EVALUATION-CENTRED DESIGN OF E- LEARNING COMMUNITIES: A CASE STUDY AND REVIEW

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ABSTRACT

This paper describes a proposal for a evaluation-centred design model based on use of the Star Lifecycle over a number of years in different industries. This paper outlines the five stages of a new star lifecycle, which are based on the various sectors of the e-learning industry, those being Consulting, Content, Technology, Services, and Support. The methods, tools and techniques for carrying out each of the five development stages are evaluated, with examples and practices from the development of systems in three projects, including Llantrisant Online. These practices are reviewed and modern practices, such as the use of scenarios in the design process are highlighted.

KEYWORDS

virtual community, e-learning systems, usability, sociability, heuristic evaluation, scenarios

1. INTRODUCTION

In the summer of 1999, the first of three projects evaluated in this paper began, known as the Virtual Environments for Communities and Commerce (VECC). This Project sought to explore the Star Lifecycle development model proposed by Hartson & Hix [1] and later accepting modifications to it by Preece [2] and utilise it to develop a number of e-learning and e-commerce communities. The most major of these was Llantrisant Online, a large large-scale development project to create an e-learning community to educate people about the culture and history of the town of Llantrisant through bringing together the various community groups in the town, including the Freemen of Llantrisant and the Parish Church. The Trust imagined a place where everyone in the town would be able to learn about history of the town including the Freeman tradition. The result of a year of development and evaluation resulted in Llantrisant Online, an extensive e-learning community with 2.43 percent of the town's population signed up as members. Llantrisant Online (Figure 1) provides members with message boards, chat groups, learning materials on the historical and cultural background of the town as well as several communities that form part of other virtual communities, such as prayer groups, genealogy search facilities, greetings cards, recipes and details on church services that they can access from any web-browser or Internet-enabled digital television. Despite a short timescale and a limited budget, Llantrisant Online was a success, with a large amount of interest in its unique features, such as the Circle of Friends, and an option to search the Freeman Roll, a database of names of those who are related to the burgesses of the ancient borough of Llantrisant. This case study assesses the approach that was adopted to develop Llantrisant Online, including all the tools and techniques that can be deployed to build a successful user-centred e-learning community.

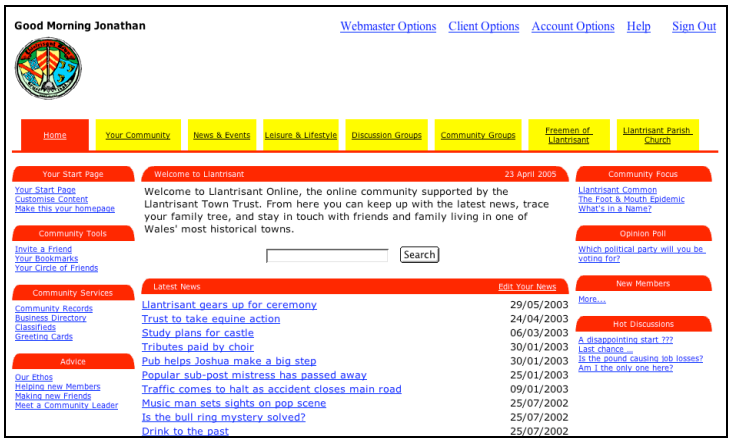

Figure 1. Llantrisant Online

The second of these projects was the Digital Classroom of Tomorrow (DCOT) Project, which was commenced on the belief that the classroom of tomorrow with be digital and will involve learners using a range of devices from desktop computers to laptops and PDAs to Mobile Phones. The project drew on the experience of educators and experts at Bryn Celynog Comprehensive School and the University of Glamorgan to develop solutions for their students and individuals in the community with specific learning requirements and to support them in doing so. The aim of the project was to put into practice specific methodologies for designing, developing and evaluating e-learning systems and to develop and refine models applicable to the development of e-learning systems with practical benefits for education. To do this the project involved developing a number of e-learning systems that make use of innovative technologies for learning in the classroom and at a distance. The DCOT Project produced a modified version of the Star Lifecycle, suitable specifically for e-learning communities. The third project evaluated in this paper is the Clicks and Mortar Environments for Learning and Leisure Experiences Project, which brought project management experience from the construction industry to the e-learning industry to refine the model further into its current form.

