Evaluation of Adaptive Course Construction Toolkit (ACCT)

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Abstract. The ability to create pedagogically driven, activity oriented personalized eLearning is a key factor in the success of future eLearning. The ability to empower course developers with intuitive environments which provide pedagogic, subject matter, activity and personalization support during the process of creating a personalized course is fundamental to the adoption of adaptive educational hypermedia systems. The ability to support the output of standards conformant educational experiences is a key enabler in the integration of adaptive educational systems and services within existing educational infrastructures. This paper describes the evaluation of the Adaptive Course Construction Toolkit (ACCT) [3], an environment that supports the rapid composition of pedagogic and active personalized eLearning experiences.

Introduction

eLearning dropout rates in the last decade have been as high as 80% [5]. A key factor in the high failure rate of eLearning offerings is the lack of active learner engagement within the pedagogic process. Even with the introduction and adoption of rich multimedia content, the lack of learner engagement is still prominent. This is also evident in the area of adaptive educational hypermedia systems where the absence of solid pedagogic foundations in the educational experience is clearly evident [4]. A key factor attributed to these failure rates is the lack of pedagogic support when building an eLearning experience and also the absence of intuitive and user friendly tools in the area of personalised course composition. The Adaptive Course Construction Toolkit (ACCT) was developed to address these challenges. The ACCT provides a course developer support environment for designing, composing and deploying personalised eLearning experiences. More specifically it facilitates the representation and construction of subject matter knowledge through the Subject Matter Concept Space editor. It supports the course developer in creating personalised eLearning designs by providing pedagogical, activity, subject matter, personalisation and learning content scaffolding. More specifically it provides an environment for graphically building pedagogically-driven personalisable eLearning narratives using an extensible range of modelled information sources, namely pedagogical models, activity models, subject matter models, personalisation models and learning content search facilities. The ACCT provides an interface to the Adaptive Personalised eLearning Service (APeLS) [2], facilitating the rapid test and appraisal of the course developers personalised eLearning designs.

This paper describes the process and results of evaluating the ACCT. The paper identifies the goals and objectives of the ACCT evaluation. The paper then illustrates the

process of the evaluation. The results will be described in the evaluation analysis section. The conclusion section will describe how the goals and objectives where reached.

1. Goals and Objectives of Evaluation

The two core goals of this evaluation are to assess the usability of the Adaptive Course Construction Toolkit (ACCT) and to appraise the beneficial contribution of this research to the educational development process. Satisfying the first goal will provide insightful analysis about the course developer's satisfaction with the support environment of the ACCT, including the model support and the interface support. By satisfying the second goal of the evaluation will provide analytical information about how the ACCT will fit into the course composition process used by real educators. This will look at how the trial participants use the ACCT when composing their adaptive personalised courses. The goals and objectives will be observed through both a qualitative and quantitative process as illustrated in the evaluation strategy section of this paper.

1.1 Usability of the ACCT

According to [6] there are four suggested principles of good interface design. Firstly, the state and the action alternatives should be visible. Secondly, there should be a good conceptual model with a consistent system image. Thirdly, the interface should reveal good mappings that reveal the relationships between stages. Finally, the user should receive continuous feedback.

Based on these key principles the ACCT will be evaluated in terms of its

- informative feedback/responses to user interactions, such as file opening, action cancelled, drag and drop and error feedback dialogs.
- communicated conformance with elements of the Adaptive Course Construction Methodology
- identifiable cyclical approach to building an adaptive course
- terminology used by the ACCT, referring to Concept Space, Narrative Structures, Narrative Attributes and Learning Activities.

These are essential in given the user a sense of control, consistency and predictability using the interface of the ACCT.

Within the process of evaluating this research, the multiple modelled elements used in developing personalisation eLearning will be evaluated for their flexibility, reusability and accessibility. These main design elements are the Subject Matter Concept Space (SMCS), the Narrative Structures (modelled pedagogical guidelines), Narrative Attributes (modelled personalisation axes) and Learning Activities.

