learning process. The acknowledgement that learning is something which takes place within an individual, and that we construct knowledge based on our experiences(Biggs & Tang, 2007), shares a number of commonalities with the notion of persuasion, where endogenous motivation is regarded as particularly important(Fogg, 2003). It became evident that both in theory and practice, the persuasive principles were already widely at use in technology enhanced learning, and as such offered no new perspectives to the further development of the technologies. From a theoretical perspective the approach to PD sprung from Fogg's original work, but was supported by perspectives from classical rhetoric and temporal logic and more nuanced definition of persuasion (S. B. Gram-Hansen, 2012). Subsequently the approach to PD was related to a constructivist approach to learning, in the acknowledgement that this particular pedagogical approach showed several similarities to the theoretical framework for PD (S. B. Gram-Hansen, 2012).

Likewise, on-going research in the cross field between PD and digital mediation of cultural heritage argue that the persuasive principles do not constitute a unique claim for PD, nor does the notion of changing the attitudes or behaviours of the users. Cultural heritage can be seen as identity-forming and –reproducing and aiming to re-establish the lost relation to our past and rediscover our roots (Lund, 2004; Lund, Andersen, Christensen, Skouvig, & Johannsen, 2009). E.g. the former Danish Ministry of Cultural Heritage was created in order to rediscover the cultural roots of the Danes in a project that can be viewed as nationalistic in its aim: to establish a national identity. As such, the project exemplifies that the concept of attitude change is also an intended outcome which is focused upon in areas beyond the field of Persuasive Technology and PD.(S. B. a. G.-H. Gram-Hansen, Lasse Burri, 2013)

With several researchers from different areas coming to the same conclusions about the limitations of the primary elements in the existing PD framework, it appears reasonably to take a step back and work towards an understanding and potential definition of PD, which acknowledges and incorporates the work already achieved within the PT field, but which also clarifies the areas in which PD may potentially enhance the design and development of interactive computer technologies in different application areas.

A matter of appropriate balance

In exploration of the notion of persuasion, and in the aim of extending the theoretical foundation of Persuasive Designs, some researchers approach the challenges of this novel field from a foundation in classical humanistic traditions such as rhetoric, logic and ethics.

The very idea of persuasion is commonly considered as having been brought into the world by classical rhetoric. Classical rhetoric has been systematically related to social psychology by Michael Billig (Billig, 1996). A central statement in Billig's *Arguing and Thinking*, is that we may gain significant insight into human perception by exploring argumentation and especially by studying what classical rhetoric can contribute to the field. Billig observed that social psychology had had a tendency to identify thinking with rule following. From classical rhetoric he learned, however, that while arguments and thought may well be based on rules, rules themselves arise from arguments, and indeed, may be disputed by arguments, that is to say that while rules do exist, they are not deterministic. One should not rely on the assumption

that following certain rules will always yield the desired results (Hasle, 2007; Pertou & Iversen, 2009).

One of the concepts, which are generally accepted as being a key element and a requisite for successful persuasion, is the rhetorical notion of Kairos. Kairos is often described as timing, or the ability to perform the appropriate action at the right time and in the right place. In term of appropriate, the performed action is required to be not only effective but also ethical. The concept sums up the principle that any rhetorical approach is based upon the specific situation, and that comprehension of the context as such is one of the most vital resources when deciding upon rhetorical means to apply to a given argument (Hansen, 2009). Hansen specifies that the definitions of Kairos vary from narrow translations such as "particular point in time" and "specific circumstance", to wider concepts such as "situation", "occasion" and "opportunity".

When relating the different meanings of Kairos in a PD context, the narrow definition serves well in relation to specific design related choices, such as determining the appropriate time for initiating a persuasive strategy (i.e. triggering a specific behaviour), an argument which has been raised by several researchers over the years (Aagaard, 2008; Glud & Jespersen, 2008) The wider definition on the other hand, supports the argument that in order to successfully select and apply a persuasive principle to the design of a technological device, the designer must beforehand acquire a fundamental understanding of the context in which the device is to be applied, and use this knowledge to create a technology which will be appropriate to the given situation.

Kairos in itself is a powerful and multifaceted concept that is not easily formalized. As such, even though Kairos is vital in relation to successful persuasion, the concept in itself does not translate easily to the digital context of persuasive technologies. However, the challenges related to integrating the notion of Kairos in the development of interactive technologies, may be addressed by considering Arthur Priors perspectives on temporal logic. More specifically, the development of PDs may benefit greatly from Priors arguments that time is not only a specific moment but also a wider contextual concept, which he distinguished between as A-time and B-time Priors notion of B-time refers to the objective perception of time, which has dominated the philosophical and the scientific debate for centuries and which is expressed by for instance traditional calendars. A-time on the other hand refers to the contextual perception of the present moment, and takes into consideration the imbalances which are caused by previous events (Øhrstrøm, 1995).

Kairos as it is described by Hansen (2009), may be related to A and B time, by considering Priors notion of A-time as the formalization of Hansen's wider definition of Kairos, whilst Priors notion of B-time may be related to Hansen's narrow definition of the concept. Glud and Jespersen elaborates upon the importance of considering not only Kairos but also Prior's notion of A- and B-time in the development of persuasive systems, in a conceptual analysis of Kairos in relation to location based services. They conclude that inclusion of Kairos in the development of mobile persuasive technologies is spatiotemporal and demand that all conceivable time dimensions are taken into consideration (Glud & Jespersen, 2008)

The different perspectives of Kairos presented by Hansen (2009) are inseparable in the respect that both must be taken into consideration when determining the appropriate moment to initiate a persuasive action. Likewise A- and B- time cannot be considered separate, but must both be taken into account when designing persuasive systems. In order to fully conceive the notion of appropriate timing, one must include both a broader understanding of the defined aim of the process, and consider the contextual reality of the user whilst the steps of the system is being completed.

It may be argued that a similar correlation or balance exists in relation to the concept of intentionality. PT is originally defined as interactive technologies that are designed with the specific intention to change the user's attitude and/or behaviour (Fogg, 2003) and as such the intention itself becomes a central element in the understanding of PD. Designers will most often have a specific and quite complex intention with the design of a technology. This intention must to some extent be balanced towards the user's intention behind applying the technology – an intention that is most likely influenced by exogenous factors. In consideration of the designer most often having a specific use context in mind when developing a technology, it may reasonably be argued that both context and design of the specific technology must be taken into consideration if such technology is to facilitate a persuasive purpose.

The notion of approaching the concept of PD as being multi-layered has furthermore been included in Fogg's original framework. When introducing the concept of persuasive technologies, Fogg distinguished between Macrosuasion and Microsuasion as a way to explain and clarify the dynamics of persuasive technologies. The distinction between the two is important in terms of both analysis and development of PD in most computer technologies. The term Macrosuasion describes an overall persuasive intent of a technology, whilst Microsuasion refers to the use of PD principles in technologies which do not necessarily have en overall persuasive goal (Fogg, 2003). As was the case with temporal logic, Macrosuasion and Microsuasion can reasonably be related to the definition of Kairos as defined by Jette Hansen. The primary distinction between Fogg's definition of Microsuasion and Microsuasion, in relation to the presented definition of Kairos and the reflections concerning the persuasive intention, is that whilst Fogg argues that Microsuasion may be applied in technologies which holds no macrosuasive intention, the latter two perspectives insist that both the wider and the narrow perspective must be considered if the persuasive intention is to be fulfilled.

Persuasive Design – A Matter of Context Adaptation

In the previous section, it is exemplified how the multi-layered perception of Kairos, may be linked to several of the perspectives which have been addressed as relevant to the further development of the PT and PD research field. Individually, these different examples do not provide sufficient insight to clearly define a unique claim of PD, however, the commonality between the different perspectives does motive a further consideration of the notion of ensuring an appropriate balance.

As mentioned, Kairos is widely acknowledged as a requisite for persuasion, and as such, a successful persuasive design must necessarily strive to comply with all three dimensions of the concept. In the process of doing so, location based and context aware systems have been credited as holding a particular persuasive potential, as they enable the design to incorporate location and time in the design. In 2007 mobile phones were argued to be the potentially most efficient persuasive technology, as they not only hold a particular technological potential, they also benefit from a unique affection from their users and have become the device which is brought into almost any situation, and widely accepted by others. (Bødker, 2012; Fogg & Eckles, 2007).

As such, various technological devices can be argued to hold the potential to meet both the timely and location based dimension of Kairos, however the persuasiveness of each technology is dependent on the device also being applied in the appropriate manner within the given context. This third and final dimension calls for a different and more nuanced evaluation of the intended use context, it may not be formalized and it may be argued to point towards the necessity of not only designing the appropriate technology, but also design the appropriate balance between the technology and the intended use context.

Previously it has been argued that the intentionality of the designer is not only directed towards the technology, but also towards the intended use context, and that by adding a technology to a given context, the user's perception of that context is altered (S. B. Gram-Hansen, 2012). In consideration of the notion of appropriate manner, it may be that this perspective should be extended, in the sense that PD not only acknowledges the impact that the technology has on the context, it aims to create the appropriate balance between technology and context.

By doing so, PD may be considered an approach to design that particularly incorporates the notion of Context Adaptation (CA). CA is most often referred to in relation to development of context and location aware systems, as these devices actively adapt information about the contexts in which they are applied. However, considering the impact that a technology may have on a given context, CA in relation to PD may be considered a reciprocal balance, were the technologies adapt the appropriate information about the context, and the context is designed to adapt the technology.

In practice, this approach to PD distinguishes itself from PT, in a way that acknowledges the theoretical and practical steps taken so far within the PT research community, by distinguishing between PT and PD approaches. System oriented methods such as the PSD model address the challenges related to the specific technology design, where as PD is considered a wider concept which focuses on the establishment of an appropriate balance between technology and context, and which may serve as a meta-perspective to more established research fields.

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Persuasive Design of TEL: Models and Challenges

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This paper reviews the emerging research literature on persuasive design models, while at the same time counterbalancing it with a comparative review of the most popular models as well as findings from the field of Technology Enhanced Learning (TEL). These models are systematically compared and analysed with regard to producing technology enhanced learning experiences. The results of this comparison can be used when selecting models for designs, in addition to concurrently serving as an offset for creating new models.

Keywords: Persuasive Technology Design, TEL, Design Models, Persuasion

Introduction

Persuasive design (PD) is centred on the concept that humans may delegate the act of persuasion to non-human entities, deliberately seeking to change or reinforce behaviours and attitudes. In 400 B.C., Aristotle defined rhetoric as "…the faculty of observing in any given case the available means of persuasion" (Aristotle 2010). PD (Redström 2006) is increasingly becoming an area of interest across multiple domains. Persuasion can be used in multiple domains, and in observing how Aristotle, Cicero and other modern scholars (Dillard, Pfau 2002) describe persuasion, it soon becomes evident that 'persuasion' is not the automatic result of certain steps engaged in by an individual. On the contrary, persuasion is a complicated and somewhat unpredictable social process tied to the rhetorical situation in which persuaders seek to persuade (Bitzer 1968, Vatz 1973, Torning 2008). In the field of PD, the topic of 'health' has especially attracted particular attention (Torning, Oinas-Kukkonen 2009, Chatterjee, Price 2009, Kamal, Fels 2012). Problems such as alcoholism, obesity and lack of exercise all provide a multitude of interesting research questions, since their singular real remedy lies in individuals changing their behaviour patterns and remaining consistently motivated towards maintaining the behavioural change thus initiated (WHO Regional Committee for Europe 2008, IJsselsteijn et al. 2006). As with 'health', 'learning' is also a complicated social process dependent on the behaviour and attitude change of individuals, as well as continuous self-motivation. However learning may not occur even if learners are both motivated and have a positive attitude towards learning. We can speculate that addressing 'learning' with persuasive design in numerous settings might be a more difficult proposition than addressing 'health'. Like persuasion, learning too is rooted in ancient Greece and rhetoric. Subsequently, Cicero went on to describe the three functions of the rhetorician: "Docere, Delectare, Movere," or "*To Teach*, To Delight, To Move." (Christensen, Hasle 2007). Thus, it becomes obvious that teaching has been an integrated part of rhetoric for many years. Persuasion and learning are very situational and dependent on the interplay of many different factors (Wang, Hannafin 2005). For this very same reason, we cannot expect to find a unified theory or model of either concept, as they are bound by a certain context comprised of (for example): student/audience, teacher/speaker, classroom/venue, topic, values, zeitgeist and culture. In the domain of learning, a relatively recent change is the adoption of interactive technologies (especially Learning Management Systems, which are being increasingly adopted by various institutions). Wang and Hannafin (2005) offer a broad definition of such technologies: "Technology Enhanced Learning

Environments (TELEs) are technology-based learning and instructional systems through which students acquire skills or knowledge, usually with the help of teachers or facilitators, learning support tools, and technological resources." In combining PD with TEL, we are able to identify the outline of a problem that is characterised by a staggering level of complexity. How can we begin to address these many different variables combined with nuances of numerous abstract social concepts? What exactly are practitioners and researchers expected to accomplish, if they wish to design a persuasive TELE? Typically, researchers have used PD to address several health educational issues. Some examples of PD would be a computerised doll designed to teach adolescents about the consequences of not using birth control (Realityworks 2010, Fogg 2003); teaching women in rural India about their menstrual cycle and personal hygiene (Parmar, Keyson & deBont 2008); changing office workers' sitting habits in order to prevent back strain (Obermair et al. 2008) and designing kitchens that promote calorie-awareness cooking (Chi et al. 2008). It is interesting to note that all these studies were conducted by researchers who were not specialists in the field of education. If researchers are to address 'learning' and education at the macro level of persuasion (Fogg, 2003), they should design models that difficult as this may be, specifically address the rhetorical situation surrounding 'learning' and include findings from educational research including TEL.

Methodology

If researchers aim at developing a TEL specific PD-model tailored to address the domain of learning and technology, an accepted starting point is a thorough review of some existing PD-models. In this paper, PD-models are coupled with TEL, by subjecting PD-models to evaluation employing the nine TEL research design principles developed by Wang and Hannafin (2005). The authors arrive at the nine principles as a result of their literature review of design-based research paradigms and state that: "To generate practical, credible, and contextual design theories, however, rigorous, disciplined, and iterative inquiry is needed […] we identify nine principles central to planning and implementing TELE design-based research" (p.15). In this paper however, the principles are applied to evaluate design models and in that sense one could argue, that the principles are being stretched beyond their intended domain. However, it is debatable if design models can be regarded as a form of meta-designs, and if they are in addition, expected to comply with sound standards of design research. The analysis presented here can be seen as a small first step towards creating a TEL centric PD-model and the resultant overview of PD-models is also intended to make the task of selecting a design strategy easier, for those wishing to mix persuasion, learning and technology.

Persuasive Design Models

Since PD is a fledgling area of research, one does not have the option to choose from numerous existing models. Three frameworks were selected for the purpose of this analysis: The Design with Intent (DwI) Method (Lockton, Harrison & Stanton 2010); the Persuasive Systems Design (PSD) Process Model (Oinas-Kukkonen, Harjumaa 2009); and the Eight-Step Design Process (Fogg 2009). These models can be considered first generation PD-models and they were selected based on general work in the field of PD. The three models originate from the Persuasive Conference Series, which is currently the main outlet for scientific dissemination centred on PD. Emerging PD-models created by practitioners (Futerra 2013) or a mix of practitioners and researchers (Fabrique 2013) were omitted. Although Fogg's first model: The Functional Triad (Fogg 2003) has often been widely used, it was omitted in favour of his newer 2009 design process.

Design with Intent (DwI) Method

Early on in the Persuasive Conference series Dan Lockton et al. addressed behaviour change from a perspective dubbed "Design with Intent," (DwI) defined as "design intended to influence or result in certain user behaviour" (Lockton, Harrison & Stanton 2008, Lockton et al. 2009, Lockton 2013). The DwI Method is intended to be generally applicable in influencing user behaviour. The latest iteration of the model (Lockton, Harrison & Stanton 2010) is comprised of two modes: 'Inspiration' and 'Prescription'.

In the 'Inspiration' mode, the designer takes inspiration from a set of headline design patterns, which are applicable to a wide range of target behaviours, grouped into six different 'lenses', representing particular disciplinary perspectives on using design to influence behaviour.

In the 'Prescription' mode, the designer formulates a range of target behaviours (intended outcomes), describing interactions and as a consequence, a subset of the most applicable design patterns from each 'lens' is presented for each target behaviour,. The total number of patterns will vary depending on the chosen target behaviour(s) (according to the authors' typically 15–25 applicable patterns). This mode effectively 'prescribes' a set of patterns, which are deemed especially applicable or have already been applied to similar problems by other designers, in other contexts.

The 'lenses' themselves, are a way of grouping design patterns which share similar considerations, behavioural understanding or assumptions about how to influence users: to some extent, these groups resolve into particular 'worldviews', the way that a designer versed in a particular discipline might approach a brief on influencing behaviour. The six 'lenses' thus target specific domains: 1) The "Architectural Lens" is based on techniques utilised to exert influence on user behaviour in architecture, urban planning and related disciplines. 2) The "Errorproofing Lens" tackles deviations from the target behaviour by treating them as 'errors,' which design facilitates in evading, either by making it more uncomplicated for users to work, with no possibility of being prone to errors. 3) The "Persuasive Lens" makes use of computers with interfaces in order to convince users into transforming attitudes and behaviour. 4) The "Visual Lens" seeks to merge ideas from product semantics, semiotics, ecological psychology and Gestalt psychology on the subject of the manner by which users distinguish patterns and meanings. 5) The "Cognitive Lens" is based on research in behavioural economics and seeks to understand by what method people make decisions. 6) The "Security Lens" symbolises a 'security' worldview, which states that it is possible to discourage and/or avert unacceptable user behaviour. When designers seek to employ the 'lenses,' a free cards based solution is available. The cards serve as a very tangible way to explore the various design patterns (Lockton 2013).

Persuasive Systems Design (PSD) Model

Oinas-Kukkonen & Harjumaa (Oinas-Kukkonen, Harjumaa 2009) offer a model grounded in previous research. The model is comprised of three distinct phases: 1) Understanding key issues behind persuasive systems, 2) Analysing the persuasion context and 3) [Selecting] Design of system qualities. The optimal result of this linear model is "Behaviour and/or attitude change".

The first phase in the words of the authors addresses the understanding of basic concerns fundamental to special persuasive information technology sytems, prior to implementing these systems. Oinas-Kukkonen & Harjumaa (Oinas-Kukkonen, Harjumaa 2009) state that, "Only after obtaining a reasonable level of this understanding can the system be analysed and designed." Seven postulates behind persuasive systems are also offered.

In the second phase, seven core elements are offered, to create a better understanding of the context of persuasion:

1. Persuader: the designer who is deliberately seeking to change the behaviour or attitude of the system user.
2. Change type: the type of change in behaviour and/or attitude the designers aim at invoking via their design.
3. Use context: the features arising from the problem domain target, which the persuasion design addresses e.g. features specific to 'health' or 'learning'.
4. User context: the traits of the targeted user, e.g. goals (including current progress toward achieving them, and potential past performances), commitment, lifestyle etc.
5. Technology context: The strengths and weaknesses, as well as the risks and opportunities, of specific technological platforms, applications and features.
6. Message: the form and content delivered to the user who has to be persuaded. The form is how the message is presented, e.g. as raw text, in a dialogue, or in a game. The content of the message has to fit the form.
7. Route: persuasion can be direct, indirect or both. A direct route would be one wherein the message contains only a few strong arguments, while an indirect route has numerous arguments.

In the third phase of the design model, the qualities of the information system being designed are modelled. Here the designer can select from an extensive catalogue listing 28 design principles for persuasive system content and functionality. The principles are ordered in the following main categories: primary task support, dialogue support, system credibility support and social support. For each category, several approaches are offered with concrete advice and examples of implementation.

The Eight-Step Design Process

Benjamin J. Fogg can be regarded as one of the founding fathers of 'persuasive technology' and at least, the most widely cited (Fogg 1998, Fogg 1999, Fogg 2003). In his eight step model, he states that, "The goal of Steps 1 through 7 of the design process is to create a digital product that reliably persuades someone — not everyone — to adopt the target behaviour." Following the steps, the designer (or design team) is guided towards creating a persuasive technology. However, Fogg asserts that, "The eight steps are not intended to be a rigid formula; instead, the steps serve as milestones to make the design process more effective."

1. Choose a simple behaviour to target: Here designers decide on an appropriate behaviour to target for change.
2. Choose a receptive audience: If the project does not demand otherwise, it is best to ensure that the audience is familiar with the technology channel, thus making them more responsive to change.
3. Find out what is preventing the audience from performing the target behaviour: As reported by Fogg, it may be either a) lack of motivation, b) lack of ability or c) lack of a well-timed trigger to perform the behaviour. However, the design process offers little evidence, which makes it difficult to assess that claim.
4. Choose a familiar technology channel: The "best" channel usually depends on three factors: the target behaviour, the audience, and what is preventing the audience from adopting the behaviour—i.e., the first three steps in the design process

- Optional (unnumbered) step: Re-ordering the First Four Steps: Designers usually perform the first four steps in sequence, but according to Fogg, in some cases designers will make an exception and carry out the steps in a different order.

5. Find suitable examples of persuasive technology: Search for examples of successful persuasive technologies that are relevant to the intervention, by seeking out solutions that succeed in getting people to change their behaviours.
6. Imitate successful examples: Rather than going back to square one, a more appropriate and desirable approach is to imitate successful examples of what is already working.
7. Test and iterate quickly: After imitating successful examples, test the designed user experience promptly and repetitively. A series of small, very quick tests (not scientific experiments) is preferable to one big test. The purpose is rapid prototyping, best achieved by measuring behaviour.
8. Expand on success: Even a small behaviour change is a milestone. The technique of expansion should be systematic, by varying only one or two attributes from the success achieved in Step 7. Fogg states that as perceived from a scientific perspective, step 8 is the starting point for a controlled experiment.

Results and recommendations

The application of Wang and Hannafin's nine principles for design based TEL research served to shed light on various traits of the PD models. Each model was evaluated against the nine principles to reveal their strengths and weaknesses as outlined in Table 1 below.

Some common issues were discovered in all the models. For instance, with regard to Principle 1 ("Support Design with Research from the Outset"), it is surprising that all of the models largely ignore the opportunity to integrate previous findings from the research areas of communications, rhetoric and ethics, as these areas predate research on PD and should be specifically addressed when presenting any model prescribing how to conduct 'persuasion'. The models also presume that anyone can generate data and analyse the user context for persuasion. Principle 5 ("Implement Research Methods Systematically and Purposefully") and Principle 6 ("Analyze Data Immediately, Continuously, and Retrospectively") are not addressed by any of the models, which thus display a common weakness, by omitting to explicitly concentrate on and tackle the generation and analysis of empirical data for informing a persuasive design. Perhaps the authors take these activates for granted. When informing a design from the User Centred-Design (Beyer, Holtzblatt 1998, Holtzblatt, Wendell & Wood 2005) prospective researchers are dominantly seeking to support tasks' completion by lowering the cognitive burden of those tasks, whereas PD seeks to transform and motivate behaviours. It appears counterintuitive that such an apparently large difference and distinction in objectives, should not somehow affect how researchers generate data and analyse it when informing the designs. However, developing clear PD research guidelines for data generation with regard to observations, interviews, surveys, document analysis or field studies etc. is a daunting task, and perhaps it would be premature, if researchers were to address that issue before designing more robust models.

The Design with Intent (DwI) model and the Persuasive Systems Design (PSD) model both fail to address Principle 7: ("Refine Designs Continually"), and therefore, testing and social interactions with users are not addressed. Another general issue with the models is that 'persuasion', supposedly resides in a right mix of strategies for the right rhetorical situation by creating a fitting (technology) response (Bitzer 1968, Torning 2008). When we speak of

Table 1. Persuasive Design frameworks measured against Wang and Hannifin's nine design princples.

Principles 1-9 (Wang, Hannafin 2005)	**Design with Intent (DwI) Method** (Lockton, Harrison & Stanton 2010)	**Persuasive Systems Design (PSD) Model** (Oinas-Kukkonen, Harjumaa 2009)	**Eight-Step Design Process** (Fogg 2009)
1: Support Design with Research from the Outset [Integrating previous findings i.e. by literature review]	• Clearly offers many references to previous work from a plethora of research fields. The model's perspective on 'design' is made very clear. • Each 'lens' is backed up by clear references.	• Offers a variety of references anchoring the work mainly in Information Sciences, Psychology, Social Psychology and Human Computer Interaction (HCI).	• Builds mainly on the author's personal experience. Offers author's website as a reference, where several references are listed. However it is unclear, how these references were integrated into the design process.
2: Set Practical Goals for Theory Development and Develop an Initial Plan	• Does not explicitly mention or address theory development. • Offers very clear research goals for the model by offering a section (2.1.3) elaborating on the evolution of the method.	• Explicitly addresses theory development i.e. "This article is conceptual and theory-creating by its nature…" • Clearly synthesizes several theories (that are described as such). • Offers very clear research goals with regard to developing the model.	• Does not explicitly mention or address theory development, but rather refers to the design process as 'best practice': "…in this paper I draw on my 15 years of experience in studying and creating persuasive technologies to offer what I consider to be "best practices"…"
3: Conduct Research in Representative Real-World Settings	• Offers a comparative clear design case using the design of an ATM machine. It is however an armchair study (no users involved). The behaviour targeted is to ensure that people don't forget their credit card, when withdrawing money.	• Offers an example design (Nike 2013) in the form of a thorough and convincing analysis employing the Persuasive Systems model.	• Does not offer research representative of a real-world setting, but uses plausible thought up examples to exemplify some points.
4: Collaborate Closely with Participants	• The Method was developed through a series of workshop sessions (with design students and recent graduates). • Does not offer clear guidelines for involving users in applications of the DwI model.	• The Persuasive Systems Design Model was developed by two researchers and does not mention validation with others. • The model does not offer clear guidelines for involving users in applications of the model.	• The Design Process is centred on the activities of a 'design team', but was developed by a single researcher, by drawing upon his personal experiences and does not mention validation with other designers/practitioners.