1.1. Virtual Communities in Context

It has been argued that virtual communities have the potential to radically transform social interaction and community formation [3]. While there have been definitions of virtual communities based on the forms they take from websites that provide facilities to discuss particular subjects or interests to groups of people communicating using instant messaging tools [4], there exists a possible social definition, which could be that an information system is an virtual community if those that use it have to go through the Membership Lifecycle identified by Kim [5]. Kim's lifecycle proposed that individual members of virtual communities would begin their community life in each community as visitors, or Lurkers, then after breaking through a barrier would become a Novice, and settle in to community life, become a Regular through regularly posting content, and then if they are fortunate enough break through another barrier to become a Leader, and then once they have been in the community for a considerable amount of time become an Elder. Primary genres of virtual communities based on this definition are easily identified by the technology platforms they are based on. Using the above definition of a virtual community, it is possible to see the personal homepage as an virtual community as in some cases those that use it have to go through the membership lifecycle in order to post messages to a 'guestbook' or join a 'Circle of Friends'. According to Kim [5] a message board is one of the most familiar genres of online gathering place, which is asynchronous, meaning people do not have to be in the same place at the same time to have a conversation. An alternative to the message board is the email list, which is the easiest kind of online gathering place to create, maintain and participate in (ibid). Another genre of virtual community that facilitates discussion in the Chat Group, where people can chat synchronously, communicating

in the same place at the same time [6]. A genre of virtual community that has existed for a long time, but is also becoming increasingly popular is the Virtual World, which may be a Multi-User Dungeon (MUD) or some other type of online fantasy game, where actors create their own world and interact with others. Two relatively new types of virtual community are the Weblog and the Wiki. Despite the newness of these they could perhaps be augmented with older models of hypertext system. The Weblog has a similar structure to the Internet Directory, such as Amazon.co.uk and BlogExplosion.com, where the owner of the site sets the topics or products and users of the site are asked to leave comments. The Wiki can be seen to have a similar structure to Hypertext Fiction systems, where the owner of the site invites individuals to add nodes to the system and link them together. of specific virtual community genres.

2. A LIFECYCLE FOR DEVELOPING E-LEARNING COMMUNITIES

The three projects were carried out using evaluation-centred design, which although a process that has been around since the late 20th century, has only be considered appropriate for e-learning communities since the early 21st century. One of the most flexible evaluation-centred design methodologies introduced was the star lifecycle [1]. Since its introduction in 1989, the star lifecycle for interaction development has been used and refined by developers of computer systems. The original model, so named because of shape, contained six points that are not ordered or connected in a sequence, meaning developers can theoretically start with almost any development activity and move on to any other one. This methodology is particularly suitable for developing usable applications, but even the 1993 version of the model was not entirely suitable for developing e-learning communities. This version of the model was highly focussed on evaluating the usability of a system, which did not take into account the importance of evaluating learning aspects of virtual communities. The model was adapted by Preece [2] to consist of five points, with greater emphasis on evaluating the system as a whole, and not just the usability. After use on the VECC Project the first stage of Preece's adaptation was changed to become 'user experience analysis', which placed a greater emphasis on discovering what the user wants to experience, as opposed to the tasks they may or may not carry out. The model proved challenging on the CAMELLE Project, where the model was used outside of the IT industry, and practices from the construction and e-learning industries were taken account of, leading to the model presented in Figure 2.

Figure 2. A star lifecycle for developing e-learning communities

3. DEVELOPING E-LEARNING COMMUNITIES USING THE STAR LIFECYCLE

The lifecycle, presented in Figure 2 offers developers of e-learning communities a clear and flexible methodology for developing e-learning communities that allow users to become part of the community and easily communicate with others, through a system that is both usable and

promotes learning. There are many techniques for carrying out these activities, which have been used in some or all of the three projects. Five stages are proposed, which are Consulting, Content, Technology, Services and Support, based on the five sectors of the e-learning industry.

3.1. Consulting

The Consulting stage was identified as it forms a core part of the industries the three projects were developed in.

3.1.1. Feasibility Studies

According to Uher and Davenport [7], this part of the Consulting Stage involves attempting to assess whether or not the proposed development scheme will meet the objectives of the project as they have been defined.