1.2 Integration with Existing Course Development Processes

As previously mentioned, one of the key barriers to the mainstream adoption of adaptive educational hypermedia systems, is the inherent difficulty of placing a person who is not an adaptive system engineer in an environment that allows them to build the "assembly language" required for adaptivity. Based on this, the trial participants were chosen from an educational background; instructional developers, subject matter experts and general educators.

The goal of this section of the evaluation is to understand and identify if both the adaptive course construction methodology and the ACCT would fit into an educators process of creating educational experiences while enhancing the produced educational experience with "personalisation". This will also aim to illustrate how the ACCT transparently disguises the technical difficulties inherent in authoring adaptive systems. This will lead to initial findings

into whether or not the people, who we need to be using these adaptive educational systems i.e. the educators, will actually adopt adaptive personalised educational systems as a tool in their day to day teaching.

2 Evaluation Strategy

In order to evaluate this research within the area of next generation personalised eLearning development tools a series of four personalised eLearning development workshops were held. The workshop participants, ranging from 4-25, varied from adaptive system engineers to instructional design experts to secondary-level school teachers. The general schedule of the workshops consisted of introductory presentations of personalised eLearning, followed by demonstrations of personalised eLearning systems and then a live demonstration of the Adaptive Course Construction Toolkit (ACCT). The interactive part of the workshop consisted of the participants carrying out a prescribed series of tasks such as creating a course package, importing and customising existing personalised eLearning models, building a customised activity-oriented pedagogical strategy, searching and selecting learning resources and publishing and testing their adaptive personalised eLearning course. These tasks would demonstrate the potential of the ACCT to trial participants and also provide them with an opportunity to thoroughly investigate all aspects relating to ACCT usability. Analytical data regarding the ACCT, the adaptive course construction methodology and the workshop organisation was collected through a series of qualitative and quantitative evaluations. The participants each completed a 42point Likert-type questionnaire with a variety of open and closed question types, covering aspects of their background skills, their ability to complete the given tasks using the ACCT, their interpretation of the usability of the ACCT and their satisfaction with the trial environment. The trial participants then participated in open discussion regarding all aspects of this research.

By implementing this evaluation strategy a series of steps would be followed:

1). Performance analysis of the trial participants with the set scripted tasks of the evaluation. The following tasks would to be completed during the trial (in the given order).

1. Course Package
    a) Load a course package
2. Subject Matter Concept Space
    a) View a Subject Matter Concept Space (Domain Ontology)
3. Narrative Design
    a) View Narrative
4. Course Package
    a) Create a custom course package
    b) Import information models from an existing course package
5. Subject Matter Concept Space
    a) Save a Subject Matter Concept Space (Domain Ontology)
    b) Edit a Subject Matter Concept Space (Domain Ontology)
    c) Export a Subject Matter Concept Space (Domain Ontology) as SVG
6. Narrative Design (Building a personalised eLearning design)
    a) Apply Narrative Structures (Pedagogical Strategies)
    b) Sequence Learning Activities
    c) Associate Subject Matter Concept Space
    d) Attach Narrative Attributes
    e) Save Narrative Model
7. Search for and Select Learning Resources
    a) Create a new Search
    b) Use Quick Search