Principles 1-9 (Wang, Hannafin 2005)	**Design with Intent (DwI) Method** (Lockton, Harrison & Stanton 2010)	**Persuasive Systems Design (PSD) Model** (Oinas-Kukkonen, Harjumaa 2009)	**Eight-Step Design Process** (Fogg 2009)
5: Implement Research Methods Systematically and Purposefully	• The Method does not offer advice or research guidelines e.g. observations, interviews, surveys, document analysis or field studies etc.	• The Persuasive Systems Design (PSD) Model does not offer advice or research guidelines e.g. observations, interviews, surveys, document analysis or field studies etc. •	• The Design Process does not offer advice or research guidelines e.g. observations, interviews, surveys, document analysis or field studies etc.
6: Analyse Data Immediately, Continuously, and Retrospectively	• The Method does not offer advice or guidelines for data analysis. • The Method does not offer advice as to how to measure 'persuasiveness'.	• The Persuasive Systems Design (PSD Model does not offer advice or guidelines for data analysis. • The Persuasive Systems Design (PSD Model does not offer advice as to how to measure 'persuasiveness'.	• The Design Process does not offer advice or guidelines for data analysis. • The Design Process does not offer advice as to how to measure 'persuasiveness'.
7: Refine Designs Continually	• Does not explicitly recommend that designers work in an iterative fashion. The Method suggests that designers innovate novel solutions but the Method does not go beyond that.	• The Persuasive Systems Design (PSD Model does not explicitly recommend that designers work in an iterative fashion. The general approach suggested is linear.	• Explicitly and at length recommends iterations i.e. "Step 7: Test and iterate quickly […] the next step is to test various persuasive experiences quickly and repeatedly. A series of small, rapid tests will teach more than one big test."
8: Document Contextual Influences with Design Principles	• Explicitly addresses contextual influences with clear domain specific design principles in the form of 'lenses'.	• Explicitly addresses contextual influences with clear domain specific design principles i.e. 'use context'.	• Suggests that the design team must pinpoint why people are not performing the target behaviour, but offers no advice as to how to do the same.
9: Validate the Generalisability of the Design	• Addresses the generalisability of the model claiming that it is generalisable. Yet, the only proof offered is the ATM-design case. .	• Design case analysis is offered as proof of generalisability. The authors openly state that the work is conceptual and theoretical i.e. based on 'postulates'.	• Mentions that the model is tailored for the early stages of persuasive technology design but does not address generalisability.

the ‘persuasiveness’ of applications, we need to discuss simple features or the whole systems effect. An obvious problem is that none of these suggested tactics by themselves individually appear to be persuasive. For instance, is a tactic such as reduction (making a task easier to complete) in fact a persuasive strategy or just a prerequisite? From one perspective, the models are seemingly collages of such tactics adopted from various fields of research.

The Design with Intent (DwI) model meets four of the Principles: 1, 3, 8, and 9 (but with little proof). It fails to adhere to Principles 4, (considering that the model itself was developed iteratively) 5, 6 and 7 (again, the model itself was developed iteratively). Principle 2 was partly met, on account of the fact that the model offers very clear research goals but it does explicitly mention or address theory development as such. With respect to TEL a clear advantage of this model is that it is very well grounded and corroborated, as it draws on many diverse sources of scientific knowledge by offering a plethora of references. With reference to persuasion in the domain of educational research, the DwI model seems to offer the most especially in situations, where one is designing a physical environment or an actual product e.g. for a classroom setting. It is very positive that the model is component based with an offset in specialist domains. It thus offers researchers the possibility to extend the model in developing new domains and context specific ‘lenses’.

The Persuasive Systems Design (PSD) model also meets four of the Principles, namely 1, 2, 3 and 8. Principle 9 is partly met, as the authors demonstrate very clear awareness issues with robustness and validation, describing the work as both conceptual and theoretical. This model leaves Principles 4, 5, 6 and 7 unaddressed. The PSD model is clearly inspired by formal approaches in Information Sciences (i.e. “software requirements”). If researchers are to address web-based e-education Learning Management Systems (such as Fronter, Blackboard or Moodle), the PSD model will certainly offer significant guidance. The many clear design principles offered are reasonably straight forward; however there is not much guidance as to the right mix of principles.

B.J. Fogg, is by far the single most influential PD researcher and is generally credited with being the founding father of the field of PD. However, his Eight-Step Design Process model only adheres partly to Principle 1 and (as the only model) Principle 7. Fogg openly states that the model is the result of informal synthesis of “best practices”, condensed from his personal work experience. But, despite Fogg’s undeniably strong ethos, from a scientific standpoint, this is problematic. Fogg claims that the model can facilitate rapid prototyping in design teams and states that scientific research experiments can only begin after Step 8. Nonetheless, even if one were to experiment i.e. measure the success of the resulting design, the foundation would not be optimal from a research-based perspective. The Eight-Step model seems most appropriate if researchers wish to get quickly acquainted with PD-thinking and reasoning. In fact, the model is a good starting point, if one is not familiar with PD and wishes to grasp the concept of PD more thoroughly. Nonetheless, this model may not be the optimal choice for more advanced scientific projects.

In delegating persuasion to non-human entities, we are left with an entirely new set of challenges regardless of which models we choose. Many difficult questions arise especially regarding ‘target behaviours’. What are we really persuading someone about, when we seek to persuade someone into learning something?... To spend time on studying? If students are dealing with cognitive problems, what are we to persuade them about? ‘Learning’ might not automatically occur even if students change both their behaviour and have the right attitude; we cannot persuade students into being able, if they are not. Another general problem with technology mediated persuasion is that it is problematic both for researchers, practitioners and users to fully understand how persuasive designs persuade. When we persuade in speech or writing, we – hopefully – strive to present cogent arguments and may employ appeals such as

logos, ethos and pathos. We have models if we want to analyse such arguments (Weston 2000, Walton, Reed & Macagno 2008, Toulmin 2003), but how do physical objects or interactive systems persuade users and how can users evaluate the validity of the 'claims' presented by designs? None of the models – for good reasons – help us answer these problems.

Conclusion

The application of Wang and Hannafin's nine principles for design based TEL research served to shed light on various traits of the PD-models. The models each had their own strengths and weaknesses and perhaps it is not surprising, that a fledgling area of research fails to address the entire complexity offered in the nine principles. Moreover, these are certainly issues that new iterations of frameworks would somehow have to integrate and therefore, there would be several larger issues left to discuss. But a first step has been taken towards addressing the possibilities of creating a 'learning' centric Persuasive Design model. It is clear that a successful model would have to address an extremely complex mesh of social science concepts. When we seek to apply persuasion to a rhetorical situation centred on learning, we are faced with considerably large and diverse challenges. An initial challenge is that it would be very difficult to be a true specialist of learning, pedagogic, rhetoric and technology design, and thus the effort of creating a Persuasive Design (PD) model for TEL would appear to be an inherently multi-disciplinary task.

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Immersive Layers Design
Exploring Culture
through a Persuasive Multimodal Interface

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The aim of this paper is to uncover possibilities for creating an interface design that supports and enhances users in accessing content in a cultural mediation context. Context is the EuroPlot-project (an EU-supported research project under EACEA) and in particular the Kaj Munk Case. This case focuses on the dissemination of biography, works, and impact history of Danish theologian, journalist, and playwright Kaj Munk.
In the course of developing relevant technology enhanced learning aids and identifying persuasive learning designs it has become evident that challenges arise in the areas of categorization, navigation and handling of complexity. It is also clear that challenges of persuasion and immersion are a vital part of the communicative and reflective process.
It is thus necessary to provide designs of overview, persuasiveness, and immersion.
This paper suggests an Immersive Layers Design as a helpful tool. It is based on a geographical layer, a temporal layer and a conceptual layer. These layers present access keys to multimodal, digital content. Layers are dynamic and designed to facilitate tangible functions to support intuitive cognition. The possible benefits of this approach are discussed and several questions for further research are suggested.
This paper is mainly inspired by the insights of persuasive technology applied to learning (Fogg, Gram Hansen et.al.), learning (Biggs & Tang, Bloom et.al, classical rhetoric (Aristotle, Hasle et.al.), and conceptual assessment interface (Sørensen & Sørensen).

Keywords: Immersive Layers Design, persuasive technology, interface, intuitive

Introduction

In recent years digital resources have been made available for the public in a multitude of different contexts. The apparently omniscient Internet provides most likely the most comprehensive knowledge base gathered in history proving even voluminous encyclopaedias pitifully unaccomplished in comparison. The Internet, however, would not possess this richness and diversity, be it not for the content supplied by multifarious providers.
This is not least true in the area of cultural mediation. In a hypercomplex society (Qvortrup) information is legion, however often also limited to dissemination in autopoietic subsystems (Luhmann). Museums and cultural institutions face the challenge of reaching out to a broader audience as the focus of these institutions is transcending from research and archival activities to presentation and dissemination as the rationale for the economical investment (Falk, Hooper-Greenville). The concept of public service thus calls for a contemporary and medialogically relevant mediation of cultural content as is required in several contexts.
A challenge that was soon uncovered in the EuroPLOT-project is the complexity of the content related to Kaj Munk. It includes theatrical plays, movie, sermons, newspaper articles, novels, lyrics, secondary literature, historical accounts, and pictures. Obviously the formats of this content are quite diverse which does support the necessity of a multimodal retrieval system. Accessibility is partly accomplished with the Munk Study Edition of searchable, annotated texts (Petersen & Øhrstrøm). A variety of other learning aids and content are also available and an increase in multimedia learning aids and content should be expected in the years to come.

Presenting such complex information in a digital environment does, however, give rise to several challenges for the optimal exploitation of this multimodal content:

1. Categorization – How may content be categorized as to support cognitive processing?
2. Navigation – How may content be simple and intuitively accessible for users?
3. Reduction of complexity – How may content be structured to enhance learning?

If the content presented is of a nature that calls for existential reflexion several further concerns may be added:

4. Persuasion – How may persuasive principles and design optimize utilization?
5. Immersion – How may content presentation and architecture support reflective learning?

Obviously, this is merely a tentative list of initial issues that will be addressed here. The aim of the paper is to suggest an approach to an Immersive Layers Design facilitating easy and cognitively tangible access to complex and multifaceted content in the realm of culture. Suggestions in this paper are generic though the examples are specific, rooted in the dissemination of the life and works of Kaj Munk. At the same time this paper reflects on the role of such an interface in a persuasive principle design process in line with a persuasive learning design network.

Background

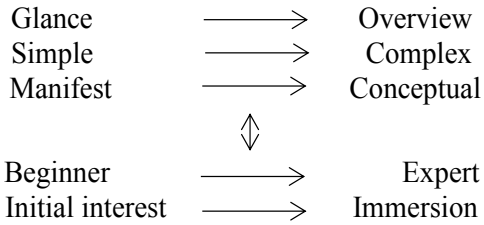
The Immersive Layers Design – concept (ILD) is developed in context of the EuroPLOT project (PLOT = Persuasive Learning Objects and Technologies), which is being funded by the Education, Audiovisual and Culture Executive Agency (EACEA) in the Life-long Learning (LLL) programme (2010-2013).
Part of this project is focused on the provision and dissemination of cultural content, the Kaj Munk Case, which has been explored by Aalborg University and the Kaj Munk Research Center. Kaj Munk (1896-1944) was a leading theologian, playwright, journalist and writer. His works commented the political and philosophical issues of the era as well as existential and religious subjects in a modern paradigm. Being executed by German authorities in 1944 his story adds to the history of Danish WWII resistance.
The mediation of Munk's works and his significance is in the EuroPLOT-project done through The Munk Study Edition (Petersen & Øhrstrøm). This application is based on an EMDROS-database (Petersen 2004) offering fully searchable annotated texts of Munk's plays and sermons. The Munk Study Edition is supplemented with GLO's (Generative Learning Objects) (Hansen, Hansen, Sørensen, Øhrstrøm 2013). A tool has been developed with a specialized focus on assessing amongst other things cultural mediation: The Conceptual Pond (Sørensen & Sørensen).

Concept of Immersion

An immersive, digital environment may be a transforming factor in the mediation of culture. The concept of immersion, and the terminology, is inspired by Janet Murray's definition in "Hamlet on the Holodeck". Here the concept of immersion is linked to the narrative potential of digital, multi-media storytelling and is expressing the full absorption into a new, digital dimension. Immersion is described as "entering the Enchanted Place" (Murray p.99) and connotations related to arousing interest, pleasure and cognitive/emotional engagement are intuitive.
In the concept of Immersive Layers Design the term immersion acts as an adjective defining

the overall aim of the learning process as supported by the interface. In Murray's definition immersion is a step to achieving two further steps of engagement, "agency" and "transformation". For the use in this paper no particular discrimination is made between the various steps in the immersive process. The importance of the concept is connected largely to the intended learning outcome rather than providing a framework for assessing the progression of engagement. The assumption is though, that some dynamics in an immersive process are vital.

Figure 1. Intended immersive processes

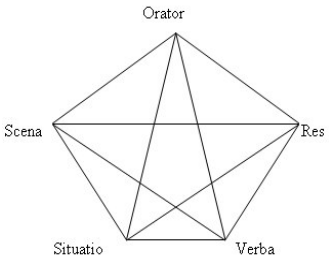


As displayed in figure 1. the intended immersive processes are based on an ongoing progression in several areas of cognition leading to immersion, which is the defined gold standard. This model may not be comprehensive but should account for the dynamics in the creation of a cultural mediation system aiming at immersion.
From a traditional learning perspective similar general progression structures apply. Bloom's 6-step taxonomy (Bloom) as well as the later 5-step SOLO model (Structure of Observed Learning Outcomes) (Biggs & Tang) define intended learning outcomes and processes that despite different terminologies are hardly contradictory to the immersion concept of ILD.

Rhetorical design

The Immersive Layers Design approach is based on the Ciceronian Aptum-model depicting basic aspects of a communicative situation. The structural potential of a basic rhetorical framework has intuitive advantages and mirrors fundamental structure in persuasive communication (Hasle).

Figure 2. The Aptum model



1. Orator represents the initial communicator. In a complex technology enhanced learning system This definition is not unproblematic. The ILD-system must facilitate access to content from a variety of contributors, including the agile implementation of user generated content. In the Kaj Munk Case contributors could be the Kaj Munk Vicarage Museum, the Kaj Munk Research Center, facilitators of geocaching, teachers, contributors of digital content etc.
2. Scena defines the actual or intended receivers of the communicative content. Since the intended audience of cultural mediation from cultural institutions is usually supposed to be comprehensive due to public service considerations it is a substantial challenge in the Munk

Case to address adequately. Also considerations must be taken to cognitive styles and learning strategies (Riding & Rayner).
3. Res defines the material content and matter of the communication. The life, works and impact history of Kaj Munk is a comprehensive subject that requires delicacy in discourse and abundance in content. The subject is related to many sub-subjects of eg. historical importance.
4. Situatio marks the stage, on which the communicative act is taking place. In ILD this is obviously in front of a screen. The interface may, however, be used individually, at a museum, in a classroom or on a projector screen for an audience.
5. Verba is the aspect of eloquence. What communicative "words" and communicative content is appropriate? Obviously, the variety of media related to the Munk Case interprets verba in a multimodal, multimedia understanding.
The implementation of the Aptum model (Aptum = the appropriate, Greek) for Immersive Layers Design may be criticised for lacking a scope of interactivity. In the context of this paper interactivity is defined as a property to the relevant rhetorical parts.

Kairos design

The threefold structure of the present Immersive Layers Design is inspired by the rhetorical concept of kairos. Acknowledging three aspects of kairos:

1. The opportune moment: Content is mediated at the contextually appropriate time.
2. The opportune location: Content is presented in suitable (virtual) geographical surroundings.
3. The opportune manner: Content is mediated through the appropriate technology (or the omission of technology).

This understanding of kairos as an important factor in learning and immersion is to some extent implemented in the division of a temporal, a geographical, and a conceptual layer. A focus on kairos is an important factor in designing the learning system. Suitable material should be presented at the opportune moment, at the opportune location and in an opportune category of mediation.

Persuasive design

A third design principle links to the Functional Triad (B.J.Fogg). This simple, triangular model suggests three fundamental categories of applied interactive digital media.

1 Tool – increases capability
2. Medium – provides experience
3. Social actor – creates relationship

All three functions obviously have a potential in the Kaj Munk case. The tool function is important for the learning system to facilitate learning. The user should be equipped with a toolbox of knowledge, skills and procedural insight.
The experience aspect is no less important. Especially at the initial stages of the immersive process experience is a vital factor. The use of visual media, sounds, videos, quests, applies a more concrete experience to the Kaj Munk learning environment. Experience is also important in the immersive process of personal reflection.
The social actor element should be explored and integrated further in the Immersive Layers Design, especially possibilities of portfolio working, peer sharing and social media connectivity.

Immersive Layers Design

On the basis of these introductory yet fundamental concepts and definitions this paper suggests an Immersive Layers Design centred around three different layers, each supporting overview and exploration. In casu EuroPlot the three layers function as a joint interface for the immersion into the time, life, works, and impact history of Kaj Munk.
Each layer has its own specific logic in categorizing and presenting content. Obviously some content is more intuitively accessible through one specific layer than through the other layers. Other content may be equally intuitively accessible through all layers.
In Table 1. each layer is labelled and commented with a number of properties being significant to the particular layer. Some overlap is natural regarding the properties since layers are designed to support user interaction and immersion and are not directly linked to the underlying categorization of content and content mediation style.
Properties are sectioned into general properties, that depict obvious characteristics of the particular layer, and persuasive properties, that refer to various functionalities supporting persuasiveness. This persuasiveness entails some reference to the terminological framework of BJ.Fogg but basically supports a more open approach to persuasive principles in learning like the position argued in the EuroPLOT Persuasive Learning Design Framework (Hansen WP3.1).
An important element og Table 1. is the depiction of certain learning values. Again, some overlap may be natural. Nevertheless it is imperative that certain intended learning outcomes or values are addressed in the design of the individual layer.

Table 2. Immersive Layers Design

Immersive layers design	Layer 1	Layer 2	Layer 3
Description	Geographical	Temporal chronological	Conceptual
General properties	Visual, maps, pictures	Timeline, time shudder	Colour/picture based
Persuasive properties	Explorability, virtual locationbased, reducing level of abstraction,	Explorability, simulation, interaction,	Intuitive access, overview, reduction, handling of complexity
Learning value	Reducing level of abstraction, acquiring understanding of geographical context and real-life events	Recognizing causal events, exploring timelines, reference to world outside the Munk-universe	Acquiring overview, supporting reflection, facilitating deep access to knowledge systems, linking content to other layers

Geographical layer interface

The interface is designed with a focus on reflective experience as well as navigation. Since geographical positioning or location is an intuitive point of approach for many users in many contexts a visual presentation of this should facilitate cognitively appropriate overview. Obviously the geographical layer may in some contexts be less relevant than other layers. This is a context dependent question depending on the actual importance of location. In a cultural mediation context as is the ecology of this paper location presumable is important, and in the Kaj Munk Case this is definitely of substantial relevance.
In the Kaj Munk Case the geographical layer utilizes a historical map of Vedersø, the village and rural area in which a great number of incidents related to the story of Munk are situated. To support an intuitive historical immersion image is an aerial photo taken by Luftwaffe during the last year of Munk's life,1944. The obvious provenience of the photo supports the war-like connotations and an emotional experience.

Aerial zoomable out into a map of Denmark focusing on other areas relevant to the life and work of Munk as well as a map of Europe. The less detailed map of Europe is important in facilitating understanding of the historical development of fascism being a major source of inspiration for Munk in many of his plays and leading up to WWII.
The geographical layer interface offers support for exploration. This may contribute to reducing the level of abstraction thus providing a more relevant learning experience.

Temporal layer interface

Maps are designed to be zoomable on a temporal axis as well. Moving dynamically from historically contemporary mapping to contemporary mapping of present day. Overlying time layers (maps/aerials) support a virtual time-travel. This supports the immediate understanding of coherence between historical periods. To mediate this understanding of chronology and kairos and a time-line shudder controls morphing as well as presenting contemporarily relevant pictures and e.g. WWII video clips in the periphery of the interface. Sounds support the visual experience. The shudder allows interactive movements back and forth in time supporting an intuitive comprehension of development in historical events.
Supporting interactivity maps are zoomable with access to multi-media experiences supporting the experience of independent immersion into the learning environment. This is done by providing abundance, so the user experiences persuasion through the element of choice.

Figure 3. Temporal layer dynamics (reduced)

Overview: Map Aerial 1944 (Luftwaffe) Airial 1945 (RAF) Maps/photos Google Maps

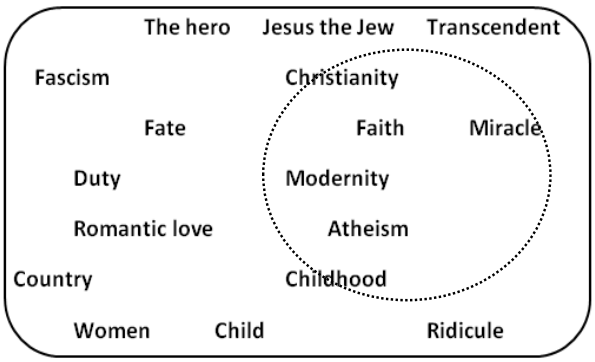
Content: Fascism Plays Sermons WWII Biography Impact history Contemporary reflection

Figure 3. displays a very simplified concept of the timeline. The temporal layer may be regarded as a dynamic version of the geographical layer adding temporal flow and temporally relevant content to the overview. The special learning relevance lies in the causal events imaging and timeline exploration.

Conceptual layer interface

The conceptual map level facilitates browsing through subjects, ideas and works. This layer leaves the tangible metaphors of location and time. Nevertheless, it is important to support and emphasize a concentration on ideas and discourse as this is a vital factor in immersion as well as an often less recognized part of understanding a cultural subject in depth.
Figure 4. displays a simplified model of the conceptual layer interface. A number of key issues and concepts in the works and thinking of Kay Munk are displayed in a way that privileges content relevance and conceptual neighboring . Categorization is thus done with a focus on issues and concepts featuring in the same discourses of Munk rather than a more formalistic categorization.
In the actual interface design coloured areas are designed to merge neighboring issues and concepts in a pursued seamless interface. Colours are omitted in this reduced model to enhance overview.

Figure 4. Conceptual layer overview (reduced)



A relevant example could be that of a user approaching the existential issues treated in Munk's play The Word (1925) (marked with a dotted circle). A number of issues such as Christianity, atheism, faith, miracle etc. are of evident relevance and a simple mouse-over procedure may highlight links from this interface into the archival and learning material of the complete compilation as well as external links.
Using this interface should support the user in finding not only information about relevant concepts and issues bit even more acquiring an impression and understanding of the connection between the individual concepts and issues with the intention of facilitating a deeper level of immersion.

Conclusion

Much good work is done in the area of producing content for digital mediation of culture. In the Kaj Munk Case this includes fully searchable databases of plays and sermons. It includes geocaches on site. It includes smaller, learning objects in the shape of Generative Learning Objects. It also includes a vast number of articles, pictures, video footage, background information etc. The challenges of categorization, navigation and reduction of complexity remain all the same.
This paper aims to facilitate a new kind of overview and tangible user interaction by suggesting the Immersive Layers Design as a framework for supporting such cultural mediation. This is done through supporting and enhancing immersive processes with the user through simple, persuasive principles. Introducing kairos as a framework seems to benefit the simplicity and persuasiveness of the Immersive Layers Design.
Learning contexts linked to temporal sequence do not necessarily need a special interface for overview (Sørensen). In case of complex learning environments featuring comprehensive learning material and multimodal technology enhanced learning some kind of persuasive interface appears needed in order to reduce complexity.
Immersive Layers Design is a suggestions for such an interface.

Further research

A model the Immersive Layers Design needs to be tested in relation to different learning contexts. A refinement would also be helpful especially in the field of concept categorization. The core of this categorization is a delicate content annotation being sensitive to not only a phrase, a picture or a piece of multimodal content in itself – bur also to the neighboring relevance to other issues and concepts.
A further field of study is whether this Immersive Layers Design is relevant in a cultural mediation context only, or whether some of the insights may be stretched into other learning

environments. In any event, it is evident that the close relationship between media content and interface is a vital issue for future exploration. Amount of cultural content is rapidly growing. Finding the right and helpful and way through the digital labyrinth is becoming even more of a challenge.

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A Unified Framework For Analysing, Designing And Evaluating Persuasive Technologies

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Abstract: Methods for designing persuasive systems continue to be a challenge and although some frameworks have been proposed to remedy this, they are all characterised with limitations that impedes their effective usage. In light of this, we propose the Unified Framework for Analysing, Developing and Evaluating persuasive technologies (U-FADE), which integrates key concepts in the Persuasive Systems Development model, the 3-Dimensional Relationship between Attitude and Behaviour model, Persuasive Pathway Model and Persuasive Technology Onion to address this limitation by providing a stepwise approach to facilitate persuasive technology design. The proposed integrated framework is conceptual and thus there is the need for further studies to investigate and demonstrate how it can be put to use.

Keywords: Systems design, behaviour change, models and frameworks, strategies

Introduction

Persuasive Technology (PT) designers are faced with issues regarding design methods. This may be due to the fact that it is considered as a relatively new domain in Information Systems (IS) development. Methods such as the Persuasive Systems Design, (PSD) Model (Oinas-Kukkonen and Harjumaa, 2009), the Behaviour Wizard (Fogg and Hreha, 2010), the and the Persuasive Tool Kit (Saidin, 2011), fail to provide all the relevant information needed for designing PT applications. This impedes their effective usage. Mostly, these frameworks do not consider the changing needs of users, and persuasive systems or applications that employ these methods become obsolete with time.

Although one can argue that the 3-Dimensional Relationship between Attitude and Behaviour (3D-RAB) model (Wiafe et al., 2011b) attempts to cater for issues regarding changes in users, it also failed to provide a holistic approach to persuasive application design. This study therefore proposes the Unified Framework for Analysing, Designing, and Evaluating persuasive systems (U-FADE). The framework seeks to address some of the existing limitations of PT design approaches by bringing together and modifying key concepts from various methods. Particularly, it provides steps and tools that can be used at each stage during the design of PT applications.

Due to space constrains, the paper starts with the general overview of U-FADE followed by discussions on the various stages of the framework. At each stage, the theoretical underpinnings for the suggested tools are discussed. This is followed by discussions on practical implications of U-FADE and a conclusion.