3.1.2. Project Initiation and Contract Selection

Uher and Davenport [7] indicate that the strategic planning part of a project involves formulating the most appropriate strategy for the preferred development proposal defined in the feasibility study. It defines the extent of the work to be undertake, why it is being developed, who is going to do it, when it is going to be done and what it will cost, and how it is going to be done. The project brief part of a project according to Uher and Davenport involves producing a detailed account of the proposed development and contract selection involves determining the obligations of each party to the project.

3.1.3. User Experience Analysis

This part of the consulting stage of the lifecycle involves analysing what the user wants to experience in the e-learning community. The development of systems in the VECC and DCOT Projects involved successfully using competitive analysis, focus groups, interviews, surveys and questionnaires, and in the case of the VECC Project methods less relevant today, including user needs analysis and user task analysis. Competitive analysis involves analysing existing websites, such as other e-learning communities that have similar objectives. These sites can be analysed to determine strengths and weaknesses and to derive and informal set of desirable features [8]. When this methodology was used, it was carried out by a representative sample of potential users of the community as suggested by Nielsen [9].In the case of Llantreisant Online these users were asked to evaluate 6 websites with similar objectives to site, including 2 virtual communities, and indicate what they liked about them. Users tended to focus on specific features and provide constructive criticism on what they did not like. For the focus groups used by Llantrisant Online, 4 representative members, as suggested by Draper [10] were asked their opinions on a variety issues, including the features they would like to see and concerns they have. Focus groups are run by a moderator, who is responsible for maintaining the focus of the group on whatever issues are of interest [9] Questionnaires and surveys are a simple way of evaluating existing systems and getting an idea of what the user wants to experience using the new system through providing detail information [11]. The surveys and questionnaires used in the development of Llantrisant Online asked potential users what features they would like to see on the site and they indicated that they would like features such as chat rooms, message boards, local news and greeting cards, among others. The Preece version of the star lifecycle recommend carrying out an analysis of the needs of the community and its users. Llantrisant Online adopted the Hierarchy of Needs [12] as the basis for understanding user needs, as recommended by Kim [5]. This process involves designers identifying what needs the user may want to meet in the virtual community. In the design of Llantrisant Online this process identified a number of needs of users, particularly social needs, which were provided for in the form of chat rooms and message boards. Whilst carrying out an analysis of user needs can lead to developers including specific features and excluding others, there have been criticisms of needs-based methodologies since Llantrisant Online was developed, including by Bishop [13]. These have suggested that users do not use virtual communities to *fulfil* needs, but to *act out*

desires, which are created by binary opposition forces. Identifying the desires that a user might want to act out can be done through using scenarios. Scenarios, as proposed by Carroll [14] provide designers with flexible examples of what users would like to do in the system, allowing them to identify the user's goals and their desires. Scenario-based design methods [15] are an alternative to task analysis that was suggested in the Preece version of the lifecycle and adopted in the design of Llantrisant Online. Through focusing on the goals and plans of the user as opposed to the tasks they may or may not carry out, scenario based design allows developers of virtual communities to get a significant understanding of what the user wants to experience in the community.

3.2. Content

The Content stage of the lifecycle involves the planning of learning and sociability of the proposed e-learning community.

3.2.1. Planning learning and sociability

Planning the learning of the community is an important part of any e-learning communities. There are essentially two types of learning that can occur in virtual communities – formal learning and informal learning. Techniques for planning formal learning are well developed, with instructional design forming a key part of e-learning projects. Stubbs & Watkins [16] identified five areas that they argue are common in instructional design methodologies and essential for learning to transpire or for learning to be more meaningful, which are pre-requisites, learning objectives, illustrative examples, problem solving and reflection. Whilst the texts they used as a premise were based on behaviourist approaches to learning, Stubbs & Watkins' conclusions still appear sound today. Planning informal learning is less universal in the design of e-learning systems, but should form an important part of designing e-learning communities. Informal learning includes anything a learner does to gain knowledge, skill or understanding from learning about anything that interests them outside of formal or organised courses that occurs either individually or collectively [17]. Informal learning can occur though users of e-learning communities interacting through communication tools such as message boards and chat rooms, so it is important to consider these technologies in addition to technologies that enable formal learning, such as Flash. When considering the technologies to use, the developers had to take into account issues of accessibility, usability and appropriateness for learning. They eventually adopted server-side technologies that outputted HTML to ensure compatibility with standard browsers and digital television set-top boxes.