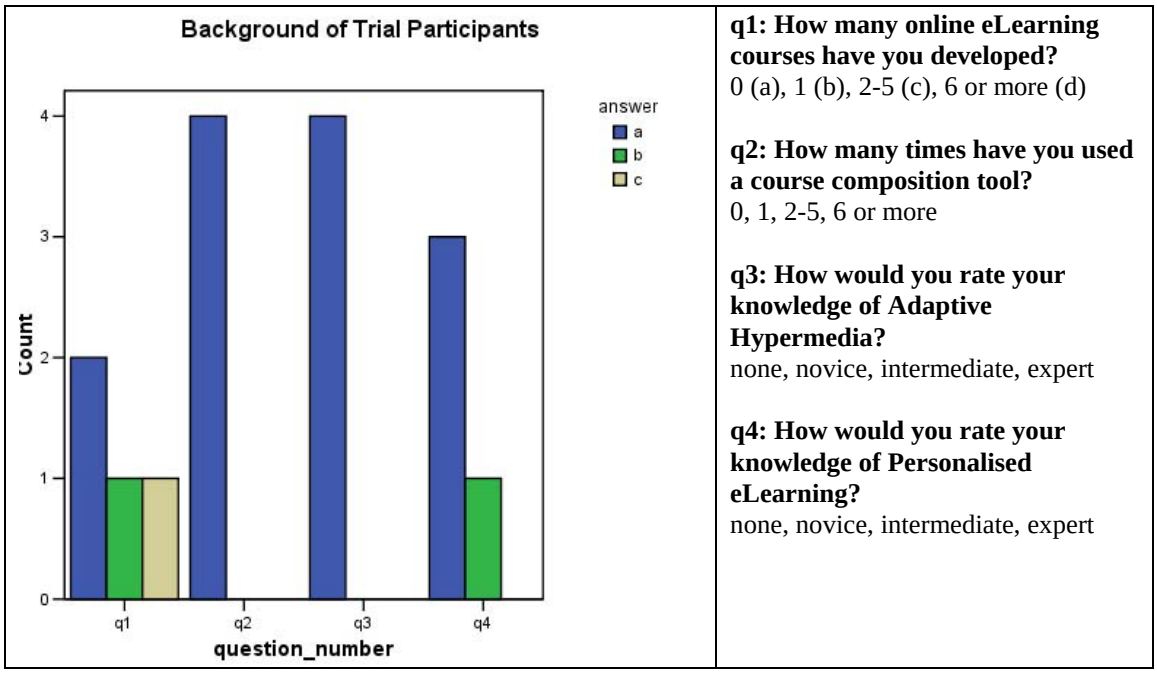
8. Publish Course Package
    a) Test Publication Connection
    b) Publish Course
9. Course Verification
    a) Build a sample instance of a Learner Model
    b) Run Adaptive Course against the Learner Model

2). Usability analysis of the ACCT and modelled personalised eLearning design elements. Based on the trial participant's completion of the above tasks, measures of usability were obtained through focused questionnaires.
3). Terminology analysis of ACCT and modelled personalised eLearning design elements. This aspect of the evaluation elicited qualitative and quantitative feedback from the trial participants regarding the terminologies involved.
4). A general discussion session at the end of each workshop was used to elicit any further comments, compliments and criticisms regarding the "realistic" adoption of personalised eLearning as a powerful and usable tool for educators, the methodology that forms the foundation of the ACCT, the modelled design elements of personalised eLearning and general design issues of the ACCT.

4 Evaluation Analysis

The evaluation analysis phase concentrated on three core components, namely the representation of disparate models used in the development of personalised eLearning, the usability of the ACCT development environment and finally the general usability of personalised eLearning in educational settings. The evaluation presented in this paper is the most recent evaluation of the ACCT carried out with 4 subject matter experts, instructional designers and educators from Intel Ireland and Skoool.ie.