Analysing, Designing and Evaluating Persuasive System

The U-FADE borrows it key principles and concepts from the PSD model. The PSD model is one of the most comprehensive frameworks for developing persuasive systems. It consists of

three main phases that is based on the principles that before a successful persuasive system is designed, the designer needs to i) understand key issues behind the development, ii) analyse the persuasion context, and iii) ensure that the system demonstrates a specific set of qualities or features. Oinas-Kukkonen and Harjumaa (2009) claimed that seven postulates needs to be considered during design. Two of these relates to the designer's assessment of the user, two on persuasive strategies, and three on the system features. Although, the PSD model presents an interesting approach to PT design

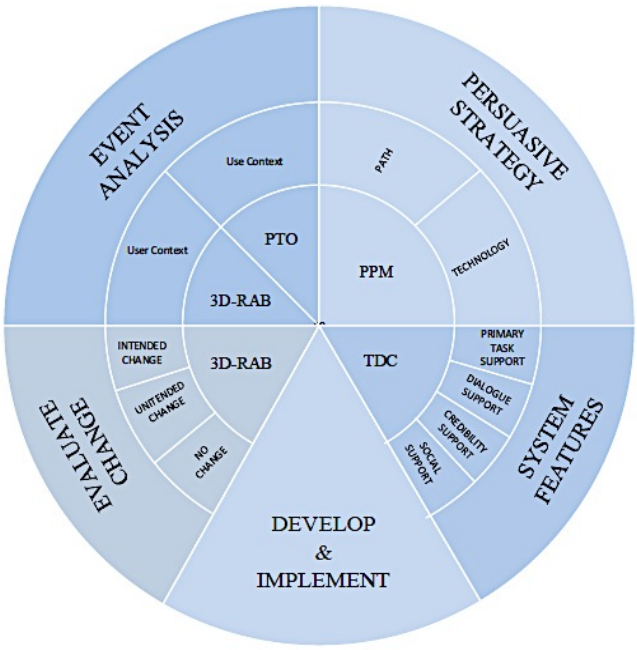

Figure 1: A Unified Framework for Analysing, Designing and Evaluating persuasive technology (U-FADE)

designers may find it challenging in applying it effectively. This is because the information it provides is not sufficient to guide the designer on how to perform the activities mentioned in the model. For instance, even though it argues that the selection of appropriate routes, methods and strategies is necessary for designing an effective PT, it fails to provide information on how to select routes, massages and strategies.

In addition, the PSD model assumed that once a system is fully functional or operational, behaviour change would be achieved. This is because it does not consider the evaluation of behaviour and how to readjust the system to cater for changing needs of the user; although Oinas-Kukkonen and Harjumaa (2009) acknowledged the need to incorporate changes in user needs. Räisänen et al. (2010) argued that although the concepts applied in the PSD model are useful, it would be more appropriate to incorporate other models into it. In this regard, we proposed the U-FADE (see figure 1), a framework that expands the PSD model to guide designers on how to perform analysis by providing tools at each stage.

U-FADE consists of three main layers. The first layer presents the five stages involved in designing PT which are: *Event Analysis*, the *Persuasive Strategy*, *Systems Features*, *Development and Implementation* and *Behaviour Change* evaluation. The second layer consists of the various activities and outcomes that are expected to be perform at each particular stage whereas the innermost layer suggests tools that can be used for the suggested activity. In total U-FADE suggest that four main tools are useful for the design of PT applications. Below is a discussion on the various stages of the model.

Event Analysis

The initial stage in U-FADE is *Event Analysis*. It consists of *Use Context* and *User Context* analysis. As explained by Oinas-Kukkonen and Harjumaa (2009) *Event analysis* enables designers to analyse issues which are peculiar to the problem domain. It highlights the internal and external factors that affect the individual to change or maintain a behaviour. U-FADE proposes that two tools are useful at this stage: the 3D-RAB model for *User Context* analysis and the Persuasive Technology Onion (Wiafe et al., 2011a) for *Use Context* analysis.

User context

In *User Context*, the 3D-RAB model facilitates analysis by categorising users into 8 states based on variations in their cognitive dissonance. It provides information on target users in terms of their Current Behaviour (CB), Attitude Towards Target Behaviour (ATTB) and Attitude Towards Changing/Maintaining Behaviour (ATCMB). Wiafe et al. (2011b) defined CB as the existing action of a person in relation to the environment and ATTB as the like or dislike for a target behaviour. ATCMB measures the agreement or disagreement of a person in relation to a change in a negative behaviour or maintenance of a positive behaviour. A user or a potential user of a PT application is therefore considered to be in one of these states at any time by assessing the parametric permutation of values (positive/negative) for each of the three factors. It argues that persuasion is achieved when users move from an undesirable to a desirable state. State *1* is considered to be the most desirable state with all factors being positive and state *8* is the worse cases state with all factors being negative. Different issues present different challenges and improper design analysis may not factor the target user's evaluation of the issue at stake. As compared to other models, the 3D-RAB model focuses on intrapersonal factors of persuasion. These are factors which may serve as internal motivators or impediments for a user to change his or her behaviour (Aronson, 1997). Specifically, the 3D-RAB model expands the cognitive dissonance theory (Festiger, 1957) for the purpose of PT design.

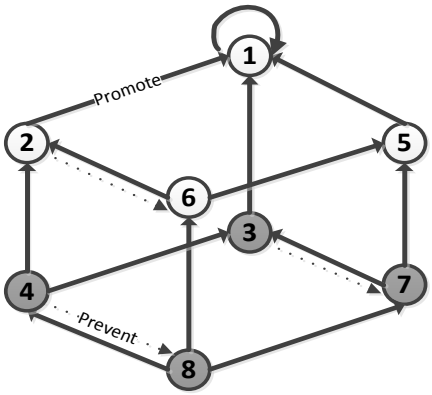

Figure 2: The 3D-RAB model (Wiafe et al. 2011b)

Use context

The information obtained from *User Context* analysis serves as an input for the *Use Context* analysis. *The Use Context* addresses issues which are domain specific. As PT focus on methodologies and tools for developing persuasive systems in addition to studying the organisational, social and end-user impact, it should incorporate the analysis of surrounding agents and systems which have direct and/or indirect impacts on its success. In particular, it should identify how changing certain key activities or personalities within the community or the target group can facilitate a particular change in behaviour or attitude (Wiafe et al., 2011a). This is because PTs are expected to operate alongside other behavioural change activities within the society. Thus it is imperative for designers to consider these issues and factor them into design. U-FADE proposes that the Persuasive Technology Onion, PTO proposed by Wiafe et al. (2011a) facilitates the *Use context* (external) analysis. Informal activities of change in relation to the dissonance state of the user (identified during the *User Context*) should be studied first. This is the Natural Attitude or Behaviour Change, NABC (Wiafe et al., 2011a). NABC consist activities within the immediate environment that changes the user's behaviour or attitude naturally. This can be motivated by cultural, social, norms, beliefs, ethics, commitments, values, etc. Although these issues are generic in terms of all IS design, it is particularly important for PT

Table 1. Relationship in 3D-RAB adopted from Wiafe et al. (2011b)

State	CB	ATTB	ATCMB	Stability	Targeted state
1	+	+	+	Stable (+)	1
2	+	+	-	Unstable (+)	1
3	+	-	+	Unstable (-)	1
4	+	-	-	Unstable (-)	2 or 3
5	-	+	+	Unstable (+)	1
6	-	+	-	Unstable (-)	2 or 5
7	-	-	+	Unstable (-)	3 or 5
8	-	-	-	Stable (-)	4 or 6 or 7

design because the main objective is to change behaviour or attitude and NABC analysis facilitates the identification of issues which are within or beyond the control of the designer. Accordingly, a designer can identify possible issues that affect target users. Issues concerning the physical appearance of the environment, the existing culture, behaviour of peers etc. all needs to be considered. Due to the complex nature of behaviour change analysis, there is no single specific method for collecting all information regarding natural behaviour or attitude change. This is because each situation presents different challenges in obtaining such information. Thus the designer must use various techniques to ensure that adequate and necessary information are gathered. Methods may include informal interviews, observations, previous experiences, etc.

Another form of information that the designer needs to know about the user is the Planned Attitude or Behaviour Change (PABC). This elaborates on existing methods which are being used to change the users behaviour intentionally (this includes automated and non-automated approaches) and it may or may not include the targeted change. Most organisations, associations, employers, government legislature, among others define rules and regulations for their members to ensure that they behave in a particular manner. Such planned activities may promote or impede the target behaviour and there is therefore the need to identify and plan accordingly. For instance, in smoking cessation this type of analysis may provide information on target users who may be using smoking for stress management, since some individuals smoke to manage stress (Kassel et al., 2003). As compared to NABC, PABC is dominated by procedures that are "well-defined". It provides how formal rules have been outlined to enable people to behave in a particular manner.

It is emphasised that the distinction between PABC and NABC overlap in some cases. Hence what may be considered as a PABC factor in one context may be an NABC in another context. However, the essence is to identify the external factors that affect the user at a particular targeted state thus a swap in factors would not affect the analysis.

Persuasive Strategy

The persuasive strategy considers how to craft the message (message pathway) and what technology should be used as a channel for persuasion. In applying the Elaboration Likelihood Model (ELM) (Petty and Wegener, 1999) to the 3D-RAB model, Wiafe et al. (2011b) proposed the Persuasive Pathway Model (PPM) (Wiafe et al., 2012). In U-FADE, PPM serves as a tool for analysing the persuasive strategy. It facilitates the identification of possible paths, selection of appropriate paths and selection of systems features. This is inspired by the fact that elaborated routed messages are more useful in inducing attitude change. An individual will careful evaluate the merits of a message before accepting or rejecting it, whereas peripheral routes present cues and heuristics that affect one's behaviour without necessarily changing attitude (Petty and Cacioppo, 1984).

STATES		Positive Behaviour		Negative Behaviour	
		1	4	6	7
Positive Behaviour	2	2→1 Elaborated Route	4→2 Elaborated Route	6→2 Peripheral Route	
	3	3→1 Elaborated Route	4→3 Elaborated Route		7→3 Peripheral Route
Negative Behaviour	5	5→1 Peripheral Route		6→5 Elaborated Route	7→5 Elaborated Route
	8		8→4 Peripheral Route	8→6 Elaborated Route	8→7 Elaborated Route

Figure 3: The Persuasive Pathway Model (Wiafe et al. 2012)

Identifying possible persuasive paths

In PPM, transitions to states that involves attitude change focuses on using elaborated messages since they consist of logical arguments. Elaborate routes are effective for long term

attitude change whereas transitions to states that involve behaviour change need to use peripherally routed messages; as they are simple and effective in changing behaviour. Figure 3 is the PPM showing types of routed messages that can be applied to facilitate a change in state. The content of the message in each route may vary depending on the intention of the message (either targeting ATCMB or ATTB). For instance although transitions from state *8* to *7* and *7* to *5* will both use elaborated routed messages, the content of message in *8* to *7* needs to focus on encouraging attitude towards change whereas that of *7* to *5* needs to focus on attitude towards behaviour.

Selecting appropriate persuasive paths

The order in which persuasive messages are presented is relevant (Wiafe et al., 2011b), thus the need for selecting appropriate paths. However, although elaborated routed messages are useful in attitude change, they are more effective when the targeted user is motivated enough and have the ability to process the information (Petty and Wegener, 1999, O'Keefe, 2002). This is because the receiver needs to process the information by performing "internal" logical arguments before accepting the message. Consequently, presenting messages through elaborated routes to target users in state 8 for instance will be less effective. Users at this state have less interest in the target behaviour and may not be ready to indulge in issues that need detailed cognitive processing. Messages that are counter-attitudinal to the receiver evoke unfavourable thoughts and are less successful. Hence, it is appropriate to present peripheral messages first to such individuals to encourage behaviour change before elaborated messages are presented to target attitude change. As elaboration increases, the user's application of heuristics (peripheral messages) diminishes and they turn to scrutinise the message and attempts to make meaning of it. Thus elaborated routes become useful. However, since the 3D-RAB model advocates for various paths that can be used for persuasion, designers may also consider other possible paths during design if it is envisaged that this approach is not appropriate in a particular context.

The technology

U-FADE considers technology as part of the *Persuasive Strategy* as compared to the PSD-model which advocates for technology to be study as part of the *Event*. Considering the selection of technology as a strategy enables the identification of appropriate technology for PT development, instead of limiting system functionality to suit a predefined technology. By this, the designer is capable of identifying the most appropriate technology for a particular problem in terms of purpose, availability, ease of use and acceptance. In cases where one is constrained to a predefined technology, it is considered to be a constraint to strategy. U-FADE therefore suggests that in selecting hardware for persuasion, designers should i) identify hardware which are familiar to targets users, ii) select those that the application can be deployed on and iii) select those that are readily available. Where the application cannot be deployed on any of the available hardware the designer should ensure that any new hardware introduced is easily accessible and also easy to use.

Systems Features

Persuasion consists of a number of activities which may be overt or covert and thus it is almost impossible to identify what actually makes people change their behaviour or attitude. Yet it is imperative for researchers to identify methods that can guide the selection of system features during persuasive design. Although the system features proposed by Oinas-Kukkonen and Harjumaa (2009) all support peripherally or elaborated routed messages depending on the context and target users, some can be considered to be more appropriate for any particular route. Table 2 is lists of possible system features categorised according to the type of message they readily promote.

Table 2. System features supporting either elaborated or peripheral route

		Feature	Example implementation
Primary Task Support	Elaborated	Tunnelling	Smoking cessation Website offers information about treatment opportunities after a user has taken an interactive addiction test
		Self-monitoring	Users monitor their daily physical activity on how much calories they burn in a day
		Simulation	Cigarette packs with before and after images of lung disease which are results of smoking
		Rehearsal	A flying simulator
	Peripheral	Personalisation	User are able to change the graphical layout of a weight management app
		Reduction	In Amazon user details are store and presented in their next visit to reduce personal data input to encourage purchases
		Tailoring	Personal trainer website provides different information to users who are beginners and those who are not
Dialogue Support	Elaborated	Suggestion	Weight management app suggests alternative meals that are healthier
		Social Role	An avatar playing the role of a social worker who advice and provide emotional support for smokers to quit
	Peripheral	Rewards	Users compete for the most decorated virtual pet by following their diet and physical activity plan in a weight management app
		Reminder	A PDA health adviser reminds users to rest their wrist whilst using a PC
		Similarity	Slang names can be used to make teenage users associate their lifestyle with an application
		Liking	Cartoons can be used to encourage children to read
		Praise	A virtual coach can provide positive feedback when users perform physical activity
System Credibility	Elaborated	Expertise	A company's websites provides information on their core know-how
		Verifiability	A website for quitters provides links to support the facts it displays
		Authority	Website quotes an authority such as a statement by a UK NHS
	Peripheral	Surface Credibility	UK NHS logo on a weight management website
		Trustworthiness	Company website provide information related to its products rather than providing marketing information
		Real-World Feel	Company websites provides possibilities to contact specific people and ask questions or get feedback
		Authority	A website with statements and quotes made by state health officials
Social Support	Elaborated	Social Facilitation	In a mobile lifestyle coaching, users can be divided into groups and they can see their group members actual performance
		Social Comparison	Users of an application share and compare information relating to their quitting methods
	Peripheral	Social Learning	A shared fitness journal in a mobile app to encourage physical activity
		Recognition	Names of successful quitters published on a quitters website
		Competition	Users compete for highest weight loss of in a weight management app
		Normative Influence	Possibility of challenging friends and relatives in a weight management app

Transition description cards

U-FADE proposes the use of a tool to summarise the entire analysis preformed. This is the Transitions Description Cards (TDC) (see figure 4). This summary provides specific information on how each of the transitions in the selected pathway would be implemented, and it is recommended that a TDC is completed for every transition from one state to another within the selected path. The proposed card is expected to contain information regarding the two states involved in the transition and highlights the previous state, the current state and the next targeted state. In addition it includes information on the general description of the targeted behaviour, the targeted state, the specific user description and transitions which

favours the target behaviour among others. TDC facilitates the development and implementation stage and it enables the designer to focus on requirement without referring to other documents used for analysis during the implementation stage. Figure 4 is a TDC template for transition n_1 to n_2, where n_0 is the previous state of a user.

<table>
<tr><td colspan="2">Transition: $n_1 \rightarrow n_2$</td></tr>
<tr><td colspan="2">Target Behaviour:
State the behaviour that is expected of target users. This should be specific and overt and measurable. (This information can be acquired from the 3D-RAB model analysis)</td></tr>
<tr><td colspan="2">Assumptions:
Lists all the assumptions related to the transition. Also provide information on what happens when assumption is false. (This is obtained from the Event Analysis)</td></tr>
<tr><td colspan="2">Constraints:
List all identified factors that may impede the progress of transitions. (This is obtained from the Event Analysis)</td></tr>
<tr><td rowspan="2">List of possible paths:
List all possible paths identified from the initial user state to the targeted state. (This is obtained from the Persuasive pathway model)</td><td>Selected path:
State the selected path for persuasion</td></tr>
<tr><td>Previous state: n_0
Mention the state prior to the current state</td></tr>
<tr><td colspan="2">Description of Previous state:
Describe the characteristics of the previous state and mention any known issue that may affect the transition. (This obtained form 3D-RAB model)</td></tr>
<tr><td>Selected system features:
List all selected system features to be used in the transition (This is obtained from system features analysis)</td><td>Selected technology:
List technologies identified for the transition (This is obtained from the persuasive strategy analysis)</td></tr>
<tr><td colspan="2">Comments:
State any comment that is necessary in relation to the transition</td></tr>
</table>

Figure 4: Transition Description Card (TDC) template

Development and Implementation

The development and implementation stage of the framework comprises generic features of the classic software development approaches and thus it is not discussed. However it is recommended that particular attention should be given to ensure that the approach used favours the design processes.

Evaluating Change

PTs can result in changes which may be desirable or undesirable (Berdichevsky and Neuenschwander, 1999). In some cases there may be no change at all. Thus it is necessary to evaluate that actual change that occurs during the use of a PT application. This is one of the benefits of using the U-FADE framework since existing methods for design do not provide means for accessing the intended change. In U-FADE it is argued that the 3D-RAB model is useful for this analysis. Designers need to perform a "before and after" analysis to identify how target users have changed (moved from one state to another) over a period of time.

The main benefit of using the 3D-RAB model for such investigations is that it is capable of identifying specific state changes which may not be overt, yet has an impact on behaviour. For instance, after a period of using a smoking cessation PT application the persuader may observe that a user who was in state *8* have moved to state *6* (change his attitude towards target behaviour, yet continue to smoke). This can inform the persuader on what to do next although an overt change was not achieved. It is recommended that an assessment plan is made to specify the frequency of behaviour change reassessment.

Design Implications and Conclusion

From the discussions above it can be observed that U-FADE overhauls existing processes for analysing and designing PT applications. The stepwise approach proposed by U-FADE and its provision of tools at each stage of the analysis is novel and useful since designers would be capable of performing analysis with informed methods. Currently, there is no existing approach or method that is used for the selection of system features, thus resulting in the ad hoc approach used by most designers. The approach suggested by U-FADE can guide designers on the selection of system features targeting either peripheral or elaborated messages, however it is emphasised that it does not guarantee the selection of the most effective method for persuasion. Rather it provides a thinking system that guides the designer during the selection process. In addition, with the provision of methods that can be used to categories users based on the levels of cognitive dissonance state and the behaviour reassessment tool, designers can automate the behaviour assessment process as part of the persuasive application. This will make it possible for the system to automatically change the persuasive message and strategy presented to users to suite their current state: an activity that is characterised with human persuaders.

In conclusion, U-FADE simplifies and suggests tools for analysis and design of PT systems, however there is the need for further studies to assess the practicality and applicability of such a framework. This will provide practical and empirical evidence of its strengths and weakness.

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Assessment and Learning Success

For any kind of learning, it is important to assess the success of the learning, to ensure that the learning outcomes have been achieved and that the learner has actually learned the material that was taught in the teaching process. For measuring this success, assessments are required, which can be either formal or informal. This is the same in both human-taught learning as well as in machine-controlled automatic teaching systems.

In the persuasive learning approach, also the assessment is to be based on persuasive design principles. In their paper, Gottschalk and Winther-Nielsen investigate the use of such persuasive concepts for monitoring students' learning success.

Another interesting aspect in persuasive learning is to measure the actual degree of motivation and persuasion, which Eric Brangier and Michel Desmarais have investigated in their paper.

Persuasive skill development: On computational surveillance strategies for modeling learning statistics with PLOTLearner

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The hypothesis this paper is based on is that computational surveillance within computer-assisted language learning [CALL] systems helps teachers to give their students detailed feedback and enables the computational system to give response to students. We discuss this hypothesis and give as example research work in progress on PeLLITS, short for a Persuasive Intelligent Tutoring System, which is an extension of PLOTLearner. As a result of the data mining it is possible to derive and model learning statistics by using the formal kernel of Item Response Theory [IRT] which has been proposed by Rasch in 1960 and is now used in a paper by Metsämuuronen from 2013. This way we integrate a feedback-loop in our CALL system to achieve a behavior change in the student. Surveillance and tailoring are essential to persuasive learning with our CALL system as this customization supports the application of modern learning theories in which communication and feedback is crucial, following the theory of leaning design formulated by Laurillard (2012). With the implementation of IRT in our CALL system, it is possible to predict the students' learning progress and to give the teacher the opportunity to gently guide student at the right point and with the best feedback. We also discuss the ethical aspects. The computational implementation of this additional module to the online application of PLOTLearner is supervised by Claus Tøndering, developer of PLOTLearner, who is the executive programmer and trains the lead author of this paper in implementing the model developed in this paper.

Keywords: Computer-assisted language learning, surveillance, tailoring, feedback, learning statistics, IRT, learning progress predication, persuasion

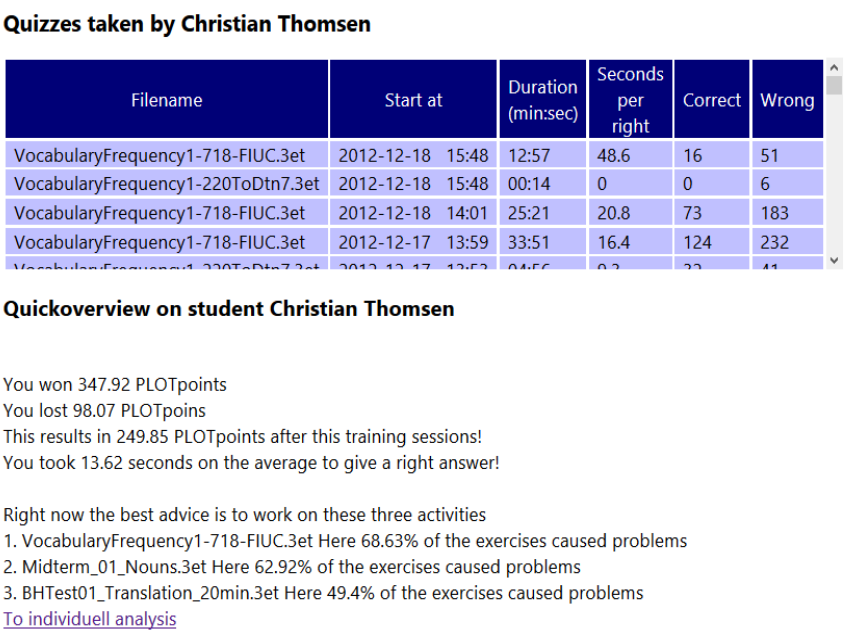
1 Introduction

Measuring learning statistics through computational surveillance and derived via data mining algorithms can support persuasive teaching in computer-assisted language learning [CALL] systems. This is the hypothesis this paper deals with. We discuss how monitoring and predicting learning progress is being used in research work in progress on an intelligent tutoring system called **Pe**rsuasive **L**anguage **L**earning **I**ntelligent **T**utoring **S**ystem [PeLLITS] which is an extension of the database-driven CALL environment PLOTLearner (cf. http://bh.3bmoodle.dk/).

Currently PLOTLearner is being repurposed as an online application, Bible Online Learner (http://pltest.3bmoodle.dk/), developed by programmer Claus Tøndering. In the new project we use logged data on learner performance from this repurposed version of PLOTLearner as input for modeling learner statistics to be used by students, peers and teachers. The ultimate goal of the new project is, however, to emulate the presence of an artificial tutor as a learning supervisor in a virtual and interactive world. The development of PeLLITS is still in the beginning; its architecture has been developed in Gottschalk (2012), where it is also described in length.

The current status of PeLLITS is: It has a web interface for facilitators and learners using PLOTLearner which we call *Learning Journey Online*. Various data mining algorithms and the formal IRT-based framework used by Metsämuuronen (2013) will enable the facilitator to in

gathering information on the learning progress of a student. This is statistically evaluated to give an overview of the students learning progress. The system can show the learning progress in detail, using graphs and tables. It can give advice on where the student needs further support and where he or she should focus on in grammatical drills, and it can predict the students learning progress as shown in the screen-shot of the *Learning Journey Online* in figure 1. The surveillance module collects data when learners choose to submit their learning statistics to the system. Based on the learning statistics, the facilitator can give a direct and informed feedback to the learners, and learners can direct their own learning project through the feedback from the system. This way they are able to tailor their own learning course via surveillance. The generated feedback loop will effect a change of behavior towards improved learning skills, which is one of the persuasive functions identified by Fogg (2003).



Quizzes taken by Christian Thomsen

Filename	Start at	Duration (min:sec)	Seconds per right	Correct	Wrong
VocabularyFrequency1-718-FIUC.3et	2012-12-18 15:48	12:57	48.6	16	51
VocabularyFrequency1-220ToDtn7.3et	2012-12-18 15:48	00:14	0	0	6
VocabularyFrequency1-718-FIUC.3et	2012-12-18 14:01	25:21	20.8	73	183
VocabularyFrequency1-718-FIUC.3et	2012-12-17 13:59	33:51	16.4	124	232

Quickoverview on student Christian Thomsen

You won 347.92 PLOTpoints
You lost 98.07 PLOTpoins
This results in 249.85 PLOTpoints after this training sessions!
You took 13.62 seconds on the average to give a right answer!

Right now the best advice is to work on these three activities
1. VocabularyFrequency1-718-FIUC.3et Here 68.63% of the exercises caused problems
2. Midterm_01_Nouns.3et Here 62.92% of the exercises caused problems
3. BHTest01_Translation_20min.3et Here 49.4% of the exercises caused problems
To individuell analysis

Figure 1: Screen-shot from Learning Journey Online

The system is inspired by experimentation in a course taught for the EuroPLOT project by Nicolai Winther-Nielsen at Fjellhaug International University College Denmark in Copenhagen. During this course he developed and tested the 12 introductory sessions which are delivered as open learning for EuroPLOT (http://bh.3bmoodle.dk/course/view.php?id=2 login as guest). In this classroom students used PLOTLearner and gave feedback on their learner experience in oral discussions during class as well as in e-mails, and the students forwarded their learning statistics for two months during this course. Both EuroPLOT's PC version of PLOTLearner and a new online application, Bible Online Learner, can manage upload to a server, and our project uses these uploaded data as input for the Learning Journey Online. Without this solution the teacher has to analyze the learning statistics by hand when he or she wants to provide feedback for the learner. This is both a time consuming task and it depends to a high degree on the teacher's previous experience of how students usually develop their language skills when making specific errors. The course design of the lecture using PLOTLearner was inspired by the idea that the learners are self-directed.