3.3 Technology

This stage of the lifecycle involved selecting technology, designing, implementing and testing prototypes and refining and testing usability, sociability and learning.

3.3.1 Selecting technology

During this stage, the goals and requirements of users that are identified during the user experience analysis are mapped to generic technologies or new software is developed. Preece [2] suggests this involves selecting software available via the Internet and tailoring it to provide usability for the intended community. Whilst there are many Internet applications that offer virtual community services, some projects required the system to be built from the ground up, as was the case with those on the VECC Project, which means going through a more thorough process of assessing what technology should be used to provide the user with what they wanted to experience. Models of virtual communities were also identified and the advantages and disadvantages of each analysed. Selecting community models is a challenge for developers of e-learning communities, and is dependent on available resources such as funding and expertise of those commissioned to build the community.

3.3.2 Designing, implementing and testing prototypes

During this stage the goals and requirements of the users of the intended virtual community are mapped with the features of possible software and the overall conceptual design is determined. This stage can utilise methods such as rapid prototyping [18]. Preece [2] suggests that this stage can involve many small iterations of design-and-test or in larger projects, as was the case on VECC, there will be a clear schedule with milestones and deliverables. When designing the system, developers should consult design guidelines to determine the most effective means of meeting the goals of users [8]. The VECC Project took into account a number of guidelines in the design of the virtual community, which fell into three categories; usability guidelines, sociability guidelines and e-learning guidelines. Usability guidelines have existed since the beginning of the microcomputer revolution. Smith & Mosier [19] produced 60 usability guidelines, of which many are still relevant today [20]. The usability guidelines chosen during the projects included avoid using frames [21], which was particularly relevant to Llantrisant Online as it was made available via digital television, avoid long pages with excessive white space, and include a search input box [22]. E-learning guidelines that were adopted throughout the projects included; ensure content is credible with sources identified, accurate and relevant, ensure that learning materials are prepared by qualified content experts with the author identified, ensure that materials are readily available and learning friendly as well as well organised. Once the guidelines have been implemented into the prototypes, there are two main approaches to evaluating them; one is to use experts in usability and sociability and the other is to use real users who are representative of those who will use the e-learning community. Expert users can carry out detailed usability evaluations, such as heuristic evaluation [23], a methodology that was used to evaluate the systems developed in the projects. Heuristic evaluation is a method for finding usability problems in a user interface design by having a small set of evaluators examine the interface and judge its compliance with recognised usability principles, which falls into the general category of usability inspection methods [24]. Heuristic evaluation in probably best carried out by experts at this prototyping stage so usability problems can be identified and resolved before the system is tested on real users. Real users can be involved at the prototyping stage and provide developers with opinions on the system and whether they feel it meets their goals. Bishop [15] investigated the Wizard of Oz technique [25] finding it to be useful for evaluating how the user interacts with the system. Bishop also found that giving the users a scenario to act out and interviewing them about their experience afterwards can provide qualitative data about what the user experienced when using the system, which can allow developers to compare the prototype system with what the user asked for at the user experience analysis stage of the lifecycle.

3.3.3 Refining and testing usability, learning and sociability

This part of the technology stage, which is adapted from Preece's [2] interpretation of the Star Lifecycle, involves more formal, larger-scale testing of usability, learning and sociability to carried out with issues being resolved. There are a number of methods to test usability at this stage of development, including the thinking-aloud technique and interviewing, both must involve using real users to be successful. The development team of Llantrisant Online used the thinking-aloud technique to evaluate how specific types of users interacted with the system. Thinking-aloud involves having real users using the system while continually thinking out loud [26] and it is argued that this technique is the single most valuable usability engineering method [9]. The thinking-aloud technique allows developers to get a considerable amount of qualitative data from a small number of users, and this was certainly found to be the case when it was used to evaluate Llantrisant Online. Testing formal learning at this stage can be done through a number of means, including assessing whether the learning objectives have been met. One of the most effective ways of doing this is to question the users about their knowledge of the topic (e.g. Llantrisant and its Freeman tradition) before using the e-learning community and afterwards. Testing informal learning is more challenging at this stage, as learners have not yet

been formally welcomed to the community as users, with a small number only playing a role as evaluators. However, techniques such as interviewing can establish whether the users believe they will be able to learn beyond the formal lessons provided in the e-learning community.