Figure 1) Results of Background Questions



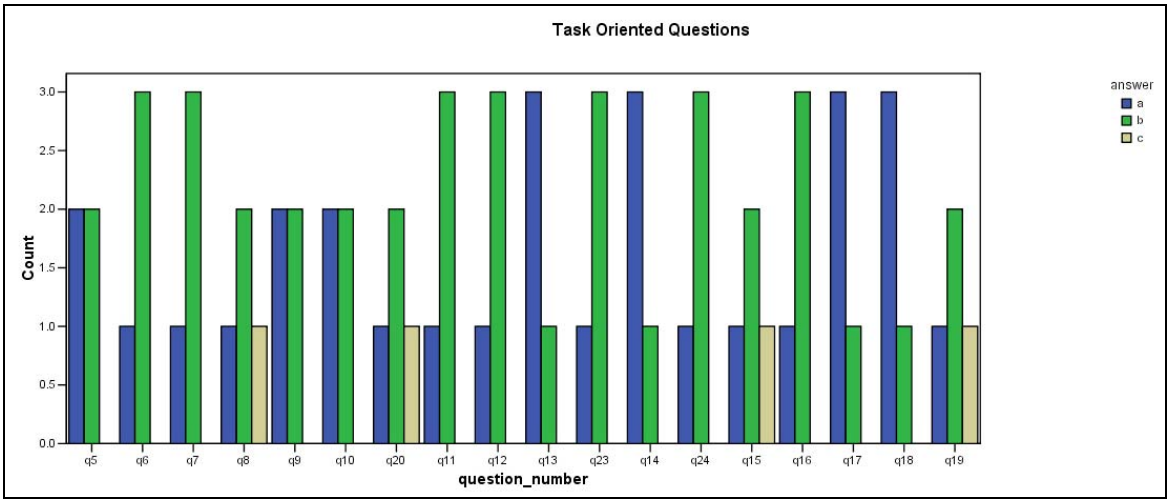
As illustrated in figure 1 above, the majority of trial participants, although general educators, have little experience in creating eLearning courses or using course composition tools. It can also be noted that these participants were not adaptive systems engineers or personalised

eLearning developers. This illustrates that the base of the trial participants was solidly rooted in traditional educational paradigms.

4.1 Personalised eLearning Development Models and the Adaptive Course Construction Methodology

The unique approach used by the ACCT expands the extensive research carried out by the knowledge and data engineering group at the department of computer science in Trinity College Dublin. Namely, it extends the flexibility of the multi-model meta-data driven approach to adaptive systems engineering [1]. Extensions in pedagogical, subject matter area, personalisation axes and learning activity modelling were made to increase flexibility and reusability of these disparate information sources for personalised eLearning development. The ability to compose adaptive personalised courses from these information sources based on the adaptive course construction methodology using the ACCT has proven very successful.

Figure 2) Results of Task-Oriented Questions



The questions illustrated in figure 2 aimed at addressing the user's ability to perform the specified tasks of the trial. As a general analogy, "a" type answers reflect a very positive response to the ACCT's ability to support the performance of a task and "d" type answers reflect a very negative response to the ACCT's ability to support the performance of a task. From the distribution in the graph, it can be claimed that in general, the ACCT can positively support the performance of the multiple tasks of personalised eLearning composition. This part of the evaluation also consisted of several open type questions where participant's views and comments were elicited.

From a technical point of view, the standards independent representation of the disparate design elements functionally promotes and supports their reuse on a number of different platforms and environments. For example, the pedagogical and learning activity models can be represented in IMS Learning Design, the subject matter concept space can be represented in OWL and the personalised eLearning narrative can be represented in IMS Learning Design level B.

From an educational aspect, the participants felt that the separated models provided an insightful view of the roles played by the different information sources in the composition of and also the execution of the personalised eLearning designs. More specifically, questions 19 and 20 addressed the participants understanding of the roles of the subject matter representation and the personalised axes, respectively, in the creation of personalised eLearning experiences. Through the course publication mechanism, question 18, the course