The research questions the current paper deals with are: 1) How does a persuasive approach to learning statistics look like? 2) What are the formal requirements on a statistics module which is designed to support tailored learning in a CALL system via surveillance?

Choosing a formal approach to the prediction of learning progress which employs surveillance naturally raises ethical concerns *because* it is possible to predict learning progress in learners. The paper discusses the ethical dimensions of surveillance in persuasive learning.

The paper is organized as follows: Section 2 discusses how surveillance can be persuasive and argues

that a feedback-loop which is created via surveillance and interaction with the CALL and the teacher will have a persuasive effect on the learner. Also ethical aspects are discussed in this section. In section 3 the formal framework for a statistics module based on Metsämuuronen is laid out.

2 How surveillance can be persuasive

The principles of persuasion that inspires our surveillance module was set out by Fogg (2003) in his introduction to Persuasive Technology. A decade of research into the role of the computer as a persuader suggested its potential for "adaptive education and training products that tailor motivational approaches to match each individual learner" (Fogg 2003:246). The PLOTLearner project has focused on how exactly technology can persuade learners and change the way they act and learn (cf. Winther-Nielsen ms b).

The development of the surveillance module aims on the one hand to be accessed by teachers and learners by a simple web interface which will enable them to keep track of the students' learning progress and on the other hand to assist the student in self-monitoring his or her own learning progress.

We define surveillance according to the theory of Persuasive Technology: "One party monitors the other party to modify the behavior in a specific way" (Fogg 2003: 46), and this is a common technique to persuade people to change their behavior. The approach chosen is uncovered monitoring; it persuades the learners in their learning by given instant and corrective feedback relative to the practice. As it has been explained in Laurillard (2012) and been exemplified in Gottschalk (2012), feedback is what most users of software for computer-assisted language learning desire. Surveillance is a way to provide this kind of feedback via detailed learning statistics, because it supports both the teachers and the CALL system in giving detailed feedback on the students' progress.

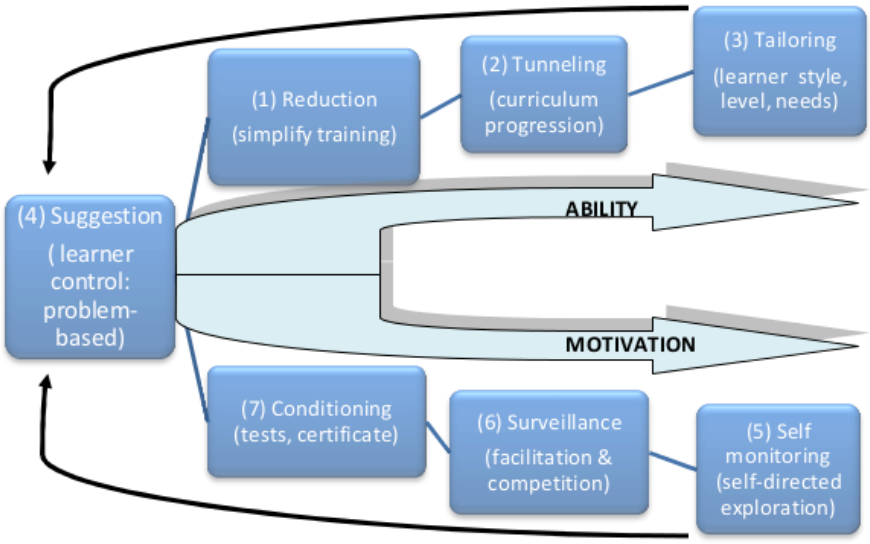


Figure 2: Persuasive architecture (Winther-Nielsen ms a: 7)

The persuasive architecture which Winther-Nielsen (ms a: 7) has developed for PLOTLearner is based on Fogg (2003), proposing only a slight modification of the architecture of a persuasive tool. Winther-Nielsen differentiates three levels in the development of ability and motivation through computer-assisted language learning. The first and simplest method to enhance ability is reduction which is well-known from quizzes satisfying the learner's basic need for reviewing knowledge and memorization. A more sophisticated approach is tunneling. It proceeds in predefined learning progression. Such a predetermined sequence enforces automated results in mastery however it also limits freedom. The most persuasive activation of ability is achieved however via tailoring. In such a

persuasive technology the training is adjusted to the learners' knowledge level, age, learning style, progression, goals and other highly individual parameters which are related to vocational needs.

It is tailoring which is supported by the PeLLITS technology. Detailed feedback based on learning statistics will make it possible to adjust the whole learning process according to the statistics results and the specific needs of the student. By choice of the student, the teacher receives a detailed learning profile of this learner's previous practice. Based on this profile the teacher can adjust his or her teaching according to the individual needs and goals of the learners. The teacher can intervene and provide the student with feedback and advice. Since the student gets feedback by the facilitator based on the learning statistics the student can as a self-directed learner focus on the teacher's advice and adjust her or his learning according to it.

The other branch of Winther-Nielsen's architecture is *motivation* with similar functions and set up in a parallel track to focus on increasingly persuasive feedback. In the traditional curriculum, the first and often only motivational factor is conditioning which is caused by fear of failing the exam, but rewarded by the hope of acquiring a certificate. This is at the core of learning technology with simple exercise functions and instant conditioned feedback. At the next more sophisticated level of motivation surveillance will offer learners the choice to voluntarily share their outcomes with teachers, fellow learners, or in an open community. Using logged data on activity, an offer to receive more instructional help could motivate learners to improve on their learning processes. Furthermore, they could be given the opportunity to attain a certain status as a good gamer in a competition with other learners or to become the best helper in collaboration among peers. However, Winther-Nielsen (ms a) assumes that the ultimate persuasive system will be based on self-monitoring as in this case self-directed learners experience the freedom of being able to actively explore the learning environment and plot their own personal course through the learning content. In this way they are persuaded to plan their individual learning journey based on a visualization of progress and they can respond to the right kind of corrective feedback. Hence, the ultimate language learning system envisioned by Winther-Nielsen uses artificial intelligence and natural language processing to record the individual's processes and outcomes and measure performance on language learning tasks. This system automatically adapts to individual learner differences and learning processes through tailoring and it primes the student for learning tasks thanks to surveillance and self-monitoring.

It is predominately the addition of a further feedback element to the learning circle which makes the system persuasive. In the current version of PeLLITS this is surveillance, but in the long run PeLLITS will be enhanced and developed into a self-monitoring system using artificial intelligence as envisioned in Gottschalk (2012).

While Fogg's approach to persuasion has inspired work on PLOTLearner and PeLLITS, the pedagogical approach for both is mainly based on the robust theory of design for learning which has been introduced in Laurillard (2012). It defines what makes the system persuasive. Laurillard's framework models the interaction between learners, facilitators and the learning environment. Laurillard's model of conversational theory is used to visualize the processes involved in learning from an external environment of a teacher (cf. Winther-Nielsen ms b). Laurillard's approach from is reproduced in figure 3, adding the surveillance part to her system.

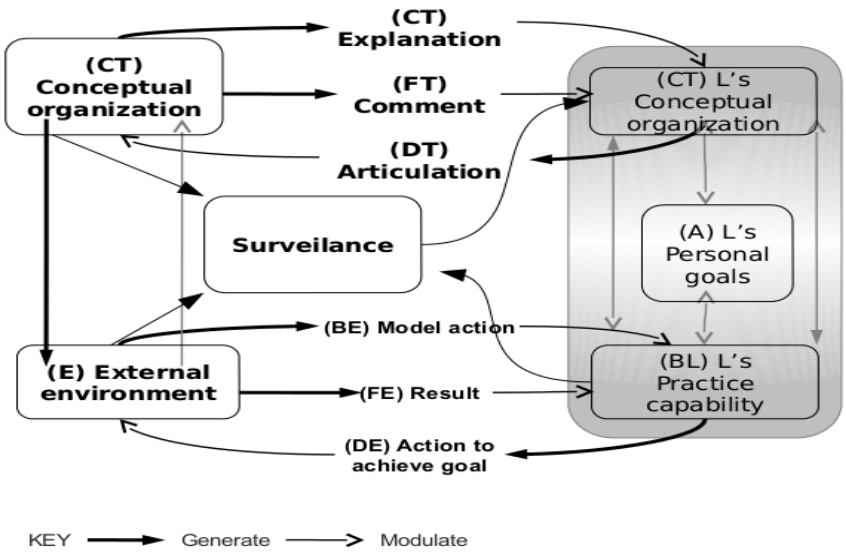


Figure 3: Surveillance added to the model of Laurillard (2012: 60)

In Laurillard's (2012: 60) approach learners use their personal goals and the current organization of learning spaces to select a desired practice which will generate learning actions on the external environment. As Laurillard explains, learners use actions which are modeled by the teacher or even results of own actions to modulate and build practice and capability. If a teacher is present in the learning cycle, there is also the possibility to learn through direct communication. Explanations and comments from the teacher or the learning environment enable the learner to develop a conceptual organization of the learning environment. This is shown by the elements (CT) and (FT).

It is specifically this part of the learning cycle described by Laurillard which is supported by the surveillance module. The reason is that surveillance activates a feedback circle which results in a behavior change in the student as he or she can adjust the learning progress according to this particular aim. This aspect of the system makes the statistics agent a tool for persuasive learning.

However, the use of surveillance in CALL raises serious concerns of ethic nature. The role of surveillance in persuasion has been discussed at length in Fogg (2003) and in Jespersen et al. (2007). Both note that surveillance makes it possible to change behavior, however this only works if the students know that they are monitored. This surveillance element might raise memories of the Panopticum introduced by Bentham and Bozovic (1995) where prisoners are permanently monitored. The Panopticum is a prison that in its center has a tower from which the guards can permanently monitor the prisoners but do not necessarily do so. This results in a deprivation of privacy and forces the prisoners to behave appropriately.

While the system was intended as an enhancement of the conditions of detention because no physical punishment is used, Foucault (1975) later criticized this approach severely and this critique is also followed by Jespersen at al (2007). The essential problem is that the Bethamian system simply redefines power in an inhuman way as the prisoners in the Panopticum lack any privacy due to the constant surveillance (cf. Jespersen at al. 2007). However, one can argue from a utilitarian point-of-view that the Panopticum has a good economic balance and does not physically hurt prisoners, and there is a better alternative and ethically more valid. The Panopticum brings wealth to a big number of people while its negative effects are moderate. This would also be acceptable to Foucault (1975) who assumes that the microwords of power cannot be changed, but one needs to deal with them.

A similar argumentation is also true for the statistics module, although with the difference in stance towards the ethical status of surveillance mentioned by Fogg (2003) and Jespersen et al. (2007): As

long as an intended outcome is friendly and supportive for the user of the software, in that it positively enhances objectively measurable processes relevant to the user of the learning software, it can be regarded as ethical. This implies that if the surveillance technology is uncovered and it supports learners in acquiring desirable skills in a target language the goal can be regarded as friendly and therefore ethical. In the end the students immolate their privacy, but receive feedback which enhances their learning. From the utilitarian position, this is positive and regarded as ethical.

3 Formal framework

To develop a formal statistics framework for PeLLITS Judith Gottschalk is now using Item Response Theory [IRT] following the earlier helpful work by Metsämuuronen (2013). The main purpose of IRT is to test people and to predict the probability of a testee's response by establishing the position of an individual testee along the line of some latent dimension. Since IRT is used in an educational environment, the latent trait is often called *ability* which is set into relation to the difficulty of an item (Partchev 2004: 5).

A first step towards applying a formal statistics approach with IRT for PLOTLearner is the identification of items which can be tested with PeLLITS. These items include the morphosyntax of the learning object dealt with in PeLLITS.

For each student an SQL database receives and stores the following: data on the student identity, the test question answered by the student (this is what is called the item in what follows), whether the student has given the correct answer, and how much time it took the student to answer the question. Whether an answer is correct is determined by the truth values true or false. If a student does not respond to a question, the answer is interpreted as false in this statistical framework. This is the information the statistics module uses to determine statistical information on both the student and the item.

For the statistical module a dichotomous Rasch-Model is used. This is an IRT model which predicts the probability of a learner giving a certain response to some item. Within this model it is assumed that learners have a different level of ability and items have different levels of difficulty (Partchev 2004: 9).

The simplest IRT model for a dichotomous Rasch-Model does only possess one item parameter. It is the item response function, which gives the probability of a correct response given the single item parameter b_i and the individual ability level θ_j. The item-response function which contains one parameter is given in (1) below. It is also known as one-parameter logistic function.

(1) The formula for the item-response function (Parchev 2004: 10)

$$P_{ij}(\theta_j, b_i) = \frac{\exp(\theta_j - b_i)}{1 + \exp(\theta_j - b_j)},$$

The crucial part of the formula is the expression $\exp(\theta_j - b_i)$ which predicts the probability of a correct response from the interaction between the ability θ_j of an individual and the item parameter b_i. The latter parameter is called the location parameter, or the difficulty parameter (cf. Patchev 2004: 11).

The question arising from this is how the ability and the difficulty of an item are determined in this model: These are parameters, which are estimated based on different likelihood methods. The likelihood method, for the determination of the ability parameter, also known as person parameter is the marginal maximum likelihood [MML] procedure. It is used to estimate the distribution of means and standard derivations of the latent ability of each students; this is represented by the θ-parameter in each updated version of the learning statistics right after each test is executed (cf. Metsämuuronen 2013: 17). For the estimation of the difficulty Metsämuuronen used the conditional maximum likelihood method [CLM] because this reduces the imprecision which would otherwise result from

the person parameter which is also used for the estimation of the item parameter. This is the β-parameter.

In view of the specific test design, it is necessary to equate the tests as pointed by Metsämuuronen. In our context the problem of different levels of proficiency for expert and novice level students does not affect the teacher surveillance tool because all students use PLOTLearner from the very beginning of learning Biblical Hebrew. If, however, the tool is used by intermediate or advanced learners and intended to store a broad number of learning profiles, the factor of comparing expert- and novice level students will play an important role.

For the current statistics database design is even more important that the test length can differ, given the different topics covered in the course of the week. It is important that the test scores are comparable and therefore we introduce vertical equation. By doing this, test scores from different tests of different lengths and administered in different time frames can still be compared statistically. Vertical equating was used for IRT modeling in the same way as Metsämuuronen:

> […] the scores were fitted to the same scale on the basis of characteristics of IRT models, which assume that a learner's latent level of ability (θ) and the difficulty level of an item (β) are identical, when certain preconditions are met (see Wright, 1968). The latent ability of each learner can be determined in the same scale for every test as long as linked items connect the test versions. Because of the small number of students in the experimental group (N = 13), the only recommendable model for estimating latent ability was the one-parameter model (that is, the Rasch model). The estimation was carried out using the OPLM program [...] (Metsämuuronen 2013: 17).

Accordingly, Judith Gottschalk uses the different equations, the CLM and MML introduced above for a Rasch-Model. It is used in the same way as Metsämuuronen does and is executed in the following order: In a first step the structure of the linked items is defined. The values of the difficulty of the linked items are exactly the same in each version, the difficulty levels of all other items can be calibrated according to the same scale as the one used for linked items. In a second step the CLM is used in order to estimate the difficulty level of each item which is represented by the β-parameter. The third step uses the MML to calculate the θ-parameter. In the final step the θ-parameter of the scores is estimated for each version. To do this, the means and the derivations of the distributions of the β and the θ are used. This estimation results in a unique latent value which is measured on a common scale for each observation of the scores in all versions. Metsämuuronen points out that the success of equating depends on three different factors which are explained.

The proficiency level of the students should be reflected by the linked items. The items should represent a sufficient range of ability and they should be neither too easy nor too difficult. In the intervention, the linked items for the next test are selected based on previous tests. Metsämuuronen points out that this enables the system to discriminate items that are considered not too difficult or too easy. The items should cover the different content areas. This selection generates a short test embedded within the main test. It is necessary that in this short test the linked items are selected in a way which represents different content areas as widely as possible. In the equation the stable parameters depend on the sample. All students were tested at the beginning of the intervention to obtain a population which is as large as possible. In this way stable item parameters are acquired:

> However, from the viewpoint of the population, the parameters for items measured only in the EG are unstable. Also, due to the small population in the intervention, the values for item "difficulty parameter" depended considerably on those students who participated in the test. Thus it was important to get all the possible test papers from the test-takers – even day after the test. Although the item parameters are somewhat vague, the results are much more accurate than if only classical metrics (the proportion of correct answers) were used in comparison. (Metsämuuronen 2013: 17)

It will be a task for future research to develop an approach to IRT which also includes the response

time in the analysis of learning statistics. The reason why it has not been used here is that the so-called coefficient of variation which is usually used to display learning progress based on response time is quite controversial. This is a further argument in favour of using the IRT approach of Metsämuuronen (2013) to formally model a statistics approach for measuring learning progress in PeLLITS and to add surveillance to the software.

4 Conclusion

Surveillance combined with tailoring is at the core of the architecture of the new persuasive tutoring system PeLLITS which we have outlined here. The system generates a feedback-loop which can either be given by a teacher or a CALL system and the response motivates learners to change their behavior as an effect of the persuasive technology. Adding a formal approach based on IRT will even make it possible to develop a framework which is so informative that it can predict learning progress, enhancing the motivation for behavior change even more.

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A set of criteria to assess motivation and persuasion of e-learning applications

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Motivational factors have long been a topic of study in e-learning applications and there is a strong overlap between these factors and the persuasive factors. This study intends to investigate this overlap. Which criteria are common to both, and which criteria are specific to each? The objective is ultimately to design an interactive persuasion criteria grid that is specific to e-learning along the lines of an existing grid, while taking into account the body of research on motivational factors in e-learning.
To investigate these questions, we compare the persuasion grid of Nemery, Brangier & Kopp (2011) with a number of the motivational criteria of Vincente and Pain (2002), and apply both approaches to evaluate the quality of an e-learning application to induce motivation to learn.

Keywords: Persuasive criteria, E-learning, Motivational criteria, Heursitic inspection.

Introduction

Few would question the power of some games to immerse their users in a state of regular and intense usage for long periods of time. The same observation can be said of some social sites. In that respect, these applications can be considered as reaching a high score on the persuasive scale. Incidentally, they are the same persuasive ingredients that designers of e-learning applications would like to assimilate to bring learners to use these applications more intensively and effectively.

However, motivational factors have long been a topic of study in e-learning applications (see Malone, 1981, for eg.) and there is a strong overlap between these factors and the persuasive factors. This study intends to investigate this overlap. Which criteria are common to both, and which criteria are specific to each? The objective is ultimately to design an interactive persuasion criteria grid that is specific to e-learning along the lines of an existing grid by Nemery et al. (2011).

To investigate these questions, we compare the persuasion grid of Nemery et al. with a number of the motivational criteria from deVincente (2002), and apply both approaches to evaluate the quality of an e-learning application to induce motivation to learn.

The persuasion grid was shown to help experts and, in particular, novices to identify weaknesses and potential improvements to improve the persuasive features of applications. It is composed of eight criteria and 23 sub-criteria. These eight criteria are credibility, privacy, personnalization, attractivity, sollicitation, priming, engagement, ascendency.

In the field of elearning, motivational scales were developed to assess the quality of an elearning application to engage the learner. The motivational criteria set of deVincente, (2002) is one such scale that is geared towards the assessment of motivation. It contains nine criteria: control, challenge, independence fantasy, confidence sensory interest, cognitive interest, effort, and satisfaction.

Both the persuasion grid and motivational criteria will be described and compared on a theoretical basis. Multiple dimensions will be investigated: intrinsic motivation vs. persuasive technology, sense of freedom vs. freely accepted compliance, and learning efficacy vs. learning enjoyment. This comparison will set the stage to an experiment on the analysis of an e-learning application on math.

The experiment consists in analyzing a drill and practice application in college mathematics. In the tradition of ergonomic inspection, the application will be analyzed by two experts with the persuasion criteria grid and with the aim to identify strong and weak elements and to suggest improvements. The same process will be conducted with motivational criteria taken (deVincente, 2002).

The elements identified by each approach will be compared over their similarity and differences, on a qualitative as well as a quantitative perspective.

Heuristic inspection

The Nemery et al. (2011) grid relies on the general technique of inspection. To inspect the usability of a product, whether a user interface or any artefact designed to be used by some user, is to make a judgement about its ability to be effective, efficient, error-tolerant, easy to learn and satisfying. This judgement is made by experts in ergonomics or HCI. Inspections are often the method of choice to quickly target usability issues and find the proper corrections to bring to the design of an application.

The persuasive criteria grid

In the field of education, user interfaces are becoming more and more engaging in order to encourage learners towards reaching learning objectives. Ergonomic inspection has long been considered to be a part of the evaluation of design processes, persuasive technology has not yet been taken into account. Faced with the lack of validated tool in this area, a set of criteria was elaborated. Following the review of 164 papers in the field of captology, eight criteria were considered to encompass the persuasiveness factors: credibility, privacy, personalization, attractiveness, solicitation, initiation, commitment and ascendency. These criteria are grouped under static and dynamic categories (see Table 1):

Static criteria are prerequisite elements to establish a fertile context within which a dynamic process of persuasion can be launched. These prerequisites promote the acceptance of a persuading process.

Dynamic criteria are involved in a process designed to engage the user in a series of planned and ordered persuasive steps in which the temporal factor is critical. At each step of the behavioral changes, elements of the interface bring the user to commit to greater levels of engagement.

Table 1. General architecture of the eight persuasive interactions criteria

Criteria	Definitions
Credibility	is the ability of the interface to inspire confidence and to make the user confident in the veracity of its information. Credibility is based on reputation and notoriety.
Privacy	refers to the protection of personal data and the preservation of personal integrity and security of the interaction. It also refers to protection against loss, destruction or inadvertent disclosure of this data. of rights and ensuring the confidentiality of information.
Personalization	refers to the concept of customization of the interface to the needs of the user. The customization can be a greeting, a promotion, or any means to achieve a more personal interaction with the user. It may also rely on group membership.
Attractiveness	is the use of aesthetics (graphic, art, design) to capture the attention of the user, to support the interaction and create a positive emotion. The animation, colors, menus, drawings, video films are designed to catch and maintain the interest of the user.
Solicitation	is the first of the four dynamic criteria. It refers to the initial stage which aims to swiftly attract and challenge the user to initiate the relationship. The interface attempts by words, graphics or any form of dialogue, to suggest a behavior and induce action through minimal influence.
Initiation	refers to elements of the media that allow the first user-initiated actions. The user's attention is captured and, on his own initiative, encouraged to realize the first engaging action. The user is caught in a gradual engagement process.
Commitment	means that system further involves the user in a process. Several queries and incentives regularly and gradually engage the user. The electronic media will induce more intensive and regular behavior.
Ascendency	is an expression of the completion of the engaging scenario. The user has unequivoquely accepted the logic and goals of the electronic media. The interaction is characterized by induced pleasure and possibly by the relief of internal discomfort. Ascendency is closely related to the concept of immersion in the video game field and it implies a high level of repetition and regularity of interaction, and sometimes emotional involvement in the story that result in dependence and game character identification. Users develop emotional attachment and cannot envision themselves without these product, or would feel a substantive negative effect in case of loss

The motivational criteria grid

As mentioned in the introduction, motivational factors in e-learning systems have been the topic of decades of research and we can expect an overlap with the persuasive criteria. We chose the criteria of deVincente (2002) as good representatives of the results of this research. Table 2 summarizes the motivational criteria. They are largely inspired from previous work on what makes an e-learning application engaging (see Tràn, 2008). We return to their theoretical groundings and to the distinctions and similarities that we can envision between them and the persuasive criteria in the discussion.

Table 2. General architecture of the motivational criteria

Criteria	Definitions
Control	Degree of control that the student likes having over the learning situation (i.e. does he like to select which exercises to do, in which order, etc. rather than let the instructor take these decisions?).
Challenge	Degree that the student enjoys having challenging situations during the instruction (i.e. does he like to try difficult exercises that represent a challenge for him?).
Independence	Degree that the student prefers to work independently, without asking others for help (i.e. does he prefer to work on his own, even if he finds some difficulties, and try to solve them by himself rather than asking for collaboration or help from others?).
Fantasy	Degree that the student appreciates environments that evoke mental images of physical or social situations not actually present (i.e. does he like the learning materials being embedded in an imaginary context?).
Confidence	Refers to the student's belief in being able to perform the task at hand correctly.
Sensory interest	Amount of curiosity aroused through the interface pre- sentation (i.e. appeal of graphics, sounds, etc.).
Cognitive interest	Refers to curiosity aroused through the cognitive or epistemic char- est acteristics of the task (i.e. regardless of the presentation issues, does the student find the task at hand cognitively
Effort	Degree that the student is exerting himself in order to perform the learning
Satisfaction	Overall feeling of goal accomplishment (i.e. does the student think that the instruction is satisfying and that it is getting him closer to his goals?).