3.4 Services

This stage of the lifecycle involves publicising the community and 'seeding' it, as well as welcoming new members [2]. Publicising the community can be done through a variety of media channels, including in print and over the air. Publicising in print usually involves producing news releases and offering interviews to journalists. A news release is a one- or two-sided document sent from an organisation to a journalist containing a news story or occasionally useful information, to encourage the journalist to use the story [27]. Three news releases were sent out to publicise Llantrisant Online, which were received with interest by the media. The news releases, which contained details on the features of the virtual community and its location, resulted in interviews with the media and publication in the news pages of local newspapers. To seed the community, members of the Llantrisant community that held prominent positions, such as the vicar of the church and local politicians, were given the role of community leaders in Llantrisant Online. Appointing leaders, particularly ones known to the members can be an effective way of encouraging users to participate. In Llantrisant Online, these leaders encouraged members of the community to take part through posting responses to messages and taking an active role in promoting sociability and learning.

3.5 Support

The support stage of the lifecycle is an ongoing process of ensuring the system meets the goals of the users. Evaluating the community at this stage can be done through a variety of means, including analysis of usage metrics, server log analysis, follow-up surveys and email feedback. Llantrisant Online recorded several metrics, including the response rate to invitations and membership levels, the number of times specific posts or help topics were accessed, and the use of specific features such as the user profiles, message boards and the Circle of Friends. Data was collected over a period of two weeks from the launch of the site and analysed. Analysis of the data revealed a number of things useful to the development team. Membership data showed that 99 users went through the registration process and signed up during this period, demonstrating significant interest in the community, most likely as a result of the media publicity generated. The metrics showed that 90 percent of registered users used the user profiles feature, suggesting that this key feature was received well. Evaluation of the community should be an on-going process, particularly in the case of learning. Nielsen [28] and Cunliffe [14] recommend continuing competitive analysis. This can be done through inviting members of the community to evaluate newer virtual communities to identify the features they like for developers to include in the design. Assessing learning should also form a part of the on-going evaluation process, particularly informal learning. Informal learning can become evident in message boards, especially in communities like Llantrisant Online, which support genealogy searching, as someone using it will post enquiries about the location of their family members and get a response from other users.

4. DISCUSSION

In the summer of 1999, the first of three projects evaluated in this paper began, known as the VECC Project. This Project sought to explore the Star Lifecycle development model and utilise it to develop a number of e-learning and e-commerce communities. The most major of these was Llantrisant Online, a large large-scale development project to create an e-learning community. The second of these projects was the DCOT Project, which was commenced on the belief that the classroom of tomorrow with be digital and will involve learners using a range of devices. The third project evaluated in this paper is the Clicks and Mortar Environments for Learning and Leisure Experiences Project, which brought project management experience from

the construction industry to the e-learning industry to refine the model further into its current form. The Star lifecycle was utilised throughout the three projects, though proved challenging on the CAMELLE Project, where the model was used outside of the IT industry, and practices from the construction and e-learning industries were taken account of, leading to model proposed in this paper. The lifecycle now offers developers of e-learning communities a clear and flexible methodology for developing e-learning communities that allow users to become part of the community and easily communicate with others, through a system that is both usable and promotes learning. There are many techniques for carrying out these activities, which have been used in some or all of the three projects. Five stages are proposed, which are Consulting, Content, Technology, Services and Support. The Consulting stage was identified as it forms a core part of the industries the three projects were developed in. The Content stage of the lifecycle involves the planning of learning and sociability of the proposed e-learning community. Technology of the lifecycle involved selecting technology, designing, implementing and testing prototypes and refining and testing usability, sociability and learning. The Services stage of the lifecycle involves publicising the community and 'seeding' it, as well as welcoming new members. The Support stage of the lifecycle is an ongoing process of ensuring the system meets the goals of the users.

The evaluation-centred approach to developing e-learning communities learning lessons from the use of the Star Lifecycle could perhaps be one of the most effective means of ensuring that the end-users of the system are able to meet their goals and be able to act out their desires through interacting with an environment that promotes usability, sociability and learning.

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