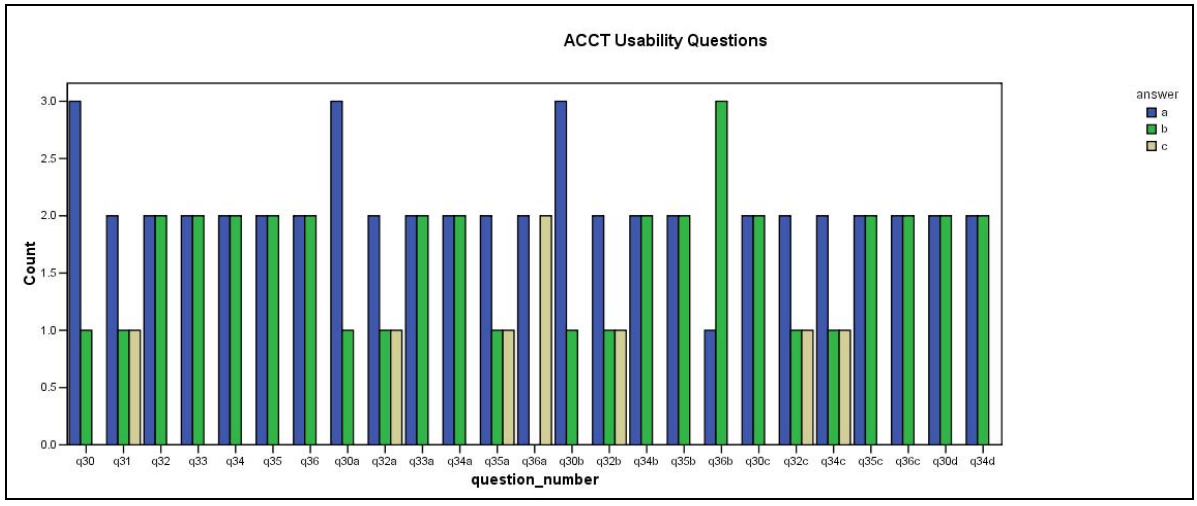
developers could see and interact with the courses that they created, in real time, and then use the ACCT to edit and modify the models and republish their courses. This facility was of key importance in the participant's realisation of the roles played by the disparate models in a personalised eLearning experience.

The participants complemented the graphical representation of the subject matter concept space (in the open questions), commenting that the visualisation of subject matter concepts and their interrelationships formed a very intuitive and real representation of subject matter areas. By keeping the subject matter concept space independent of content, the participants identified the flexibility of this approach in facilitating and promoting the reuse of this knowledge. Based on open discussion, it was identified that the trial participants felt that the workspace for building the personalised eLearning design (Narrative) was very intuitive and supportive. The supporting models of pedagogy, learning activities, subject matter and personalisation axes made the task of composing the adaptive course easy to perform. This flexibility supports the rapid prototyping of personalised eLearning course structures. The ability to interact with and select content from multiple remote learning resource repositories facilitated the instantiation of the realistic personalised eLearning experiences.

4.2 Usability of the Adaptive Course Construction Toolkit (ACCT)

The interface of the ACCT is an easy to use drag and drop composition environment supporting the course developer in building personalised eLearning experiences. Based on the responses of the trial participants, the ACCT interface is intuitive, easy to use and very supportive in feedback and closure notifications when actions are performed.

Figure 3) Results of Usability Questions



The usability questions illustrated in figure 3, addressed the ACCT's use of terminology, messages and informative feedback, error prevention and error correction, predictability and reliability from a completely technical perspective. As the distribution of the graph depicts, the trial participant's responses to the general usability of the ACCT were typically positive. For example, question 32 relates to the informative feedback (through dialogs and systems responses) provided by the ACCT and question 33a relates to the predictability of performing a system operation.