A case study for the two criteria grids

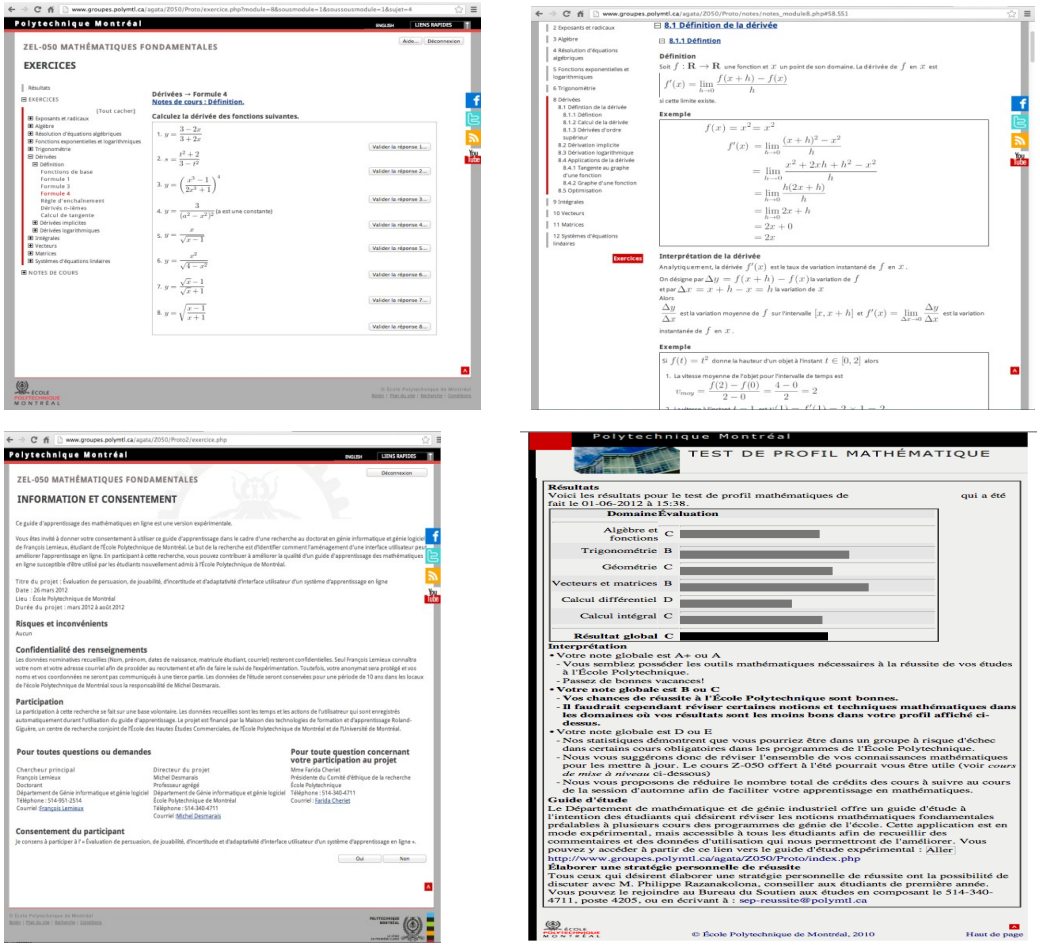
In an effort to better assess the overlap and the uniqueness of the persuasion and motivational criteria grids, we analyse an e-learning application with each of grid. The application is designed for the purpose of drill and practice on the topic of college mathematics. We will refer to it as the Exerciser. It aims to help newly enrolled engineers to assess their level of mastery of college math with respect to the level expected in their first year. If their mastery is lacking on any of topic, or if they want to enhance their skills, the Exerciser contains over 1000 problems and the equivalent of approximately 150 pages of notes that cover the theory. The notes were contextually accessed within the exercise section, and vice-versa.

Figure 1 contains some of the screen dumps of the Excerciser that were used for assessing its persuasive and motivational factors. The assessment is conducted with the aim to address the following questions:

How heuristic inspection could be done on motivational and persuasive elements situated in HCI?

What are the explanatory contributions of each grid in measuring the quality of Excerciser interfaces?

Figure 1. Screen captures of the exerciser.



Is there any ergonomic recommendations which can be learned to improve the interfaces?

The Exerciser was analyzed by the two authors who are HCI and e-learning experts. Their analysis was done separately and consensually combined in a second step.

Highlighted deficiencies with persuasive criteria

In terms of credibility, the Exerciser's interface inspires trust in the accuracy of its content. Explicit signs of its source and ownership (names and addresses, logo) and the school and professors recognized competence induces a sense of confidence in the learner. The system meets its promise: it contains exercises and solutions in college math.

On privacy, personal data and privacy are respected. A commitment is made early on by the site owners to ensure confidentiality and the user is reassured of the absence of risks that establishes a relation of trust.

In terms of personalization, only the user name (name, login, code) is explicit. We find no other signs of personalization (greetings, photo, etc.). The interface lacks features to promote personal closeness to the individual. It does not gradually collect the characteristics of the user allowing more personalized messages. Individualized information on the scores and results of the learners are known to the system (figure 2), but they are not used to in messages of support and motivation for the task. Individualization is therefore low. Yet, highlighting individualized features could raise user attention and interest in his/her training task,

ultimately fostering engagement. Furthermore, we note that there is no reference to group membership, nor to peer practices and performances and to tutor monitoring or other incentives that could induce some social pressure to engage in the task.

The attractiveness of the interface is weak. The aesthetics and appearance are relatively neglected, suggesting a somewhat cold and austere course, rather than the enthusiasm of an original exciting activity. Lack of attractiveness can deter the will to engage in the interaction. We note also that the design does not seek to be as close as possible to the values and needs of students. Finally, we note that the call to action is non-existent: the user is left to himself without a clear plan to follow or task sequencing incentives.

The Exerciser scores low over the dynamic factors. With regards to solicitation and commitment we note that besides the incentive mail to invite users to use the Exerciser (figure 1), the Exerciser does not sollicit, hunt for, or encourage learners. Suggestions and teasing that could awaken the curiosity are absent. The same is true for the sub-criterion of the initiation of the users who use the system once; they are not guided to undertake a first engaging action. Similarly, the incentives are reduced to the simple presentation of results to exercises (right or wrong), and it is the student himself declares success or failure (see figure 1).

With regards to commitment, we note the absence of a student engagement process in the design. The inspection of the interaction sequences does not reveal features to involve the individual in an gradual process that would lead to greater engagement towards learning goals. There are no systematic means to stimulate the user. The interface has no explicit feature to attempt to hold the student's attention.

As commitment is not supported by the interface, we cannot find elements that would lead to any form of control or addiction of the user.

Highlighted deficiencies with motivational criteria

The Exerciser gives full control to the learner, offering very little guidance apart from the navigation panel that indicates the topics and exercises covered.

The exercises represent a challenge in themselves, but the user can always choose to be given the answer instead of being required to find it by himself. This feature reinforces the control given to the user in his learning process, but at the cost of reduced challenge. However, the student can freely choose the exercises at the appropriate level of difficulty.

Learning is designed to be entirely independent, as the learner is not provided support or monitoring, neither from a human tutor, nor from colleagues.

Fantasy is absent altogether.

Confidence obviously varies considerably depending on student ability and personality, and the criteria should be considered from the perspective of whether the interface supports confidence for students of different profiles. The freedom to choose topics and obtain answers to exercises reduces the chances of feeling overwhelmed by exercises that are too challenging.

Sensory interest of the interface is very low and the comments on *attractiveness* of the persuasive interest apply here as well.

Cognitive interest also varies on a personal basis. From the perspective of HCI and e-learning application design, we find few means, if any, that can be leveraged to raise interest and that do not overlap with the other criteria.

Effort refers to a measure of use and cannot be derived from the interface itself, therefore it does not apply to a heuristic evaluation. However, from Lemieux and Desmarais (2013), we

have evidence that cognitive interest is generally low, with about half of 117 users spending less than an hour of total use. Yet, about 10 users spent over 10 hours and up to 140 hours, confirming that individual differences on the cognitive interest is highly variable.

Satisfaction is yet another factor that is assessed empirically instead of by inspection. We have no data to assess it for the Exerciser.

Discussion

We first note that some motivational factors of de Vincente et al. (2002) are not defined for an inspection process, namely *effort* and *satisfaction*. These can only be realistically assessed through experimentation.

However, given that we had data on the time spent by each student and the number of exercises completed, it must be emphasized that the array of levels of usage varies extensively, from a few minutes to over 100 hours. A reasonable interpretation is that some other factors are highly variable across individuals and is a determining factor that can overshadow all others. The most likely factors in are analysis are the *cognitive interest* or the *challenge*, and possibly a factor that is absent from deVincente et al. motivational criteria: the **perceived value**, which represents the importance that the learning goal represents to the user.

Another notable observation from the data is that about half of the users spent less than an hour in total, sometimes only a few minutes. Would this suggest that they do not have the same level of cognitive interest in mathematics or that they are not challenged by mathematics? Probably not since they have chosen to enroll in an engineering program that is itself challenging and involves mathematics. Can this be attributed to the perceived value of the Exerciser? Namely that they do not see the need to spend time in improving their math skills or the efficiency of doing so with the Exerciser. This is more likely, but it is not the sole interpretation.

Another reasonable interpretation lies in the persuasive factors. The low score on the attractiveness criterion and the quasi absence of means to support solicitation and commitment that would foster a progressive engagement is a sound explanation for the large proportion of users who spend a few minutes exploring the Exerciser without committing to its long term use. We could also refer to the *fantasy* and *sensory interest* as other means that could have been better deployed to address the low engagement.

Conclusion

This study aims to uncover the overlap between persuasive and motivational criteria, and the criteria that are unique to each, as well as their respective importance. The intent is that a better set of criteria can be obtained and used in an *inspection* process and help the design of an e-learning application.

We find that motivational criteria of fantasy and sensory interest can be considered similar to the attractiveness criterion of the persuasive grid. The persuasive grid has specific criteria such as credibility, privacy, and personalization that are specific. However, all of these criteria are not considered critical to explain the large variance in long term engagement that was observed for the usage of the Exerciser in practice.

Instead, motivational criteria such as cognitive interest, challenge and a criterion absent from deVincente et al. (2002), perceived value, are better candidate to explain the high engagement observed for some users. Conversely, the dynamic criteria of the persuasive grid are seen as

good candidates to explain why many users did go beyond cursory exploration of the Exerciser.

Finally, we observe that the data on long term usage of the application, which are indicators of the *effort* and possibly *satisfaction* criteria of the motivational factors, were critical in our analysis and cannot be obtained solely from expert inspection of an interface.

This study offers some guidance on what would represent a combined set of criteria to assess an elearning user interface, comprising both persuasive and motivational factors. Unfortunately, not all relevant motivational criteria can readily be assessed through the user interface inspection methodology and some require usage data, or questionnaire data.

Future work should focus on establishing the relative importance of the combined criteria. Experiments such as A/B schemes, where users are randomly chosen to be presented with one or the other user interface, could lead to interesting results in that respect.

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Specific Technologies for Persuasive Learning

The implementation of persuasive learning requires the development of novel technologies which support the concepts of persuasive design. Bech has investigated the use of **Augmented Reality** as a paradigm which shows the information right at the relevant location in the real world. Grund-Sørensen has developed the ***Conceptual Pond*** for obtaining trends and user interaction. Sandborg-Petersen has developed the EMDROS database system which is suitable for developing learning objects which work with large corpus-based annotated texts.

Augmented Reality in Persuasive Learning using The Kaj Munk Case

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Through theoretical analysis, this paper aims at taking a close look at how immersion is achieved when augmented reality is applied to a museum context. Augmented reality is by many regarded as a technology with high value to the teaching and learning community. This is due to the possibility of learners interacting with otherwise unavailable content and information. It is a central criterion of success, for any medium, that the user experiences a sense of immersion. When augmented reality as a medium is capable of changing user's perception of reality, or in other words the world in which the user perceives himself to exist within, the immersive part of the experience becomes central, as it is the gateway to a mediated view of reality and thereby persuasion through augmentation. Through chosen examples of immersive augmented reality usage within museum and learning contexts, the theoretical implications of achieving immersion, while facilitating cultural heritage by persuasive means, is discussed in relation to the possible use of augmented reality at the Kaj Munk Museum at Vedersø Denmark.

Keywords: augmented reality, immersion, persuasive design, persuasive immersion

Augmented reality and persuasive learning

Augmented reality as a technology has been defined in several different ways. The most commonly used definition is also the earliest one by Azuma who states that augmented reality systems must have the following three characteristics (Azuma, 1997):

- Combines real and virtual
- Interactive in real time
- Registered in 3-D

As such the system is not defined by the technology used to combine the virtual content with the real world environment, even though the display technology obviously has an effect on how the augmented content is experienced. The ability to interact with the virtual content must be in real time and this is central to the usage of augmented reality as a learning tool. Real time simulation provides the ability to have direct interaction and exploration of otherwise unavailable information and content through simulation. Research have pointed out that this makes the technology ideal for discovery based learning (Angelopoulou et al., 2012), which places the usage within a constructivist tradition of learning (Biggs et al., 2011). In regards to how this relates to persuasive design, learning would for the purpose of this article be seen as behavioral change. This is especially true when learning is seen within a museum context, where the primary aim is to expand on the learners' cultural understanding of a certain subject or matter. In this specific case, which will be elaborated on later, the focus is on the complex history and cultural significance of the Danish pastor and playwright Kaj Munk (1898-1944).

If augmented reality is seen as a persuasive technology within this context, one could look at how augmented reality as a medium persuades the learner to achieve the wished for outcome. The ubiquitous nature of many augmented reality systems also makes the persuasive principle

of Kairos highly applicable (Fogg, 2003) (Mintz and Aagaard, 2012). The growing popularity of smartphones, tablets and other powerful mobile devices, makes augmented reality systems available in situ, when needed and therefore opens up for the possibility of combining ubiquitous learning with augmented reality as a learning tool. The concept of Kairos can be seen as more than simply timing an action to interfere at the opportune moment, in order to achieve a certain outcome. A wider definition opens up for the possibility of Kairos (Gram-Hansen et al., 2012) being a more central term in defining whether content is suitable in the context where it is being presented. Not only how the content is presented is then in play, but also what content is presented and when. In a museum context, this is highly important as cultural heritage often is presented from a predefined perspective. How augmented reality is experienced in terms of immersion within the system is then also related to Kairos and the persuasive role of the augmented reality as a medium.

Virtuality and reality of an augmented possible world

Augmented reality has been described as being the middle ground between the completely virtual, as in virtual reality and the completely real, as in the real world environment surrounding the technology (Milgram and Kishino, 1994). Even the term augmented reality, hints that the focus is to augment the perception of reality and thereby add to it. Augmented reality is mainly made up of real world entities with virtual entities added to it, making the virtual secondary to the primarily real world. Still, the virtually augmented content and the way the virtual is combined with the real, is what makes the augmented reality experience. In describing how immersion is achieved within augmented reality and how immersion effects a successful persuasion, I will be looking into how these are affected by both the reality and virtuality of augmented reality. It has been pointed out that a conceptualization of these two concepts of augmented reality could be beneficial in relation to artistic potential and application of augmented reality (Ma and Choi, 2006). This also relates to the idea of Kairos, which is based on localized parameters that correlates to how the system is interactive. Then again, interactivity further affects the way in which and to what degree immersion is achieved.

For the purpose of analyzing how immersion has been achieved, I have chosen some examples that share a context similar with that of the Kaj Munk Case. I will be using a model, which takes the technological context into consideration, as well as how the virtuality and reality of augmented reality affects immersion. The technological context sets the immersive boundaries in regards to interaction and how the virtual content is being added to the real world. The analysis will be based on the assumption of seeing the world as text, much like how augmented reality can be seen as a mediator between the real world and a textual world. Further on, it is important to note that augmented reality can be regarded as more of a media aggregator, with the ability to augment the user's perception of reality through all types of media. Even so, this is highly dependable on the display technology. In theory the augmentation of sight, which rarely stands alone, is only one possible augmentation.

The virtual content itself is regarded as text and at some level it is nothing but text. The basis of all virtual content is computerized language, maybe the format be in letters or numbers. The virtually added content will therefore be seen as text, even though it could be made up of a wide variety of media. The content is delivered through the augmentation of the senses, currently and primarily the sense of sight and hearing, but in theory senses as touch, taste and smell could be mediated as well, thereby expanding further on the possible media used. For the purpose on this theoretical analysis on immersion, the augmentation will be seen as text, in which text is defined in widest possible way, so that everything that makes up the

augmented possible textual world is seen as text. Therefore, as augmented reality combines the real with the virtual, the real world context will be considered as text as well.

The analysis seeks to evaluate on how the textual worlds are created in terms of the technology used in relation to both the possible persuasive usage and how this relates to immersion. As the prime characteristic of augmented reality is the mix of the real and the virtual, the analyses will look at each of these aspects separately and then as to how the real and virtual is combined. The persuasiveness and possibility of success in regards to the goal and function of the system relate to how the combination of the real and virtual content manages to immerse the user within the system. Different types of immersion apply in different types of context. In this case, what often motivates a user to learn in a museum context is how the system involves and excites the learner or user (Yuen et al., 2013). This translates to the different types of immersion known from among others the gaming industry, but Ryan (2001) also differentiates between different types of immersion, as will be shown doing the analysis. One significant type of immersion, which also is the most significant in terms of Kairos, is spatial and temporal immersion which covers the feeling of being immersed in space and time. Per definition this type of immersion could often be seen as the main focus of a museum, as it serves to give visitors or learners a feeling of how it must have been to have actually lived in the setting on display. Now this does depend on the type of museum. One type of could be being a museum of art. Here the focus is on the individual pieces of artwork. Another type could be museums which focus on a certain period of time of significance or a certain personality or place of significance. This last loosely defined type would be the one covering the case concerning the Kaj Munk Museum at Vedersø.

These real world entities or the parameters of the real world context, define the technical possibilities and the secondary entities, being the virtual augmentation. The real world surroundings or the real world situational context plays a central role in terms of immersing the user into the augmented reality world perception. When augmented reality is applied as a learning tool within a museum context, they are almost always only locally usable at the museum, meaning that they need the physical surroundings of the museum to function. In combination, the augmentation creates a possible textual world and the type and degree of immersion determine the possible persuasive outcome of the augmentation.

Immersion through augmentation

A commonly referenced example used when defining immersion and the immersive experience, is that of how one can be absorbed into good literature. One can forget the surrounding world and all focus centers around the literary possible world projected from the text. It is important to note, that in theories of immersion, some have adopted Leibniz's concept of possible worlds, with the important addition, that in the works of Ryan and others, possible worlds serve as instruments of understanding rather than the Leibnizian idea of possible worlds as something with a rather specific ontological status.

Different media and genres, with varying low or high tech formats possess different types and degrees of needed immersion. Immersion is as such highly dependable both the mediated context and the genre. Concerning augmented reality, which as previously stated, is an aggregator of all types of media, the situational context defines the need for immersion and to what degree. Of course the technology itself sets out limitations. As exemplified by the quality of the display used, which relates to aesthetics and ultimately how real the augmented content is experienced. Then again, the content does not always need to appear real in order to be immersive or persuasive. This comes down to the situational context, as both fictional and factional genres can immerse the reader. There is an underlying theoretical question of whether immersion applies to augmented reality, in the same way as it does in regards to other

media. When one reads a book, plays a videogame or enters a virtual reality universe, one is immersed into a possible world projected by the media. The basis of augmented reality is to merge a possible world directly with the real physical world. As the user is not immersed into a purely possible textual world, but rather a mix of the actual world augmented by the possible textual world, immersion does not only define the transcendence between worlds, but also the acceptance of a combined mixed reality view of the world. The traditional definition of immersion as the suspension of disbelieves and acceptance of a presence in a possible textual world is therefore challenged. The experience of presence within an augmented possible textual world is untouched within augmented reality systems, as it is the added virtual content, which still is the lesser of the two defining entities, that plays the defining role. Embodiment of the user is still relevant, but there is no displacement of the perception of presence. The possible textual world created by the augmented reality system still needs to be accepted and the augmented content, again depending of its character, still needs to be accepted, perhaps through suspension of believe but not necessarily. As such immersion, in terms of augmented reality, has more to do with the acceptance of an augmented view of reality, than the displacement of presence.

Persuasion

Finding the right persuasive strategy requires clear persuasive goals. In terms of cultural heritage and learning within a museum context, I have found that even though there often is a more or less specific general goal or purpose of the installation or museum. These goals tend to be rather fuzzy. Often the sole object appears to be spreading information of a certain subject, because of its historical importance. Therefore a persuasive augmented reality design, would need clear persuasive goals beforehand and then approach these from a persuasive design approach afterwards. When determining how immersion relates to persuasive power or persuasive strategies, one could look at how a persuasive technology, as a persuasive media, facilitates degrees and types of immersion. If an augmented reality system provides metadata for installments at a museum expedition and relates these to other related pieces at the museum. Then these could be seen as a way to tunnel the user through a predetermined route. Here the immersive experience stands in the background, as the tunneling of the user is a relatively simple persuasive tool (Fogg, 2003), which does not take on a significant role in terms of attention. Other types of persuasive media roles could be seen as facilitating more significant degrees and types of immersion. This establishes a relation between the role of the persuasive media and degrees and possible types of immersion.

Augmented Immersion and Persuasive Immersion

In terms of immersion, the relationship between the physical real (reality) and the augmentation (the part of reality that is assigned as such) can be described in the following manner. Reality itself, as presented by the curators of an exhibition, can obviously be the focal point of experience. An augmentation understood as a caption or meta-text can also be the focal point of experience. In the case of augmented reality, that is, the combination of the two, the presentation can be such that reality is favored and the augmentation remains in the background of attention. Conversely, the augmentation can also be favored over reality such that it becomes the primary object of attention. This constitutes an ascending order of augmented inversion (as illustrated in Figure 1).

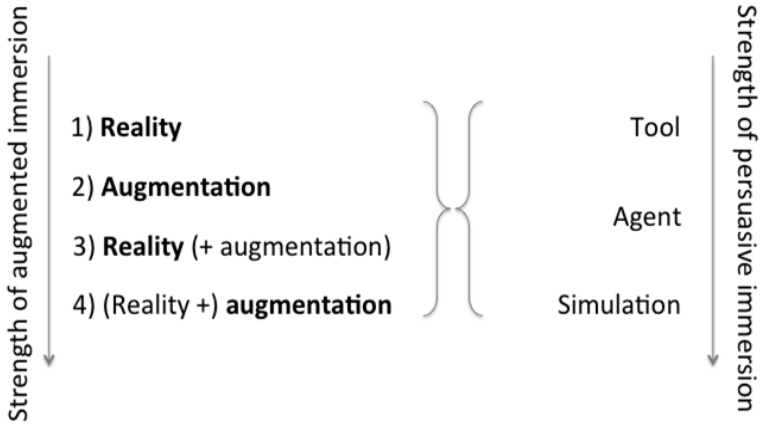

Figure 1: The relation between the strength of augmented immersion and strength of persuasive immersion.

In Fogg's thinking of persuasive principles (Fogg, 2003), three main categories are established. Interactive systems can function as tools that make desired actions easier to do. Interactive systems can also function as social agents that create relationships by praising and rewarding the user. Finally, interactive systems can serve as simulations, offering the user experiences and room for active experimentation. This division is known as the functional triad, and is understood as aspects of persuasion that complement each other. They differ, however, in how they facilitate types of immersion. Under the tool perspective, the focus of attention remains locked on the subject being presented because tools mainly are used to accommodate the user's interaction without drawing much attention to itself. In the agent perspective, immersion may become more pronounced because of the more direct and personified interventions. And finally, the simulation aspect allows for stronger aspects of immersion because attention is drawn directly to the dynamic and interactive presentation of material. When in this fashion, a user is allowed to 'play around' and explore consequences of actions, the persuasion takes on a stronger form of immersive nature.

Examples of augmented possible textual worlds

In the 2011 study "Using augmented reality and knowledge-building scaffolds to improve learning in a science museum" an augmented reality system at a science museum in used to show students how the human body can conduct electricity (Yoon et al., 2012). The research design focusses on how digital augmentation can function as a scaffolding technique together with collaboration, written and verbal instruction etc. In regards to immersion, the study did not focus on this, even though it clearly was an underlying aspect of getting the students to achieve cognitive gains through the augmented reality experience. The real world situational context here was a science museum, in which students in groups were introduced and presented with tasks that included using the augmented reality system, in different forms, to answers questions. It is important to note that the augmented reality system used in this specific case was stationary, thereby eliminating much of the informal discovery based learning that was mentioned earlier. But what this study clearly shows is that the level of interaction plays a large part in creating an immersive system. When the students managed to conclude the circuit with their hands, the digital augmentation would be activated to illustrate the flow of electricity. The simplistic nature of this example shows that augmented reality can be used in a learning environment to build knowledge. Here augmented reality not only serves as a theatrical prop to make the museum more interesting, but also as a knowledge building

scaffold, that develops cognitive gains. The term cognitive immersion (Bjork and Holopainen, 2005) can be applied here. Through problem solving, although not at a complex or advanced level, the students apply reasoning and thereby engage themselves cognitively with the system. This leads to an immersive experience and acceptance of the augmented perception of reality. The physical involvement in completing circuit, the interactivity with the system which is one of the key characteristics of augmented reality technology, further immerses the students into an augmented view of reality. According to Ryan, the mediating of the body, thereby using the body as an interface with the system, leads to a more natural interaction, thereby strengthening the immersive experience (Ryan, 2001).

It is important to note, that the immersion into a mixed reality world where projected animations run over once arms to illustrate current, is only accepted as part of a possible textual world, if it is believable. In this context believable means realistic or artistically pleasing. According to Coleridge this is caused by the "willing suspension of disbelief". Here the user of the system chooses to believe that the fictional augmentation is real, in order to be immersed into the possible world projected by the system. The learners are accepting, what could be seen as a fictional augmented view of reality, but in accordance with literary theory, a possible world, in which the augmented content is possible. The transparency of the medium (Ryan, 1994), the projection of the virtual content into the real world, makes the content appear even more real. This is caused by the user not having to look at it, through a screen. The computer generating the virtual content is not visible or at least it appears as if it is not visible. Different systems offer different degrees of transparent computing, which is closely related to the idea of ubiquitous computing. As such the baseline of possible immersion is highly dependable on the technology used. Yuen, Yaoyuneyong and Johnson differentiate between three technologically dependable levels of immersion (Yuen et al., 2013). The way in which the seamlessness of the virtual content is blended into reality is here the main defining factor in which the display technologies are categorized as either low immersion, high immersion or total immersion. Video projectors, as the ones used in the augmentation mentioned above are categorized as "low immersion". This is due to the immobility and psychical visibility of the display technology being used. As an example, when using a projector as display technology, one can actually see the light that the projector makes, a byproduct of the augmentation, rendering it less immersive and this light is not a part of the possible world the augmentation creates. At the other end of the scale, technologies such as HMDs or display implants are categorized as "total immersion", as these in theory offer higher mobility and a high level of seamlessly integration between the real and virtual content. The type of immersion referenced to here is spatial immersion. Spatial immersion, in the terminology of Yuen, Yaoyuneyong and Johnson, means the experience of being surrounded by aesthetically and enjoyable augmented content. This clearly applies in the "be the path" augmentation as well. If the augmented content is not clearly understandable or believable, then there is a chance that the system fails to immerse the users with the possible world and thereby failing as a learning tool. The setup discussed here is rather simplistic and spatial immersion does not play a significant role, as the augmented content is rather limited, which means that the possible world is limited as well. The augmentation could here be seen as a social agent, in the way that cooperation between the students is needed in order to complete the circuit. The cognitive immersion is thereby established through the persuasive role of agent.

Spatial immersion plays a more significant role in the augmented reality system used at Sutton Hoo archaeological site near Woodbridge England. In the 2012 paper "Mobile Augmented Reality for Cultural Heritage" a augmented reality system is utilized to engage visitors at the site by augmenting content to provide information and gamify the experience.