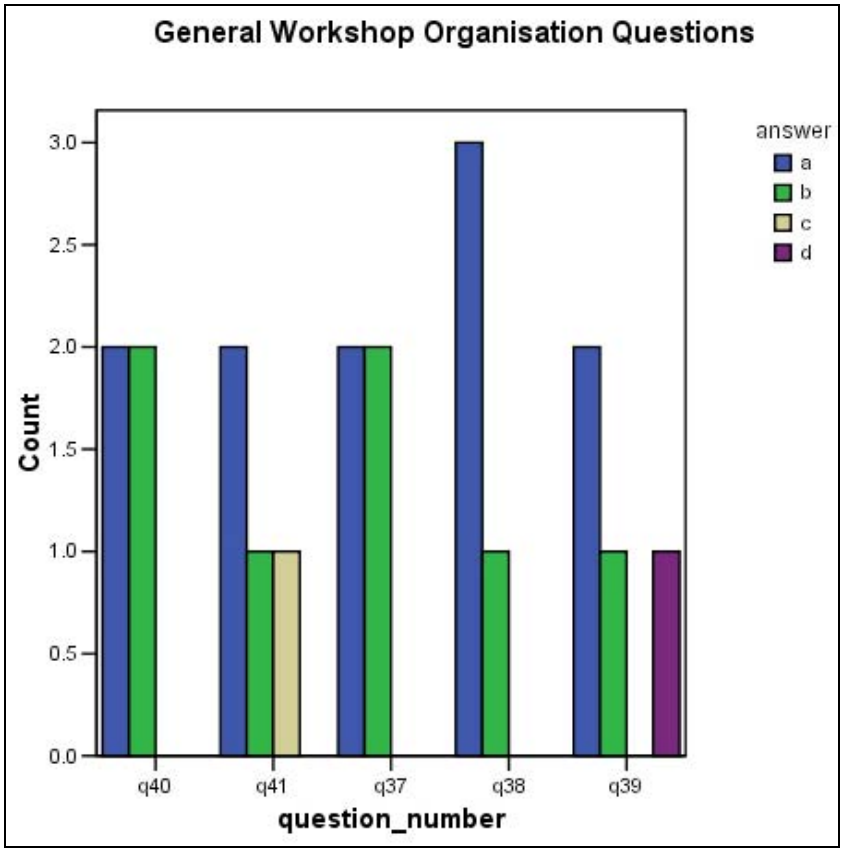
However, some higher-level usability issues with the ACCT were identified at this stage of the evaluation. For example, the flat list representation of subject matter concepts available during the composition of the adaptive course does not effectively visualise the graphical nature of the relationships that exist within the concept space. This inadequate

visualisation of the subject matter concept space slowed down the course composition process, according to comments from the trial participants. Based on suggestions from the trial participants, the visualisation of instantiated narrative, i.e. narrative with content, was confusing since the associated learning resources where not displayed in the graphical view. Having to right click on a concept and select "view candidate resources" slowed down the course composition process. These and other usability issues are currently being addressed.

4.3 General Usability of Personalised eLearning

Although the beneficial contributions, to day to day education, offered by personalised eLearning was realised by the trial participants, one of the key findings of this evaluation and the primary obstacle identified by the trial participants involved the terminology of adaptive educational systems, as illustrated by question 39 in figure 4. This became very clear from both the open questions of the evaluation and the general discussions of the workshops. The educators who we need to be using these systems are not familiar with the terminology and notation of adaptive hypermedia or the semantic web. They therefore do not initially understand what terms such as ontology, narrative, adaptive axes, subject matter concept space actually mean. This was one of the main criticisms from trial participants; the learning curve involved with identifying and understanding the meaning behind the terminology of personalised eLearning was quite steep.

Figure 4) Results of General Workshop Questions



5 Conclusions

Current research focus will develop mechanisms to support exporting standardised representations of the disparate information models specified by this research. We are building a plug-in to facilitate the ACCT in producing IMS Simple Sequencing and IMS

Learning Design so that personalised eLearning experiences developed with the ACCT can run on standards conformant Learning Management Systems (LMS). A residual affect of this evaluation is the pioneering of a fundamental requirements specification phase for effective personalised eLearning development environments (PEDE).

Based on the evaluation of this research it has been identified and proven that with an environment such as the ACCT it is possible for technical and more importantly non technical course developers to use, reuse and repurpose the disparate models of personalised eLearning in order to compose adaptive personalised eLearning experiences. The evaluation proved that non technical course developers can understand how the disparate models are used in concert to produce personalised eLearning experiences without having to understand the underlying technologies and representation languages. Based on the enthusiasm of the trial participants it indicates an appetite for developing and using personalised eLearning in their day to day teaching.

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