Several studies have showed how augmented reality can be used in a learning context, to engage the learners (Yoon et al., 2012). In terms of immersion, this study is interesting for two reasons. The first being uses highly mobile devices as display technology for the augmented reality system, making the system more ubiquitous or agile and giving the user a higher degree of interaction – both of which means a greater degree of immersion in terms of technically ability . Secondly, the learning context shares some basic premises with the Kaj Munk Case. The system relates relevant information and interpretation, at times when these would appear relevant for user, based on positioning and user input. This directly relates to the idea of Kairos, in which persuasive tools as tailoring and suggestion can be seen as applied in order to provide the user with the right information at the opportune moment. Further on, there is a social element, in how it is possible to cooperate with museum visitors at a distant location. Again, the system takes on the persuasive role of a social agent, as it facilitates cooperation. This social interaction could be seen as facilitating emotional immersion, as the visitors at each museum becomes dependent on each other in order to complete the goals set up by the game established within the possible textual world.

The Kaj Munk Case

At concept level, there have been ideas of using tablets to augment the visiting experience at the Kaj Munk Museum. The aim is to establish a textual possible world, that serves to persuade the user as to fulfill the museums wishes for better spreading knowledge and maybe acknowledgement of the life and significance of Kaj Munk. One of these ideas involves bringing Kaj Munk back to life through the augmentation of an actor playing the role as the pastor and playwright. This would clearly bring the augmentation in the foreground of attention. In terms of the persuasive role of such a possible textual role that actually simulates the main character of the textual role at Vedersø, this could provide several interesting types of immersion of varying degrees. In terms of spatial and temporal immersion, it is clear that the combination of not only being in the real physical home of the possible textual worlds deceased main character – but also experience him in character, provides a high level of immersion and persuasive possibility. Emotional immersion is clearly involved as well, but this is of cause related to the visitor's relation to Denmark and national history. Combined with Kairos, the experience could be customized to fit the visitors need through user input. Emotional immersion could then potentially prove to make the experience especially persuasive – although there are some clear ethical implications related to this, which lies outside of the scope of this paper.

Another idea is that the collected digitalized works of Kaj Munk, from the Kaj Munk Research Center at Aalborg University, could be utilized through relevant hyperlinking between relevant locations and or objects at the museum in Vedersø. This could serve as cognitive immersion, by providing the material at the right moment, in order to trigger a relation between the real world environment at Vedersø and the augmented digitalized works of Kaj Munk.

Furthermore, as groups often visit the museum together,it would be foolish not to utilize this in terms of persuasive immersion. The augmentation could act as a social agent, in the sense that the augmented possible textual world could motivate debate and discussion within the group of visitors. Thought provoking examples of Kaj Munks writing could be augmented, at the right moment and in correlation with the group of visitors' physical placement at the museum. This could lead to a greater degree of cognitive immersion among other types of immersion. If the augmented reality system takes on several persuasive roles, being both the role of persuasive tools, that of the social agent and at last but not least – the role of

simulation. Through the role of a social agent, the system could try and provoke the visitors to discuss some of the more controversial statements given by Munk. This could lead to a greater degree of cognitive and emotional immersion. If the system takes on role of simulation, it could facilitate a possible textual universe, in which it simulates what could have happened, had Kaj Munk not been murdered by the Gestapo in 1944. This type of persuasive role, especially if the system allows the visitors to have choices and then play out alternative World War II scenarios, could possibly mean an even greater degree of cognitive and emotional immersion. This could be beneficial for visitors and further strengthen the chance of visitors leaving with a greater knowledge of Kaj Munk and his historical importance.

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Intuitive Surveying & Quantification of Qualitative Input through the Conceptual Pond

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"The Conceptual Pond" is an application for assessment designed to gather qualitative input through an intuitive, visual interface. The process of using the application serves as a conceptual aid for personal reflection as well as providing an evaluation system with the ability to transform this input into quantitative data. The application thus serves three distinct yet parallel purposes:
1. One of assessing and evaluating through an interface designed with a focus on intuitive handling, visual language and facilitating input of a qualitative nature.
2. One of processing such assessment of qualitative input so it is transformed into quantitative, comparable representations.
3. One of supporting learning, reflection and immersion through agency in a digital environment.

The Conceptual Pond is developed as a response to challenges of evaluation related to the EuroPlot-project (an EU-supported research project under EACEA), in particular the Kaj Munk Case, focusing on the dissemination of biography, works, and impact history of Danish vicar, journalist, and playwright Kaj Munk. The application is designed implementing persuasive principles (Fogg, Oinas-Kukkonen et al.), learning taxonomies (Biggs & Tang, Bloom) together with a rhetorical understanding of kairos.
This paper includes the evaluation of several use cases as well as two modifications to the original application design supporting pre-literate children as well as implementing a temporal perspective to application functionality.

Keywords: Conceptual Pond, persuasive technology, assessment, intuitive

Introduction

In Western societies (and most other societies) it is the prevailing order that most learning is done within the framework of an organized school system. Teaching a curriculum through various methods shapes the knowledge and reflection of pupils and students. Progress in the field of reaching intended learning outcomes are usually monitored through exams, tests, and assessments. (Biggs & Tang, Bloom) Despite of changes in pedagogical method and learning designs the dichotomy and interaction between learning and assessment is stable. Even if grading is not an issue the mere evaluation of learning is necessary for the planning of future learning events by the educator.
In a number of contexts, however, formal evaluation in the shape of exams and tests are a less viable option. Much learning is done, insights gained and reflection facilitated in a number of less patterned learning environments (Falk, Hooper-Greenville). In the area of cultural mediation learning is only partly consistent with the formal education system. It is often based on casual interest, fragile preceding knowledge and fluctuating attention. So, in cultural mediation or pedagogical work with small children for example, another approach to learning and assessment may be appropriate.

Development of The Conceptual Pond has been made in order to facilitate the gathering op input of a complex nature such as impressions, reflection, opinions, and less categorized knowledge. These are gathered through a simple interface with an emphasis on overview, intuition and interface tangibility.
At the same time this diverse input is compiled in the application and is transformed into generic data suitable for data presentation and cross tabulation thereby transforming qualitative data into material suitable for quantitative analysis.
The intention has been to develop an assessment tool shaped to fit the interests and expressions of the users rather than fitting these interests into too firmly predefined frameworks. User adaptation is supported by the interactivity of the digital format.
This paper serves to present a pilot study of The Conceptual Pond and the theoretical framework behind it as well as suggesting areas for further research.
The Conceptual Pond is designed to solve tasks primarily in the field of learning, social sciences and human sciences. The theoretical background and functionality however makes it no less relevant in other sectors such as human computer interaction, psychology, or social sciences. The need for analyzing humanly expressed thoughts is central in a broad variety of academic, pedagogic, cultural or societal projects. Use cases referred to in this paper should demonstrate this applicability in several environments.

Background

The Conceptual Pond is originally developed to meet challenges of evaluation in the environment of the EuroPlot-project (an EU-supported research project under EACEA). Part of this project has a focus on the provision and dissemination of cultural content. The Kaj Munk Case has been explored by Aalborg University and the Kaj Munk Research Center. Kaj Munk (1896-1944) was a leading Danish theologian, playwright, journalist and writer. His works comment the political and philosophical issues of his era as well as discussing existential and religious subject of the modern paradigm. Kaj Munk also contributed substantially to Danish WWII history by being executed by German authorities in 1944 for his nonviolent resistance to the German occupation. Ideas from Kaj Munk were inspirational for the implementation of truth committees in the South African reconciliation process after apartheid, thus proving the heritage of Munk to be relevant in a history of impact.
Due to the complexity of the content of this cultural mediation several approaches have been made providing digital learning material content (Hansen, Hansen, Sørensen, Øhrstrøm 2013). Archival access is facilitated through The Munk Study Edition (Petersen & Øhrstrøm) offering fully searchable annotated texts of Munk's plays and sermons. The application is based on an EMDROS-database (Petersen 2004) The Munk Study Edition is supplemented with GLO's (Generative Learning Objects) (Hansen, Hansen, Sørensen, Øhrstrøm 2013). Working with these multimodal learning processes raised the attention to the need of acquiring valid feedback of not only knowledge but also interpretation and impression. For this reason The Conceptual Pond was designed in cooperation with Mathias Grund Sørensen (Sørensen & Sørensen).

Persuasive assessment

As mentioned in the introductory remarks assessment is a consistent part of most common theories of learning. In the neoclassic understanding of cognitive domain in Blooms Taxonomy (Bloom) assessment is a vital part. In the Structure of Observed Learning Outcomes Taxonomy of Biggs (Biggs & Tang) evaluation and assessment play an equally important role – emphasizing the importance of

observation in the term "Observed Learning Outcomes" of the SOLO taxonomy.
In the Anglo-Saxon learning paradigm to which the two learning theories belong assessment plays a more dominant role than in Scandinavian school tradition. However, since evaluation is an integrated part of contemporary educational practice. It is necessary also for the EUROPlot-project to develop and present suitable assessment tools for the evaluation of the individual student/users as well as groups. Nevertheless, as Odendahl points out: "Abstract principles have to be translated into real tests for real students … "How" decisions include question format: selected-response tasks, in which the student selects from among answers that are provided on the test, or constructed-response tasks, in which the student generates a product or performance." (Odendahl, 2011, p. 8). The process is in casu assessment related to the Kaj Munk Case of a two-step nature (Rossman & Rallis):

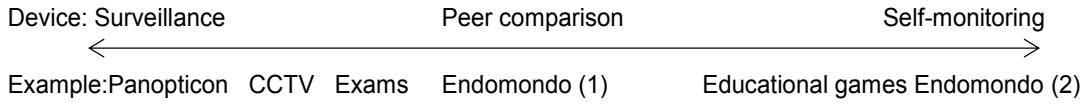
1. The gathering of valid qualitative input.
2. The adaptation of these data into an environment suitable for further analysis.

The first part of this two-step model implies the motivation and persuasion of the learner to take part in the process of assessment. In a regular school system at any level this may often be a minor challenge. Moving into the area of cultural mediation users usually feel less obligation to take part in surveys etc. This calls for another motivational approach than the Benthamian concept of the omnifocal Panopticon in which prisoners were subject to assessment in the shape of surveillance. The Panopticon is used also as a societal metaphor by Michel Foucault (Foucault, 1977; Jespersen et al. 2007). Perhaps a third aspect needs to be added to the Rossman & Rallis approach:

3: The implementation of qualitative input into a persuasive process for enhancing reflection.

Tools and principles for meeting this challenge may be found in discourse in the field of persuasive technology. The basic discourse in the persuasive technology field is rooted in the research of behavioral psychologist B.J. Fogg. In his book "Persuasive Technology – Using Computers to Change what we Say and Do" he combines observations in the human computer interaction field with a psychological understanding offering a number of methods or devices to persuade the user into adapting a certain attitude or behavior "without coercion or deception" (Fogg, 2003).
Many of the "classic" persuasive devices of the 2003 book require a certain kind of monitoring, assessment or feedback to function as intended. This also applies for Foggs' persuasive tools, namely tailoring, conditioning, reduction (to some extent), and in some cases also tunneling, and suggestion. These persuasive devices most often function with the assistance of interactive feedback that allows for proactive agency decided by the feedback of past choice, such as product recommendation systems utilizing past user purchases.

Figure 1. Assessment in Persuasive technology



Assessment and evaluation is often at the center of technologies related to self-monitoring and surveillance (Oinas-Kukkonen). In Figure 1. the role of assessment in Persuasive Technology is defined as an axis with three elements: Surveillance, peer comparison, and self-monitoring.
A not very benevolent interpretation could be to make a parallel between surveillance and assessment in the shape of exams and tests. This may be partly true. At the same time peer comparison is an important factor in educational assessment systems, and even the element of self-monitoring is vital part of the motivational process for the individual student. The pinpointing of exams to one single point at the axis is therefore reductionist. The examples may be pinpointed differently on the surveillance - self-monitoring axis depending on the actual use. Therefore

Endomondo, the sports tracker, is also pinpointed as (1) or (2) depending on what features are used in the app. If the tracker is applied only for personal individual use it supports and motivates through self-monitoring. Once results are shared on social media a more or less voluntary submission to surveillance is accepted.
In the Persuasive Technology field such dynamics are heavily discussed, especially in the areas of health-care and prevention. A classic example is Fogg's heart-rate monitor (Fogg). In an extended form it plays a role in studies of persuasive motivation (Munson, Lauterbach, Newman, and Resnick) where the role of assessment is linked with a social network site in order to benefit from the persuasive power of social comparison and peer support. Another example is the studies of weight loss websites by Lehto and Oinas-Kukkonen (Lohto & Oinas-Kukkonen)). They underscore the worth of assessment in the context of *social facilitation*, which is closely related to self-monitoring and social comparison.

Kairos

In several aspects the ancient rhetorical concepts are helpful in designing with persuasive intent (Hasle) Bringing the concept of kairos into play in a postmodern paradigm facilitates a three-dimensional view to the potential of The Conceptual Pond. Reaching kairos is the art of designing and applying technology at:

1. The opportune time
2. The opportune place (locationary or virtual)
3. The opportune manner (also medium)

This suggests an ecological approach focusing on adaptable systems design suitable for any learning environment.The Conceptual Pond facilitates the implementation of all three aspects of kairos.
From a perspective of reflection it is imperative that some acts of evaluation are carried out immediately after receiving the impression. In the use case of the teenagers evaluation of impressions from viewing the Kaj Munk play, they still had the experience in vivid memory when accessing the survey. Since TCP is part of technology enhanced learning and is available at all kind of online devices it may be used at any given time. Another aspect of kairos is the time elapsing carrying out a task. In relation to this it is promising that tests displayed response times between 95 and 140 sec. on average which appears considerably less time consuming than comparable questionnaires.
Since learning and reflection takes place in a number of environments it is imperative that the evaluation system may be available everywhere. This is the case since The Conceptual Pond is itself everyware in the sense that technology allows for it being used even in the open country by the Kaj Munk Vicarage Museum, at a kiosk at the library or at a school computer.
The third aspect of kairos refers to the function and characteristics of the system itself. Does it offer content in a contextually relevant way? In relation to The Conceptual Pond the question primarily is one of mediation. As shown in the use cases the choice of technology and mode proves to be convincing. Apart from the few motorical problems handling a non-touch device the system seems fully sustainable. Using The Conceptual Pond should facilitate reflection and assessment in a helpful way thus mediating in the opportune manner.

The Conceptual Pond

On the basis of these insights from the areas of learning and Persuasive Technology the conceptual Pond is designed as an intuitive, visual interface for assessment.
Depending on use TCP facilitates a type of qualitative assessment which may be relevant at any point of the axis of Figure 1. On the other hand it is obvious that the complexity of the possible input from

users makes it less helpful for the rather more simplistic answers that will usually be collected in a multiple choice test.
The Conceptual Pond is designed with a simple graphical interface. This is important, as the application should be intuitive and easy to navigate even for primary school children and the technologically challenged. Navigation is a simple drag-and-drop movement and the user is always able to alter her choice and change position of the marker. The user has the command of a number of markers, each of them marked with a word or a short sentence. The user can insert non-pre-designed words of her choice thus extending her expression (if this is not prohibited in the evaluation set-up). Unused markers stay in the right side of the screen, unless the user chooses to leave them otherwise. The markers are clearly marked as moveable boxes and have a clear inscription of the corresponding word. In special situations the markers could be substituted with pictures, colors or symbols as previously mentioned.
The left and center part of the assessment screen is dominated by a circle of relevance. This circle of relevance marks the area in which the words relevant to the user, describing her denotations and connotations related to the subject, are dragged and dropped at will. The center of the circle of relevance is a marked in a clear color fading slowly into a lighter color. The position relative to the center signals the strength and importance of the expression. Using gradients of the colors green enhances the intuitive impact of the interface. As noted in research (Ham & Midden) the colour green is intuitively recognized as something positive and thereby reduces the cognitive load of the user.

Figure 2. The Conceptual Pond (simplified)

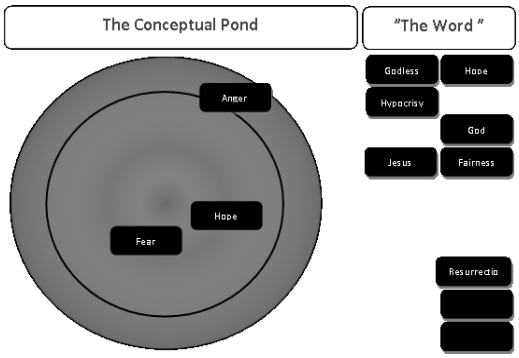


Figure 2. shows a simplified example of the use of The Conceptual Pond related to the Kaj Munk Case. Results of actual use case presented below.

Use cases

The Conceptual Pond has been implemented at a number of tests. One of these tests (Ex 1: Reception of Munk's play "The Word"The Word) is presented in detail.

Table 1. The Conceptual Pond full-scale testing

Ex	Period	Number	Participants	Place	Assessment
1	October 2012	23	Confirmation class 13-14 y.o.	Church House Nørager	Reception of Munk's play "The Word"
2	November 2013	25	Library users 8 – 76 y.o.	Mun. library Nørager	Satisfaction and interests at library
3	March 2013	40	Philosophy Students	Aalborg University	Reflections on Munk's play "Love"
4	April 2013	29	Various adults attending Easter on Facebook	Internet survey Denmark	Reception and reflection on Easter on Facebook-project
5	June 2013	83	Various adults attending Danish Church Days	Aalborg Conference Center	Opinions on important subjects in Church communication
6	2013 planned	25 approx	Preschool children	Kindergarten	Testing TCP featuring images instead of text

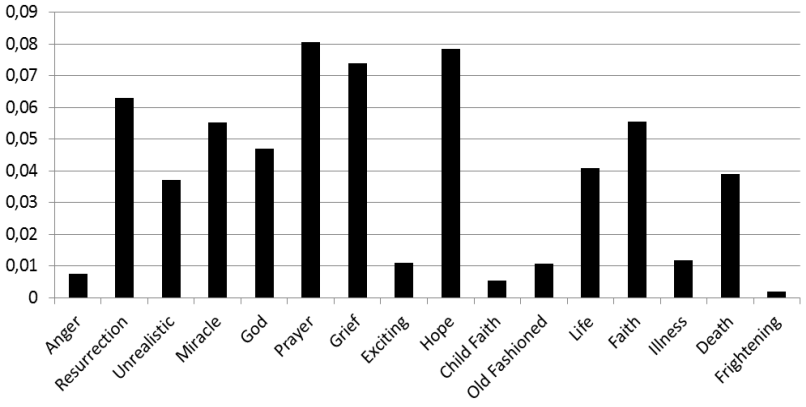
Kaj Munk: The Word

A group of 23 teenagers (13-14 years old) viewed a selected scene of the play "The Word" by Kaj Munk (1962) in a well-known 1955 movie adaptation of Carl Th. Dreyer. The movie was rewarded the Golden Lion Award at the 1955 Venice Film Festival. Despite an antiquated visual language featuring slow dialogue and black/white aesthetics the scene of the resurrection of a woman deceased in childbirth proves to be very moving and is an iconic moment in Danish dramatic tradition.

Question was, however, how would this group of teenagers react to the screening? What are their impressions and reflections? At the same time it was vital not to influence the participants in the survey. Immediately after the screening the teenagers were given a very brief introduction to The Conceptual Pond (2 minutes). Remaining in silence they accessed the system individually contributing with their observations and reflections. The interface was accessed on a laptop PC similar to devices used at school thus eliminating cognitive stress in operation. The laptop was placed in a kiosk setup with the screen turned away in order to secure privacy of the users and avoid possible peer pressure that could bias the results. Each of the 23 teenagers initiated their session filling out a few pieces of generic information (name, gender, age). Subsequently all contributors accessed the interface and reported their impressions to the system.

This process was monitored from some distance to respect privacy and at the same time record the time lapse. Average operating time was 105 seconds ranging from 25 seconds to 180 seconds. All participants except 2 performed between 75 and 135 seconds. Only one user displayed any hesitation in using the system. None required additional instruction. All 23 participants explicitly preferred The Conceptual Pond to a paper questionnaire. 9 users had specific comments. 2 suggested minor changes in design. 7 applauded the user freedom compared to other evaluation methods (such as questionnaires and qualitative interviews).

Figure 3: Graphic presentation of case results "The Word"



Results of the results of the teenagers were transformed from quantitative expressions to qualitative data. Production of graphic was done instantly in TCP-application.

Development: Implementing temporal sequence

In a number of contexts a temporal sequence assessment may prove useful. The linking of several proceeding psychological tests may be an example (Sørensen & Sørensen). Development in psychological evolution may be stored and analysed through the system. In a dynamic understanding of kairos this would entail the opportune moment turning into several opportune moments linking together in kairos.

Development: Adaption to the illiterate

Recognizing the needs of children and other illiterate people markers may be exchanged by images or pictograms. In a pedagogical analysis situation as an example markers describing everyday situations with words may be exchanged by pictograms. Placing the pictogram into the circle of relevance at a desired position may be a valid expression of trust or anxiety in a given situation.

Implementing a visual language may also benefit literate users of certain cognitive styles (Riding & Rainer).

Conclusion

Applying the Conceptual Pond to appox. 200 people in quite different contexts with quite good results and good feedback allows the conclusion that The Conceptual Pond is a helpful tool. It facilitates easy and intuitive gathering of – often complex – qualitative information. It facilitates easy quantification and instant access to this data as well as making I possible for further cross tabulation.

The greatest experience working with The Conceptual Pond has actually been the expressions of the users in relief that the design is intuitive and not another complex questionnaire-based survey. Recognizing the number of agents using questionnaires it is not surprising that a certain fatigue builds up which may also damage the acquisition of valid data.

Nevertheless a the development and refinement of the conceptual

Further research

Testing so far of The Conceptual Pond has pointed to it being persuasive, easy to use, and helpful in the acquisition of qualitative data. Nevertheless TCP needs to be tested further refining the interface design to support clear user expression and secure assessment does not facilitate any kind of bias.
Avery promising field is the area of tailoring TCP for certain assessment goals.
Another promising field is the implementation of a temporal flow in assessment, as well as creating a fully functional interface for illiterates, children and the handicapped.

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Architecture of applications built on Emdros: Case studies in systems for persuasive learning

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This paper describes the nature and scope of Emdros, a text database engine for annotated text. Three case-studies of persuasive learning systems using Emdros as an important architectural component are described, and their status as to participation in the three legs of B.J. Fogg's Functional Triad of Persuasive Design is assessed. Emdros is shown to be able to form the foundation for any persuasive learning system whose primary function involves text being stored in or retrieved from a database. Similarly, Emdros is shown to be able to provide important support for all three legs of the Functional Triad.

Keywords: Software Architecture, Persuasive Learning Systems, Text Database Engines

Introduction

The EuroPLOT project aims to make it easy for educators to create, share, and reuse "Persuasive Learning Objects". This goal has been attained so far in a number of systems, including the so-called "PLOTLearner" text-driven language learning tool, and the "Kaj Munk Study Edition", which is a software program for the display and study of the works of a Danish poet, pastor, and playwright, Kaj Munk. In this article, we explore the architecture of each of these systems, and also describe the architecture of a third system, namely the "Kaj Munk Virtual Research Laboratory". All three of these systems are persuasive in nature, and all three of them have a particular database management system as their architectural underpinning, namely the Emdros database engine.

The rest of the paper is laid out as follows. We first describe Emdros, its nature and its scope of use. We then describe the three systems under case-study, including their architectures, and we show how each of them embodies some aspects of the Functional Triad of B.J. Fogg [Fogg, 2002; ch. 3-5]. Finally, we offer some concluding remarks.

Emdros: Nature and scope

Emdros is a database management system for managing a particular kind of data, namely "annotated text". Annotated text can be described as "text plus information about that text." Text is fundamentally different in nature than, say, employee records or databases of movie information, due to some properties of text which are not usually present in data which fits easily into the relational database model. Three such properties of text include: First, the linear nature of text, in that text is meant to be read and understood in sequences of varying length. Second, the embedded nature of text, in that language can be seen by linguists, writers, publishers, and others to exhibit hierarchical structures, including the "word --> clause --> phrase --> sentence" linguistic hierarchy, and the "sentence --> paragraph --> section --> chapter --> book" compositional hierarchy familiar to readers and writers. Third, the phenomenon of "gapping", or "distant relations", whereby one part of a sentence – such as the preceding – is separated from another by a parenthetical clause or phrase (as just exemplified). All three phenomena – sequence, embedding, and gapping – are properties of

text which call for special handling in a database, and Emdros caters to each of these properties, as well as other properties of annotated text, in meaningful ways. It does so by implementing a database model and a query language which make it easy to think about, implement, query, and use the textual data.

Thus Emdros implements a particular database model of text, which makes it easy to think about text in database terms. The database model is called the "EMdF model", and is a descendant of the MdF model described by Crist-Jan Doedens in his PhD dissertation [Doedens, 1994, chs. 2-4]. Similarly, Emdros implements a query language called "MQL", which again makes it easy to query annotated text in meaningful ways. The query results of MQL fit naturally with the EMdF model, just as the query results of an SQL query fit naturally within the relational model [Codd, 1980]. The MQL language is a reformulation and implementation of the QL language also described by [Doedens, 1994, ch. 6].

Emdros also implements other layers, including a "Full Text Search engine", built on top of MQL. The "Full Text Search" engine provides proximity searches, exact phrase search, optional trunkation of search terms, and other features.

Another layer provided by Emdros is a "harvest layer", which makes it easy to "play back" parts of documents stored in an Emdros database. For example, an XML, HTML, PDF, or MS Word document, having been stored in an Emdros database, can be easily "rendered" back as either HTML, XML, JSON, RTF, LaTeX, or whatever notation one wishes to employ. The format to be output is described in a "style sheet", which tells the harvest layer what to do with textual objects in the database such as "paragraph", "sentence", "token", or whatever object types the database designer has chosen to implement in the database application under construction.

A relational database management system does not dictate what tables to put in a particular database. It merely provides a database model (the relational model) within whose parameters (tables, columns, column types, primary keys, foreign keys, etc.) the data must be modelled in a schema. The schema, in turn, provides the parameters within which the actual data can be used to populate the database. A relational database management system also usually provides a query language (most likely SQL) in which to define the schema, create the data, update the data, query the data for retrieval, and delete the data.

Similarly, Emdros does not dictate which kinds of textual annotations of textual elements to store in a database. Instead, it provides parameters within which those textual elements and textual annotations can be defined in a schema, and entered into the database as data. Similarly, Emdros also provides a query language (the MQL query language) for defining the schema, creating the data, updating the data, querying it in meaningful ways for retrieval, and deleting the data. Thus the user is free to choose, for example, whether to include a "sentence" object type, and whether to store the text as individual graphemes, morphemes, words, sentences, or even higher-level units as the basic unit of text. The construction of the schema, with its concomitant choices for the determination of the nature of the textual data, is up to the programmer and/or database designer who uses Emdros. For an overview of these aspects of Emdros, please see [Sandborg-Petersen, 2008], as well as the Emdros documentation available from the Emdros website, http://emdros.org/.

Emdros is not meant to be used in isolation. It implements some layers which has the potential greatly to reduce the code-base of any system having to store text in a database. Thus Emdros plays its part in a larger system, for example an application sitting on the user's desktop, on an iPad or iPhone, on an Android device, or even on a server. The two great advantages of Emdros are: First, its ease of use for the programmer of the system dealing with text, whose task is made much simpler and cleaner. And second, its speed. Both of these

aspects have been described in [Petersen, 2005, 2006a, 2006b] and [Sandborg-Petersen, 2008]. For a concise introduction to Emdros, see [Petersen, 2004].

Emdros is Open Source under the GNU Public License version 2, and is available for free download from the Emdros website.

Case studies

In the following, we describe the nature and architecture of each of the three systems under case-study. We first describe the PLOTLearner, then the Kaj Munk Study Edition, and finally the Kaj Munk Virtual Research Laboratory.

PLOTLearner

PLOTLearner is a tool developed within the EuroPLOT project which aims to make it easy to create, reuse, and consume Persuasive Learning Objects within the domain of language learning. It builds on a number of ideas, including the following: First, that language learning can be driven by particular texts, where those texts have been analysed linguistically. Second, the idea that the quiz format, with its questions and required answers, facilitates learning. An early version of PLOTLearner has been described in [Tøndering, 2009].

The idea is to give the learner a piece of a text, along with a number of questions which the learner must answer about the text. The questions are taken directly from a database of linguistically analysed or annotated text, embodied in an Emdros database. It is the task of the learner to answer the questions correctly, and thus gain greater insight into the system of the language being studied. For example, questions can relate to the parts of speech, tense, aspect, number, gender, meaning, and other lexical and morphological aspects of individual words. Or questions can relate to features of phrases or clauses, depending on the underlying database.

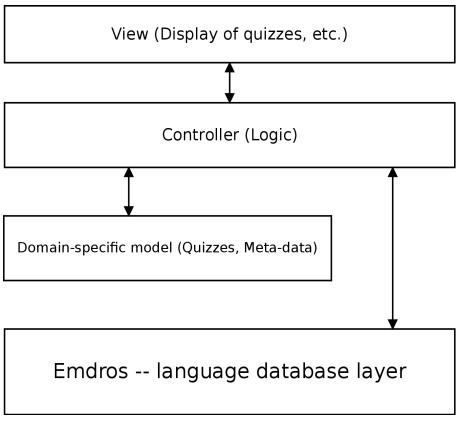

Figure 1. Architecture of PLOTLearner

PLOTLearner has been designed to be language-independent and text-database driven. Thus a number of databases for various languages have been published alongside PLOTLearner, including Ancient Hebrew, Ancient Greek, and modern German. There is a “facilitator's view” (or “teacher's view”), which deals with designing questions and saving them in a separate file as a persuasive learning object. The other view deals with “playing back” the questions and

asking for answers in a “student's view”. The “facilitator's view” depends on the underlying Emdros database for drawing information for the questions from the annotated text.

Thus Emdros it situated at the bottom of the architecture of the application, as depicted in Figure 1. The architecture is, as can be seen, a fairly standard “Model – View – Controller” architecture, with a database layer underneath in the form of Emdros.

Kaj Munk Study Edition

The Kaj Munk Study Edition in an earlier form, its content, its rationale, and its architecture are described in greater detail in [Sandborg-Petersen, 2008]. Here, the following description will suffice for our purposes. The Kaj Munk Study Edition has been further developed within the EuroPLOT project. It is in essence a “Kaj Munk Browser”, which builds on the rather self-evident idea that in order to get to know an authorship, one has to have access to the texts constituting the authorship. Thus the Kaj Munk Study Edition software contains and displays the works of Kaj Munk, an important cultural figure in Denmark and even in Europe in the period between World War I and World War II. The software provides easy access to not only the works of Kaj Munk, but also a wealth of explanatory notes, introductory material, pictures, and other information about Kaj Munk and his works. Both simple and advanced search facilities are included, there are “backwards” and “forwards” buttons, and in general, the user experience is much like that of a “web browser”, only it is the works of Kaj Munk that are “browsed”, rather than the web.

The wealth of information provided by the Kaj Munk Study Edition is shown to the user in a number of panes driven by custom HTML widgets. The left part of the screen displays the text being read. The right part of the screen can be chosen by the user display the list of works, ancillary information, explanatory notes, or search results.

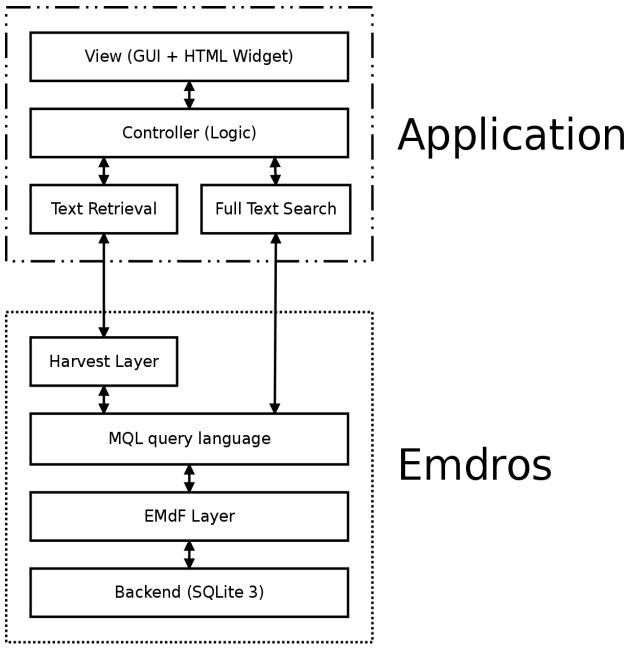

Figure 2. The architecture of the Kaj Munk Study Edition software

As can be seen in Figure 2, the architecture of the Kaj Munk Study Edition software also has Emdros as its underpinning. The code base of the Kaj Munk Study Edition is very small considering the many features. In fact, it only comprises about 10,200 lines of C++, not including the aforementioned HTML widget. Of these 10,200 lines, most are taken up by the View and the non-database-facing parts of the Controller. Only about 1,600 lines are

necessary for retrieving and assembling all of the various kinds of displayable information from the databases of diverse kinds. Thus Emdros is seen to be easy to use for the programmer, and to assist in reducing the number of necessary lines of code to a large extent, as compared to what would otherwise have been necessary.

Figure 2 also shows the inner architecture of Emdros itself: At the bottom, there is a storage backend; in this case, it is SQLite 3, but other backends are supported such as PostgreSQL, MySQL, SQLite 2, and the author's own proprietary “Bit Packed Tables” or “BPT” engine. The latter makes deployment of Emdros feasible and useful on low-powered devices such as iPods, iPads, iPhones, and Android devices, due to the speed of the BPT engine.

The next layer of Emdros is the database model layer, embodied in the EMdF layer. This in turn is called upon by the query language layer, the MQL layer. The application is able to use MQL directly, or use any of the other layers, including the harvest layer and the Full Text Search layer.

The Kaj Munk Study Edition implements its own Full Text Search layer, for historical reasons, but could easily be adapted to use the Full Text Search layer of Emdros, thus reducing its code-base even further. The Controller layer of the Kaj Munk Study Edition is a thin layer between the upper View (GUI + HTML widget) layer, while the Text Retrieval layer is a very thin layer on top of the Harvest layer of Emdros.

Thus the architecture of the Kaj Munk Study Edition software is similar to that of the PLOTLearner: A Model – View – Controller application with Emdros serving as a backend. As has been pointed out, the code base of the Kaj Munk Study Edition is rather small compared to the wealth of features it provides, and this is due to the power and ease of use of the undergirding database engine.

Kaj Munk Virtual Research Laboratory

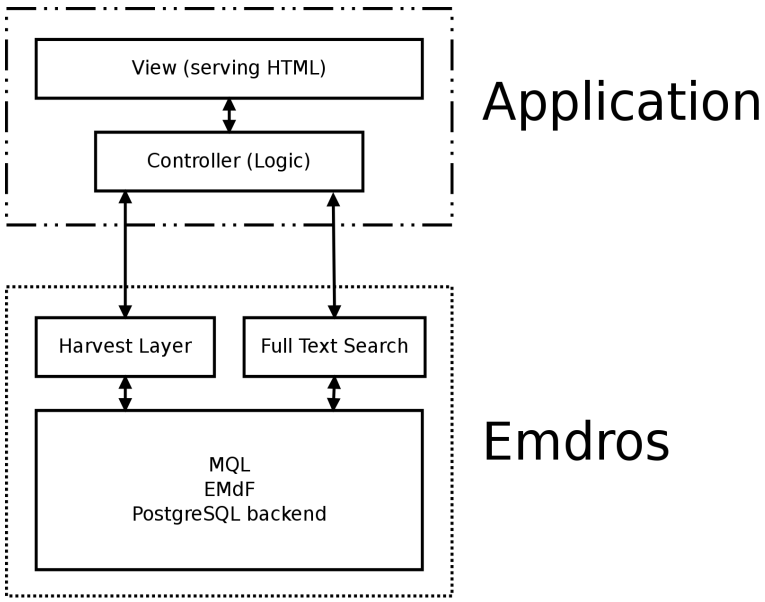

Figure 3. The architecture of the Kaj Munk Virtual Research Laboratory

The Kaj Munk Virtual Research Laboratory is a web-based collaborative research application, which aims to gather researchers around the texts of Kaj Munk. It provides the literary, historical, or theological researcher with tools to author explanatory notes to the works of Kaj

Munk, and to anchor these notes in the text. The Laboratory also provides the researcher with social tools such as the ability to comment on the notes of other researchers, thus keeping the scholarly debate and dialogue open and transparent. The notes themselves can also be viewed in various ways, both situated within the texts and aggregated over many texts at once, thus providing a better overview of the corpus of annotations having been written. Finally, the Laboratory provides access to the works of Kaj Munk, both in terms of displaying the works, and in terms of searching them.

The web application itself is a very thin layer built on top of Emdros, using the same databases that are used in the Kaj Munk Study Edition. The architecture can be depicted as in Figure 3.

In a sense, the Kaj Munk Virtual Research Laboratory possesses the simplest architecture of the three systems under case-study, in that it does not have a model in and of itself – Emdros is enough to provide the model entirely. Thus it implements a View and a Controller, and lets Emdros play the role of both the database backend and the model.

Persuasive nature of the case-studies

As described by B.J. Fogg in Chapters 3 through 5 in [Fogg, 2002], Persuasive Design encompasses three ways in which a computer system can be persuasive, as embodied in Fogg's "Functional Triad", also described in [Fogg, 1998]:

1. First, by being a "Persusaive Tool", which "does" something for the user.
2. Second, by providing "Persuasive Media", in which the user is encouraged to consume information, for example.
3. Third, by being a "Persuasive Social Actor", in which the computer either facilitates and mediates social interaction between humans, or interacts socially with humans by itself.

Fogg's Functional Triad can be depicted as in Figure 4.

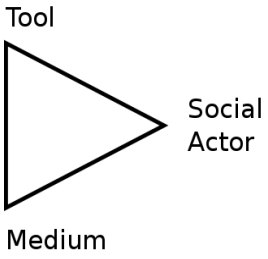

Figure 4. The Functional Triad

As summarized in Table 1, the three systems under case-study exhibit some or all of these persuasive characteristics in Fogg's "Functional Triad".

Table 1. The Relationship between the Cases and the Three Legs of Fogg's Functional Triad

System	Tool	Media	Social Actor
PLOTLearner	X	X	
Kaj Munk Study Edition		X	
Kaj Munk Virtual Research Laboratory	X	X	X

The PLOTLearner system can be characterized by both being a “Persuasive Tool” – because it persuades the user to do something in the task of learning a language – and by providing “Persuasive Media”, in that PLOTLearner provides the opportunity to consume both some text from the language being studied, and an analysis of these texts. Notice that Emdros plays a central role in the implementation of both the “persuasive tool” aspect, and the “persuasive media” aspect, given that both the quizzes and the texts from which they are derived have their origin in Emdros within the system.

The Kaj Munk Study Edition provides “Persuasive Media”-style access to the texts of Kaj Munk by making it very easy to study the works of his authorship. The program is itself not a social actor, nor does it facilitate social interaction between students of the works of Kaj Munk. The program does not really function as a persuasive tool either, since it does nothing particularly persuasive or special to assist the user in his or her study of the texts. That is, there is no set agenda through which the order of the steps being taken by the user in order to study the works of Kaj Munk can be carried out. Thus the concept of persuasive “tunnelling” does not apply, for example. Notice again that Emdros has a central role to play in the implementation of the persuasive media, in that almost all of the various kinds of media being offered for consumption by system have their origin in Emdros.

The Kaj Munk Virtual Research Laboratory, on the other hand, exhibits all three legs of Fogg's Functional Triad. First, it is a tool which persuasively helps the user perform a task, namely the annotation of the works of Kaj Munk. Second, it provides access to “persuasive media”, by making it easy for the user to consume both the works of Kaj Munk and the annotations connected to the text. Third, it is a “persuasive social actor”, in that it facilitates easy social interaction between the various researchers who use the system, as well as being a social actor in its own right in its persuasive messages to the user, which sometimes are of an encouraging or even forbidding nature. Notice yet again that Emdros, being the model component of the system, plays a very central role in all three persuasive aspects of the system.

Not all persuasive learning systems will be able to benefit from Emdros. Systems which do not deal with text as the primary content in their persuasive learning objects may not be able to benefit much from Emdros, being, as it is, primarily a text database engine. However, as can be seen, Emdros is able to facilitate the implementation of all three legs of the Functional Triad inherent in Persuasive Design, probably reducing the necessary size of the code base. Thus persuasive learning systems of many kinds will be able to benefit from using a solidly theoretically founded text database engine such as Emdros. In addition, any system whose primary functions include giving access to, searching, creating, or otherwise dealing with text plus information about that text in a database are likely candidates for systems that could benefit from incorporating Emdros.

Conclusion

In this paper, we have provided an overview of the Emdros text database engine for annotated text, and have developed three case-studies of persuasive learning systems which incoporate Emdros as an architectural underpinning. The three systems have been described as regards purpose, nature, functionality, architecture, and as regards the three legs of the Functional Triad og Persuasive Design described by [Fogg, 2002]. We have argued that Emdros is capable of undergirding all three aspects of any persuasive learning system whose primary content includes text plus information about that text. We have also argued that the power and ease of use of Emdros makes it likely that the size of the code base necessary to accomplish the goals of such systems can be reduced by incorporating Emdros, as compared to systems

which use other forms of databases. This is due to the fact that Emdros caters specifically to some aspects of text which are hard to implement in traditional database management systems, including the phenomena of sequence, embedding, and gapping.

Acknowledgements

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Application Domains

Persuasive Design can be applied in a variety of applications, and different technologies can appear most suitable for specific application needs. Two examples will be presented here: Gram-Hansen has used mobile learning technologies **for teaching about Danish literature**. Bertel and Rasmussen have employed entertainment robotics **in Autism therapy and education**.

Motivating the interest in Danish literature with Mobile Persuasive Learning

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This paper analyses and discusses the potential of Mobile Persuasive Learning (MPL) in relation to learning scenarios that involve complex and interdisciplinary learning material. A specific example of MPL is presented, which has been developed with the intent to motivate the interest of the life and works of Danish author and playwright Kaj Munk. A Persuasive Learning Design (PLD) is tried in a specific learning scenario that aims to introduce the history of Kaj Munk to students in lower secondary education in Vester Hassing in Northern Jutland. The methodological background for the chosen scenario is described and evaluation activities are presented and discussed and it is argued that while the topic is possibly too complex for the particular age group of students chosen, evaluation feedback and researcher observations point towards a significant potential in further developing MPL-designs in a school context.

Keywords: Mobile Persuasion, Collaborative Learning, Kaj Munk, e-PLOT, Mobile Persuasive Learning

Introduction

This paper presents and discusses a test project concerning MPL in a small Danish village, where a group of students were involved in a number of learning acitivities regarding the historically significant Danish vicar Kaj Munk.

Kaj Munk served as vicar in Vedersø in Western Jutland, and was assassinated by Gestapo in January 1944 after having aired his resistance against the German occupants through his sermons and his literary works. As a result, Kaj Munk has become an important figure not only in Danish literature, but also in Danish history, and the mediation of his life and works receives attention both in learning and in mediation of cultural heritage. One of the interesting aspects of the works of Kaj Munk is the fact that many of his dramas and other texts are closely related to specific places – mainly in Denmark and very often in the area around Vedersø in western Jutland where he lived and served as vicar. The close connection between many of Kaj Munk's texts and specific locations in different parts of Denmark, constitutes the primary reason why MPL may show particular potential in this work case (Gram-Hansen & Gram-Hansen, 2013) (Gram-Hansen, 2013b).

The Kaj Munk example springs from research conducted within the EU funded e-PLOT project. E-PLOT aims to explore the theoretical and practical overlap between persuasive design and learning technologies, through further development of two existing technologies;

PLOTLearner and PLOTMaker. It has been argued that mobile devices hold potential which may ease the task of incorporating the surroundings in a design (Fogg & Eckles, 2007) (Bødker, 2012), and as a result PLOTmaker now provides teachers with the ability to create not only traditional but also mobile learning objects which can be executed through smartphones and tablet computers. In order to test both types of learning objects, the Persuasive Learning Design (PLD) presented in this paper, includes both traditional and mobile learning objects all of which are linked to an overall intended outcome.

The trial took place at the local school in a small village in Northern Jutland called Vester Hassing. The link between location and learning material in this is case exemplified by a historical anecdote describing how Kaj Munk once agreed to give a sermon in Vester Hassing church, but only after having received written notice from the village snow bailiff, letting him know that the local pastor was in fact a very funny man - a notice which Kaj Munk found funny enough itself to make him agree to visit the village. The anecdote itself is not of major significance to Kaj Munk's works in general, but it does provide an example of the mentality of Kaj Munk which might facilitate the student's understanding of him as a historical figure. Furthermore, the fact that the home village of the students was somehow related to Kaj Munk was also expected to motivate the students' interest in the topic - especially as Vester Hassing is a small village with little significance in the overall history of Denmark. The persuasive learning design in Vester Hassing was divided into three phases, followed by an evaluation session involving all participating teachers, observers and the entire group of students. The inclusion of both traditional and mobile learning objects, sought to constitute a multimodal learning experience with a strong emphasis on collaborative learning.

From Geocaching to Mobile Persuasive Learning

A 2006 pilot study from Thorning elementary school, Denmark, used mobile technology to enable teaching outside the classroom (Thomsen, 2008). Using the location-based GPS-hunt Geocaching, teachers motivated students to learn different subjects in appropriate surroundings leveraging the students' fascination with technology to spark their interest. Generally, the students were successfully motivated to engage in learning via location-based mobile technology, and even in situations when the educational benefit was minimal, the students were still motivated by the idea of doing classes outside the classroom. However, the teachers learned that they needed to carefully prepare material for this specific type of teaching. When the content was planned more thoroughly, the geocaching activity could be used to motivate students of all ages and in a wide variety of subjects.

Subsequent research has argued that the dynamics of Geocaching hold an interesting persuasive design potential, as Geocaching combines elements such as location and context aware technologies with elements of competition, rewards and a number of persuasive design principles (Gram-Hansen, 2009). Ongoing research in digital dissemination of cultural heritage suggests that the dynamics of Geocaching holds the potential to motivate an interest in areas of cultural heritage, which may not receive much attention otherwise. The research is exemplified by a number of Geocaches located in the area around Vedersø where Kaj Munk served as vicar.

The results of both the pilot study and the ongoing investigation of Geocaching in a PD context in Vedersø, serves as a primary source of inspiration for the Persuasive Learning Design (PLD) in Vester Hassing. The overall plan for the design was to create a multimodal learning experience where an appropriate balance was established between the learning material, the intended learning outcome and the learning context. Of particular importance was the understanding that being at a specific location when receiving learning material,

influences the way students perceive the material. In consideration of the time that has passed since WWII, the students have no natural understanding of the age in which Kaj Munk's literary works were produced. As a result, the learning design sought to not only present the learning material in an appropriate and motivating manner, but also to enable the students to create their own references to locations and events which were important in that time.

Mobile Persuasive Learning in Practice

Previous research has argued that the unique claim of persuasive design is not tied to certain technologies, but rather depends on how these technologies are applied within a specific context. As such, persuasive design becomes the discipline that creates the link between technology and context, based on a strong focus on appropriateness within that context. Rather than constituting an approach to technology design which offers little novelty when related to more established research fields, persuasive design becomes a Meta layer, where the context is explored in a wider sense, and where the focus of the designer is to establish a link between the context, the persuasive intention and available technology while remaining a recurring ethical perspective (Gram-Hansen, 2013a; Gram-Hansen, 2013b). When related to learning design, this new and more nuanced understanding of persuasive design acknowledges the various recognised approaches to learning, which are already applied in a variety of setting. The PD approach supports these approaches by adding an overall reflective perspective, which motivates teachers to consider ways to actively adapt the surroundings in the learning design.

One of the challenges for teachers who work with a constructivist approach to learning, is argued to be contradiction between intentions related to the learning scenario and the physical frames of the setting (e.g. an auditorium does not motivate student activities; see (Leijon, 2012). By its wide and context-oriented perspective, persuasive design may potentially provide teachers and learners with new approaches to teaching and learning, which may help overcome the challenges related to physical surroundings. As a result, the persuasive learning design describes the overall understanding of the intended learning scenario, and the learning technologies applied within the learning design become facilitators for reaching the intended outcome. Thereby it is still agreed that a technology is only persuasive, when applied appropriately within the intended use context.

As described above, the described understanding of persuasive learning designs has been tried in a specific learning scenario that aimed to introduce students in lower secondary education in Vester Hassing in Northern Jutland, to Kaj Munk. The 18 students that participated in the trial were 13-14 years of age and did not have any previous knowledge of Kaj Munk. From films and literature, they did however know a little about WWII, and did as such have some understanding of the dynamics that influenced the world when Kaj Munk was murdered.

PLOTMaker enables teachers to produce both traditional and mobile learning objects. In order to test both types of learning objects, the persuasive learning design developed for the students in Vester Hassing, included both traditional and mobile learning objects all of which were linked to an overall intended learning outcome. The use of mobile learning objects were of particular relevance to the Kaj Munk case due to the connection between historical events, literature and specific locations, which is a particular distinction for this work case.

The overall persuasive learning design was widely inspired by the previously mentioned results from applying geocaching in digital mediation of cultural heritage. In particular, the notion of Mystery Caches, where the users must solve a puzzle in order to find a specific location, was a motivating factor in the development of the learning design.

The overall approach to the development of the persuasive learning design is based on the 6 step guide to persuasive learning which has been developed in relation to the e-PLOT project (Kristensen, 2013). The 6 step guide combines an acknowledged Danish approach to learning designs with Fogg and Eckles' 8 step approach to persuasive design, and seeks to provide teachers with a step-by-step framework for developing persuasive learning designs. The guide approaches learning design preparation through two different phases, the first one placing a focus on the learning scenario, and the second phase focusing more specifically on the learning material. Both phases include contextual reflections based on the rhetorical notion of Kairos, and both phases undergo a recurring evaluation process, in order to ensure that the final learning design meets the requirement of an appropriate balance between intended outcome, technology and context.

Put to practice, the guide served as a supporting framework throughout the design process, ensuring that particular attention was drawn towards the context, and more specifically the balance between student's ability, the technologies used, and the intended learning outcomes. With reference to the wider understanding of the concept Kairos and the notion of context adaptation (Gram-Hansen, 2013a), the influence of persuasive design in this particular learning design is defined by the reflections regarding how the student's normal surroundings and media can be applied in the learning scenario. As the intended outcome of the learning design is for the students to learn about Kaj Munk, it is important that the technologies do not outshine the learning material by drawing all attention. Nor must the technology appear too complex, as the students may then focus more on how to use the devices and less on what the technologies are mediating. Instead, the technologies and the learning objects mediated through them must function as facilitators that underpin important arguments at appropriate moments, for instance when the students are at a specific location, or as a way to follow up on a more general introduction. These reflections proved themselves to be particularly important due to the age group of the students. Whilst older students may be able to distance themselves from the excitement of new technologies in a learning scenario, the students in Vester Hassing appeared be more easily distracted by new devices.

Prior to the trial, the students were told about the e-PLOT project and explained that their input and comments about both the learning experience as a whole and the different technologies is both welcome and important to the researchers in the project. They were also informed about the overall plan for the day; that they would be doing a combination of group work in the classroom, and a trip around their town, during which a tablet computer would guide them and supply them with additional learning material. They were informed that an observer would accompany them, both in the classroom and en route, but that they were expected to work independently. It was heavily emphasised that from a research perspective, the aim of the day was to explore how the students respond to this approach to learning, and to learn more about what motives the students.

In practice, the learning design consisted of three different phases followed by an evaluation:

1. ***The introduction phase***, during which the students were given a general introduction to Kaj Munk and the intended learning outcomes of the day. The theoretical framework in e-PLOT includes reflections regarding the notion of Constructive Alignment in relation to outcome based learning, which emphasises the importance of letting the intended learning outcome be known to both teachers and students (Biggs & Tang, 2007; Gram-Hansen, 2012). The intended outcomes for the students were as follows:

    - The students will gain a basic understanding of Kaj Munk as a historical figure and of the role he played during WWII.

- The students will be able to identify the link between Kaj Munk's works and specific locations in Denmark

This phase took part as a traditional classroom setting, where the material was presented through PowerPoint. The introduction was kept very short (approx. 15 mins.), and was mostly used for practical information. The introduction to Kaj Munk was limited to three points:

- Kaj Munk was a Danish Vicar
- He was a poet and a playwright
- Gestapo murdered him during WWII.

As one of the aims of the trial was to evaluate the potential of persuasive learning objects, it was considered important to let the students know as little as possible before engaging in the learning material.

2. ***The classroom phase***, during which the students worked in smaller groups (4-5 students in each group), and engaged in more specific exercises. All groups were presented with a worksheet with different questions about Kaj Munk and WWII, and in order to answer these questions the students had to explore a number of Kaj Munk related Learning Objects. Originally, the intention behind the exercise was that by answering the questions correctly the students would be provided with a series of GPS coordinates that would determine their route around Vester Hassing. However, in order to ensure that not all groups would be on the route at the same time, it was decided to simply dispatch groups every 10 minutes, and let the groups which returned back to the classroom first, complete the worksheet upon their return.
3. ***The Mobile Learning phase***, which took place on a tour through Vester Hassing. As the groups were dispatched, they were given a 7" tablet that had been prepared to execute the learning material. The students were sent out on a specific route to explore the village and amongst other things discover how buildings that no longer serve a specific purpose, carried historical significance. For instance, the students were sent by the old train station in Vester Hassing, and asked to solve a photo challenge, whilst learning about the time when members of the Danish resistance in WWII blew up the railroad in Vester Hassing in an act of sabotage. While at the specific location, the students were presented with a photo of the station as it appeared during WWII, and asked to use their cameras in their mobile phones to capture a new picture of the station, in the same angle as the old picture.

   The learning material and the tasks presented to the students during the tour of the town, was presented through mobiles GLOs, which were activated by scanning a QR code. The decision to activate the Mobile GLOs with QR codes rather than GPS, was based on the students working in groups rather than individually. The GPS option would enable the learning material to be activated on specific locations, however the QR codes held the benefit of engaging all members of the group in searching for the location, rather than just the person holding the tablet.

Evaluation and reflection

Once having completed the 3rd phase, the students reconvened in the classroom for a closing evaluation session. Through a combination of quantitative and qualitative evaluation methods, the aim was to evaluate not only the learning potential of the design, but also the

persuasiveness of the experience as a whole. Evaluation the persuasive potential of the design called for careful consideration, as the students due to their age group were believed likely to respond positively to the learning experience, simply as a result of the activities being something new and technology-based.

In practice, the evaluation phase consisted of a number of activities which sought to be inclusive towards all students, and which allowed students to respond anonymously to questions regarding the learning experience.

In order to assess if the students had met the intended learning outcomes, the evaluation phase started with a group competition in terms of a quiz. A number of questions were read out one at a time, and for each question, the groups were given a moment to quietly discuss their answer and write it down on the quiz form. The questions were all based on information the students had been presented with during the day, either during the classroom phase or on the route in Vester Hassing. The groups were informed that they were not allowed to use their notes from the earlier phases to answer the questions; they were however allowed to use the pictures they had taken while solving the tasks of the MLD. If the photo challenges had been solved correctly, their pictures would include some of the answers to the quiz.

Although the students had only been told very little about Kaj Munk in the beginning of the day, all groups performed impressively well in the quiz. The quiz included questions such as "Why was Kaj Munk murdered", "Why did he agree to speak in Vester Hassing", "How many of Kaj Munk's literary works can you mention?" and "What is Kaj Munk trying to say in his song about The Blue Anemone?", and did as such require the students to not only know facts about Kaj Munk, but also be able to reflect upon the material they had worked with. Results showed that even though the students had not been told much about Kaj Munk before engaging in the different phases, three out of five groups were able to answer all ten questions correctly, and the remaining two groups each had one wrong answer.

The positive results of the quiz may be credited to the students' engagement in the MPL tour around town. One of the particularly interesting observations made in several of the groups, were that when reaching one of the intended location, one group member would read aloud the content of the learning object, and the remaining group members would appear fairly uninterested. The technology itself did not motivate much interest, and in some cases no one really wanted to be the one in charge of the device. In spite of showing such little enthusiasm on location, observers noted that as the groups were walking from one location to the next, they would discuss and reflect upon the material they had just received, and in some degree translate it into something they could all understand. As such the application of mobile learning objects appeared to motivate an important degree of collaborative learning, which all members of the group were able to engage in and benefit from.

As mentioned, the evaluation of the persuasiveness of the PLD had called for careful methodological considerations, as the students were perceived to potentially be more easily influenced by the situation. The evaluation was approached form a qualitative perspective, as it was considered of greater importance to gain a deeper understanding of how the students experienced the PLD, and whether this approach to learning had any motivating effect. The overall approach to the qualitative evaluation is based on phenomenography (Ashworth, 2010), and sought to influence the students as little as possible, and to allow them the anonymity to respond critically if necessary.

Much was gained from the observation studies, and in particular the walk along and in situ interviews during the Mobile Learning Phase provided valuable insight to the potential of the learning design and to the actual application of mobile devices in a learning scenarios. For instance, the mentioned lack of enthusiasm from the students as they were on the route was

surprising, as expectations were that the use of tablet computers in itself would be a motivating factor, as this is not yet widely applied in Danish schools. The original concern that the students might be so engaged in applying mobile devices for learning, that the device would outshine the learning material was proven to be unnecessary. Contrarily it may be that as the students are born as digital natives and with mobile devices as a natural element in their everyday surroundings, the future of MPL calls for much richer ways to present learning material. Technologies themselves do not impress the future users, so the design of the device applications must constitute an engaging and intriguing experience. Particularly if the design is to hold persuasive potential, as likeability is argued to be an important motivational factor (Fogg, 2003).

In order to supplement the observations made during the day with specific input from the students, the day was finished with a couple of evaluation activities that enabled the students to submit individual feedback. All students were asked to fill out a questionnaire regarding their attitude towards both Kaj Munk and the subject of history in general, and finally all students were given a blue and a yellow piece of paper. On the blue piece of paper they were asked to complete the sentence "I learned a lot today because…" and on the yellow piece of paper they were asked to write down three adjectives, which described their impression of the day. The dominant adjectives entered on the yellow piece of paper were "Fun", "Exciting" and "Different". A majority of the students credited the MPL experience, the collaborative learning and the high level of physical activity as the main reasons why their learning outcome had been good. On student did comment that he/she was unsure about the actual learning outcome, as many of the details about Kaj Munk would most likely soon be forgotten.

Results of the questionnaire showed that a majority of the students found that the PLD experience motivated them to learn more about history in general, however only 4 out of 18 students replied that the experience motivated them to learn more about Kaj Munk. 4 students replied that they did not feel motivated to learn more about Kaj Munk, and 10 students replied that the experience did not influence their interest in Kaj Munk in either direction. These results were not as positive as hoped, but also not entirely unexpected. Although a majority of the students responded positively with regards to being motivated towards history lessons in general, one of the aims of the learning design was to motivate an interest in the life and works of Kaj Munk and this was not entirely achieved by the learning design. One reason for this may be that although the students do learn about WWII, the history about Kaj Munk and in particular his literary works constitutes material that may be too complex for students of this age to comprehend. Nonetheless, the benefit of testing the PLD with Kaj Munk material remains that as the students have not previously been introduced to Kaj Munk specifically, they students commonly engage in the experience with no knowledge about the material they are to work with, This taken into consideration, it can be argued that the learning potential of the design is considerable.

In summary, there is no empirical support for claiming that the MPL trial in Vester Hassing directly motivated the students' interest in the subject of Kaj Munk. However, the students showed that they were able to learn about a complex subject through the combination of learning objects and different learning activities. Furthermore, the trial provided a valuable experience in the use of mobile persuasive learning objects in practice. Based on the experiences of this trial, it would be interesting to explore the outcome of a similar PLD, in which the learning material is better matched to the specific user group.

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PEERs at Play: A Case Study on Persuasive Educational and Entertainment Robotics in Autism Education

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This paper introduces the notion of Persuasive Educational and Entertainment Robotics (PEERs) as the intersection between Persuasive Design, Human-Robot Interaction and Didactics and investigates the persuasive potential of PEERs in special needs education through an empirical study on the implementation and use of the robot seal PARO at a school for children with autism. Results include a categorization of user-developed concepts of PEER-supported interventions in special needs education as well as persuasive design principles that emerges from the comparison and combination of design strategies within Persuasive Technology, Human-Robot Interaction and Didactics.

Keywords: Persuasive Design, Human-Robot Interaction, Autism Education

Introduction

Robots are increasingly implemented as teaching aids and assistants at universities, secondary and even primary schools to increase interest STEM teaching (Mataríc, Koenig & Feil-Seifer, 2007 and Majgaard & Misfeldt, 2010) and language learning (Han & Dongho, 2009) by providing a platform for experimentation, reflection and collaboration. The application of robots to motivate social interaction and communication in autism education has also gained increased interest in recent years (Dautenhahn et al, 2009, Lee, Breazeal & Picard, 2008, Robins et al, 2009, Kozima, Nakagawaand Yasuda, 2005). For robots to succeed as motivational trainers, teachers and playmates their physical appearance, interactivity and social behaviour must match the users' needs and meet the demands of an ever changing educational context. This calls for well-established guidelines as to how such robots should be designed and in what ways interacting with them can support learning.

Within the field of Persuasive Design (PD) it is argued that technologies can be persuasive in the role as social actors. Naturally, from a PD perspective social robots can viewed as social actors since their main purpose is to engage in social interactions with humans and thus one might consider the principles of PD when designing social robots for persuasive purposes. From a Human-Robot Interaction (HRI) perspective, though, the design of robots for particular (often persuasive) purposes, has also received a great deal of attention in recent years. Thus, this paper shows that a lot can be gained from looking at the taxonomies of HRI when designing persuasive social actors. Furthermore, this paper argues that for robots to be persuasive within an educational context, one must also consider the conditions of this particular context of application. Specifically, this paper proposes the combination of PD, HRI and Didactics as a framework for designing robots that motivate play and learning. The notion of Persuasive Educational and Entertainment Robotics (PEERs) is introduced and based on a case study on the implementation of the therapeutic robot seal PARO at a school for children with autism, the different roles of the robot in persuasive interventions are outlined and discussed in relation to the framework. The paper is concluded with thoughts on the perspectives and limitations of the work with directions for future research.

Persuasive Educational and Entertainment Robotics (PEERs)

This paper builds on the work in (Bertel, 2012) which argues that the combination of theory on motivation, interaction and learning within PD, HRI and Didactics can provide a framework for designing robots specifically for the purpose of education. Thus, the PEERs model (see figure 1) is a conceptualization of robots designed to motivate play and learning as well as a categorization of related fields and technologies;

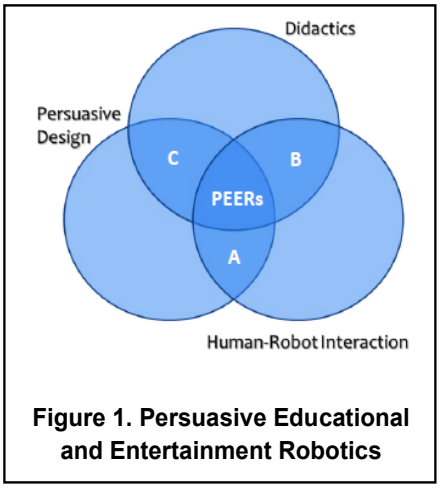

Figure 1. Persuasive Educational and Entertainment Robotics

A. Persuasive Robotics, i.e. robots that motivate behavior change through social support (e.g. robotic weight consultants that keep track of users' dietary information (Kidd & Breazeal, 2008) or service robots that elicits emotional responses to users' energy consumption (Vossen, Ham & Midden, 2010) to encourage a healthier or greener lifestyle).

B. Educational Robotics, i.e. hands-on robotic kits such as *LEGO Mindstorms* used to teach topics within STEM education. These robotic kits have generally been argued to support a constructionist approach to learning (Papert, 1980) and thus facilitate embodied learning through experimentation, reflection and collaboration (Mataríc, Koenig & Feil-Seifer, 2007 and Majgaard & Misfeldt, 2011)

C. Persuasive Learning Designs (PLD), also termed Persuasive Learning Objects and Technologies (EuroPLOT, 2010) covers the application of ICT tools to motivate and enhance learning. Theoretical concepts and design methodologies have been developed in (Gram-Hansen, 2012 and Gram-Hansen, Schärfe & Dinesen, 2012) with a particular focus on including the context of the interaction in the design of PLD's.

The conceptualization of PEERs creates the opportunity to compare these related research fields theoretically and compile their respective strategies and principles when designing social robots specifically with the purpose of motivating play and learning.

Robots in Persuasive Design and Persuasion in Robotics

The fields of HRI and PD have in common that they both argue robots as possible persuasive agents. From an industrial HRI perspective, robots are most often considered to be tools (with the primary purpose of increasing efficiency and reducing complex tasks and thus costs). However, from a PD perspective this is not viewed as particularly persuasive even though it quite possibly induces behavior (and perhaps even attitude) change. Within PD some technologies described as simulated objects could also be considered robotic (e.g. the well-known Baby Think It Over which provides compelling experiences to young women about the advantages and (particularly) disadvantages of early motherhood (Fogg, 2003). So according to the PD framework, a social robot that imitates the behavior of an animal or a human convincingly can also be viewed as a portable persuasive simulation technology provided that it seeks to highlight the impact of certain behaviors and motivate behavior or attitude change (Fogg, 2003). However, although it seems that whether a robot should be considered a tool (reducing complex tasks), a simulating medium (simulating physical, psychological or emotional intelligence) or a social actor (engaging in social interaction, providing feedback and creating social relations) would depend on the design of the technology, the task at hand and the context of the interaction, most of the principles that can be directly related to social robotics come under the persuasive role as a social actor. The

principles of this persuasive role are not limited to robots and include other technologies that possess social qualities as well (virtual avatars etc.). Here, it is argued that the fact that people respond socially to technologies has significant implications for persuasion as it allow these technologies to apply a host of persuasion dynamics that arises from social situations (Fogg, 2003). These social cues are then formulated into a set of PD principles (see table 1) that describes particular ways of utilizing these cues of social influence to motivate and persuade:

Table 1. Social Cues and Principles of Persuasive Social Actors

Cue	Examples	Persuasive Principle
Physical	Face, eyes, body, movement	Visually attractive PT is likely to be more persuasive
Psychological	Preferences, humour, personality, feelings, empathy	People are more readily persuaded by PT products that are somewhat similar to themselves in some way
Language	Interactive language use, spoken language, language recognition	By offering praise (words, images, symbols, sounds) PT can lead users to be more open to persuasion
Social Dynamics	Turn taking, cooperation, praise, answering questions, reciprocity	People will feel the need to reciprocate when PT has done a favour for them
Social role	Doctor, teammate, teacher, guide	The role of authority enhances powers of persuasion

Within robotics, the research field of social robots emerged from the area of biologically inspired robots and the idea that robots should be able to interact and share information, not with humans, but among each other, as is the case with swarm robots (Dautenhahn & Billard, 1999). From the beginning of this millennium, though, social HRI gained increased interest, and in 2003 the term *Socially Interactive Robotics* (SIR, i.e. robots whose sole purpose is to engage in social interaction) was defined (Fong & Dautenhahn, 2003) and a taxonomy of characteristics and key components of SIR developed (see table 2).

Table 2. Taxonomy of Socially Interactive Robots (SIR)

Properties	Example	Description
Morphology	anthropomorphic, zoomorphic, caricatured, functional	Establishes social expectations and provides information about the intended function of the robot
Emotions	anger, fear, sadness, joy, surprise, neutral and combinations	Facilitate credibility in HRI and serve as feedback to the user about the robots internal state
Dialogue	synthetic language, natural language, non-verbal cues	Exchange and interpretation of symbols and information about the context of the interaction
Personality	tool, pet, character, supernatural, human-like	A set of qualities which are particularly significant for a specific robot
Perception	face/gaze tracking, speech/gesture recognition, tone of voice	A social robot must possess a number of perceptual abilities to engage in social interaction
User Modelling	qualifications, experience, cognitive abilities	The ability to create different user models so as to adapt to and shape the interaction in relation to specific user characteristics
Situated learning	imitation, learning	The ability to transfer information, skills and tasks between robots and humans
Intentionality	targeted behaviour, theory of mind, joint attention	For people to be able to asses and predict behaviour, it is necessary that the robot expresses intentionality

Some of the characteristics in this traditional HRI taxonomy are similar to the social cues highlighted in PD. For instance the terms *morphology* and *emotions* cover qualities much like the physical and psychological cues of persuasive social actors. *Dialogue* can be viewed as a combination of the cues related to language and social dynamics. Finally, the robots *personality* is also similar to PD's idea about the social role of the technology. The remaining components revolve around particular cognitive abilities (perception, user modeling, situated learning and intentionality). One could say that the first four types of characteristics of HRI similar to PD focus on qualities that shape the social interaction, whereas the last four types characterize the prerequisites for fully autonomous social HRI.

The idea that robots can motivate behavior change through social support is not unknown to the field of HRI. This is also referred to as the overlap between SIR and Assistive Robotics, i.e. Socially Assistive Robotics (SAR), which most often describes assistive robotic technologies that support physical or cognitive rehabilitation not by physical manipulation but through social interaction (Feil-Seifer & Mataríc, 2005). The SAR framework (see table 3) adds to the existing taxonomy for social robots the following concepts:

Table 3. Taxonomy of Socially Assistive Robots (SAR)

Properties	Example	Description
User population	elderly, users with physical or cognitive disorders, students	SAR can address various populations of users, ranging in age, impairment, and need.
Task	tutoring, physical therapy, daily life assistance, emotional expression	SAR must engage the user effectively, achieve the goals of the domain-specific activity and be responsive to the needs and requirements of direct users and indirect stakeholders
Interaction modality	Speech, Gestures, Direct Input	SAR interactions vary in type and modality. Interactions should be treated separately from the robot's personality and also describe the reciprocal interaction by the human user.
Role	Caregiver, therapy aid, companion	The role of the robot may be defined by the task it is assisting with, the user population it is working with and the impression it gives through its appearance and behaviour.

It can be argued, that these SAR concepts define Persuasive Robotics, i.e. the overlap between PD and HRI (see figure 1) which is distinguished from other types of social robots since having a predefined user group and task entails a specific (persuasive) intention. However, the SAR taxonomy has much greater focus on the target user and the context of the interaction.

Positioning PEERs: The Importance of Context in Persuasive Learning Designs

As argued in (Gram-Hansen, Schärfe & Dinesen, 2012) the traditional approach to PD as a context-independent framework limits its applicability as a design tool, particularly within the field of education. This holds for the principles related to the persuasive role as social actor as well. Here, the complex and highly contextual social cues that cause people to make inferences about social presence (i.e. physical, psychological, language, social dynamics and social roles) are reduced to a few narrow and unilateral principles revolving around only a fragment of those social cues (i.e. visual attractiveness, similarity and reciprocity, praise and authority). It could be argued that whether a social robot will be considered visually *attractive* depends on the user and the nature and purpose of the interaction. For instance, a human-like design was specifically avoided when designing a social robot to assist in the relocation of patients (Mukai et al, 2010). Its size, colors and visual design were chosen to signal cleanliness and robustness, but could also possibly be seen as intimidating in other contexts.

Similarly, as argued in (Bertel, 2010) the effects of *praise and rewards* are not constant over time or across contexts. Rather, they are mediated by the power structure in the social context of the interaction and the relationship between persuader and persuadee. Furthermore, although a technology can certainly be persuasive in the role as an authority, it is not difficult to imagine situations where authoritative behavior will have a detrimental effect on motivation, particularly within education. Thus, when it comes to the design of robots as social actors the PD principles do not really reflect the complexity or cultural and contextual dependency of the aforementioned social cues or provide a method for prioritizing and operationalizing them in specific designs. The taxonomic additions in SAR, however, contribute to both the PD and HRI frameworks as it stresses the importance of context in persuasive HRI and argues that particularly the role of the robot is defined by the task it is assisting with, the user population it is working with and the impression it gives through its appearance and behaviour (Feil-Seifer & Mataríc, 2005).

PEERs at Play: A Case Study in Autism Education

To understand in what ways PEERs can facilitate motivation and what roles they can take on for specific educational purposes, we conducted a three month case study on the use of the social robot PARO at a school for children with autism.

Figure 2. The PEER PARO

PARO is an autonomous robotic seal equipped with sensors and actuators and computational intelligence that enables it to simulate the sounds and movements of a real baby harp seal. It is being used with great success in dementia care in Japan and Europe as a robot companion with the purpose of increasing quality of life and reduce stress and anxiety and to provide a therapeutic tool for specific individual interventions (i.e. calming down, keeping/removing focus, reviving memories or language rejuvenating the identity as a caregiver etc. (Klein, Gaedt & Cook, 2013 and Wada & Shibata, 2007). Recent research suggests that PARO can be used as a facilitator of social communication for children with autism as well (e.g. Marti et al., 2005 and Roberts & Shore, 2013).

Whereas much of the related research on PARO for autism education were done in experimental settings, in this case we did a 3 month field study on the implementation and use of PARO at school for children with autism. This provided the opportunity to study long-term interactions in real-world educational settings as well as to promote a high level of user involvement in the development of the didactic designs supporting the use of PARO as a PEER. A total of three PAROs were implemented in 3 groups of children divided by age but with similar level of cognitive development (0-1 years of age) in which most have no spoken language and use alternative tools for communication. In total, 20 children and 7 teachers participated in study. The didactic applications of PARO were developed entirely by the participating teachers through 3 participatory design phases; exploration, co-ideation and co-creation/evaluation. The research setup and participatory framework is described in detail in (Bertel, Rasmussen & Christiansen, 2013). The following analysis will thus focus on the role of PARO as a PEER and the persuasive principles utilized in relation to this role, in particular.

The Role of PARO as a PEER in Persuasive Interventions

From the case study we found, that PARO had different roles in different teacher-developed didactic designs depending on the individual child, the goal of the intervention and the specific context of the interaction. The observed interventions were often centered on facilitating specific types of attention (bodily/verbal/social) and can be categorized as follows:

Bodily/Verbal Attention (see figure 3)

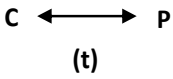

Fig. 3. Interacting with PARO to motivate bodily or verbal attention

PARO was used as a sensory/cognitive stimulant to motivate verbalization and meaningful physical interaction (e.g. eye-contact, petting) either independently or supported by a teacher. This didactic design was deployed with a child, who would mostly touch things very lightly with his fingertips. With PARO he would engage in bodily interactions (using arms, chest and face) for longer periods of time. Also, the children were encouraged to verbalize their thoughts while interacting with PARO (e.g. "dog/ seal", "feed/sleep" and "tail/ eyes"). The teachers reported that the children were particularly interested in the eyes and would instantly seek eye-contact, which they would normally avoid. Here, it was thus the morphology, i.e. the visual, tactile and auditory feedback as well as the simulated perception (gaze-tracking, reaction to touch) that supported the persuasive intervention in question.

Joint Attention (see figure 4)

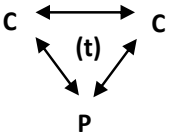

Fig. 4. Interacting with PARO to motivate joint attention

PARO was used as an object of joint attention between to facilitate social interaction. E.g., one group of teachers used the act of grooming PARO to get two children of whom one was afraid of the other to jointly touch PARO and eventually touch each other. They were already working on this particular goal. However, the children had never shaken hands or touched each other spontaneously until the sessions with PARO. In other cases, PARO was used with three children in the introduction and rehearsal of social concepts such as care giving (e.g. grooming, feeding, and tucking in) and social events such as birthdays, dance parties and tobogganing. The teacher explained how the one child with more ability to get ideas for social concepts would instruct the second child who would then instruct the third child in the concepts he had learned from the first child. Here, PAROs morphology, personality and perceptive abilities motivated the children to take on the social role as teammates and sometimes even teachers.

Center of Attention (see figure 5)

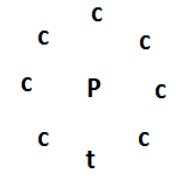

Fig. 5. Interacting with PARO to motivate social attention

PARO was used to create a centre of attention for a larger group of children. The context would often be a social gathering of some sort, e.g. singing Christmas Carols or playing musical instruments. The children would gather in a circle around a table or on the floor and PARO would be placed in the centre. The interaction would be initiated and maintained by the teacher and there would be less physical interaction between PARO and the children. In some cases PARO would even be turned off. However, it would be included in the social setting of the interaction, often initiated by the children. One teacher described how the children would provide PARO with a songbook of its own. Another teacher described how a child had changed the lyrics from a lullaby to be about PARO.

Directing and redirecting attention (see figure 6)
Finally, in some didactic designs, PARO was used to direct or redirect the attention of a child in certain difficult situations. For instance, if a child would have to stay focused on a specific task for longer than usual (e.g. for psychological evaluation), or if a child was intimidated either by external factors such as new and unfamiliar surroundings (e.g. going to a new playground or to church at Christmas) or by the fact that he or she were to be the center of attention at a specific social event (e.g. visiting and introducing oneself at a new school). In these cases PARO would be used strategically to shift focus from the child's activities and performance to the activities and performances of PARO for which it would need the child's 'help'. Thus, rather than PARO accompanying the child, the child would accompany PARO as a helper, teammate or teacher.

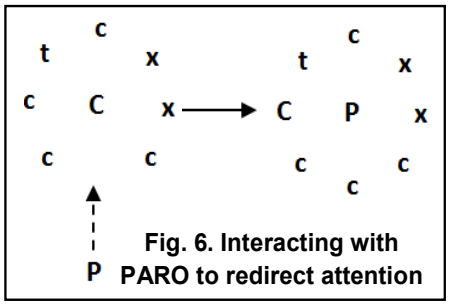

Fig. 6. Interacting with PARO to redirect attention

Conclusions and Directions for Future Work

Based on the empirical findings the role of the robot (as stressed in SAR) plays an important part in defining the persuasive potential of social robots for persuasive, educational purposes. In none of the above four types of teacher-developed didactic designs is there a particular preference for the robot in the role as an authority, and especially in the latter a directly inverse relationship between the user and the robot is considered the key to enhancing motivation. That is, in this case the user is the authority (the teacher, guide or helper) and the robot is the one requiring care and assistance. Thus, for the principles of PD (i.e. attractiveness, similarity, authority, praise and reciprocity) to be useful as PEER design tools, we argue that they must be extended and understood as the *strategic* use of particular properties of HRI in relation to a specific target group, task and context within education. The following is an attempt to do exactly this:

Table 4. Persuasive Principles of PEERs

Original Principle	Extended/Revised Principle	Related properties of HRI	Didactic Application
Attractiveness	Strategic design of physical cues	Morphology (SIR), Personality (SIR)	PEERs physical appearance should be attractive to both students and teachers
Similarity	Strategic design of psychological cues	Emotions (SIR), Intentionality (SIR), Perception (SIR)	PEERs should express intentions and affective states meaningfully. If possible be able to perceive these in users too
Praise and rewards	Strategic interaction design	Dialogue (SIR), Interaction Modalities (SAR), Social Dynamics (PD)	PEER interaction design must match the physical appearance and user preference. If possible it should be multimodal
Reciprocity	Strategic design of tasks	Task (SAR), Situated learning (SIR)	PEERs should solve tasks not solvable by humans. It should not replace humans.
Authority	Strategic design of social relations	Role (SAR), User Modelling (SIR)	PEERs should be able to assume different roles depending on user, task and context

In the future, these findings will be further explored in larger-scale, long-term and cross-contextual case studies with morphologically different social robots, for different users, tasks and contexts of interaction to investigate the applicability and replicability of these particular persuasive principles of PEERs.

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