STUDENT SEARCH BEHAVIOUR IN A DIGITAL LIBRARY

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ABSTRACT

Digital repositories have become increasingly popular in recent years, but suffer from poor levels of use by engineering designers. The aim of this work is therefore to evaluate student information searching behaviour using a digital library. The Integrating Design Project (IDP) was a 6-week project where students had to search for relevant information, develop concepts and prototype them. Throughout the project, all interactions with the digital library were logged by the system, allowing research and teaching staff to monitor activity. In addition, questionnaires were distributed to garner student opinion on the usability and usefulness of the library. There were several key findings, including: a need for embedded information literacy support; an advantage to close proximity of collaborative tools to the digital library; a tendency for students to browse for material; and peak usage at the project start and end. The student-generated nature of the material in the LDL gives the content a contextual quality it is hoped will encourage use throughout the design process and in diverse project arenas.

Keywords: Engineering design ,information retrieval, design data

1. BACKGROUND

Throughout the design process, large amounts of data must be managed by the design team [1]. When teams are working remotely, as is often the case in today's global, multi-disciplinary design projects, access to a shared information space where teams can store, organise and share project information is even more crucial [2]. The advantage of storing such information digitally is the ability to retrieve and utilise it quickly, making it ideal for the dynamic nature of the design task.

In response to this, a large number of digital libraries and repositories have been developed for engineering designers. Many of these existing resources, such as subject gateways and portals, however, suffer from low levels of utilisation amongst undergraduate students [3]. These resources can be unresponsive in informing design work as the information is stored in a hierarchical structure and presented in a traditional, multi-layered interface which is not necessarily orientated to the needs of designers. In recent years, systems such as Web-CADET [4] and ITCOLE [5] have recognised some of the problems regarding usage of such digital repositories, and have tried to enhance their transparency. From a product data perspective, systems such as the COLIBRI system have attempted to share design constraints across a team based on product CAD data [6]. There remain, however, usability issues [7] associated with the key aspects of uploading, accessing and sharing of information, and integrating these into the designer's daily design activity.

By rethinking these methods of interaction, it is hoped that team use of digital resources and subsequent project information management can be improved. This paper considers student behaviour when using one such repository in a short engineering design project. The Integrating Design Project (IDP) was a 6-week project to design a fruit squeezer where students had to search for relevant information (Phase 1), develop and select a concept (Phase 2) and prototype and evaluate it (Phase 3). A class of 80 students were placed in teams of four, making use of the groupware to search, store, share and organise their information and design work.

2. DEVELOPMENT OF LAULIMA

Since 1995 DMEM has been developing research in tools to support collaborative working with a strong emphasis on the working practices of designers. Recent work has focussed on the performance of globally distributed design teams, and the result has been the development of a digital repository for design engineers called LauLima, Polynesian for 'a group of people working together'. The repository utilises a split architecture to allow users to save, store, organise and share information in a way which will be useful to them as designers in an informal environment (the LLE), as well as a store of formal design information they can search and browse in a digital library (the LDL) which is added to with each project completed. This is in accordance with DMEM's preference of allowing designer's to work naturally with multi-media tools as a support, rather than insisting that work takes place in a specific manner or in specially customised areas.

The LauLima Learning Environment (LLE) has been embedded in the classroom using a constructivist pedagogy, and has had tangible impact on the design activity [8]. Student feedback in the form of polls, questionnaires, and feedback to staff has been positive from teams who have shown a high level of utilisation. They have cited strong team management benefits from using the system. It has also proved popular with students in terms of sharing and organising their design work, and creating new knowledge structures through linked team wiki pages, and there is confidence that LauLima addresses key needs of designers in relation to collaboration and design methodology.

The LauLima Digital Library (LDL) is a newer component of the system. Material, primarily student generated in the form of sketches, photographs, models and reports but also some links and external resources, has gradually been added and a preliminary interface is now in place to allow users to browse and search for resources. By increasing the proximity of a formal digital library with more informal collaborative tools, it is hoped to increase the utilisation of digital resources. This project, provided the first opportunity to observe student use of the library.

2.1 Uploading, sharing and accessing information

Three modes of interaction with the digital repository have been identified: the method of uploading material into the LLE; incentives to share information across both the LLE and the LDL; and downloading material from the LDL. This is based upon a revised version of Eris and Liefer's Design Knowledge Framework [9], which defines the three knowledge creation loops in relation to team design activity. Within each of these loops, there are key characteristic interaction modes (uploading, sharing and accessing) with the LauLima digital repository in relation to both formal and informal design information (Fig. 1). This model incorporates an information specialist and a design expert as part of the model to facilitate the process of information management and knowledge creation.

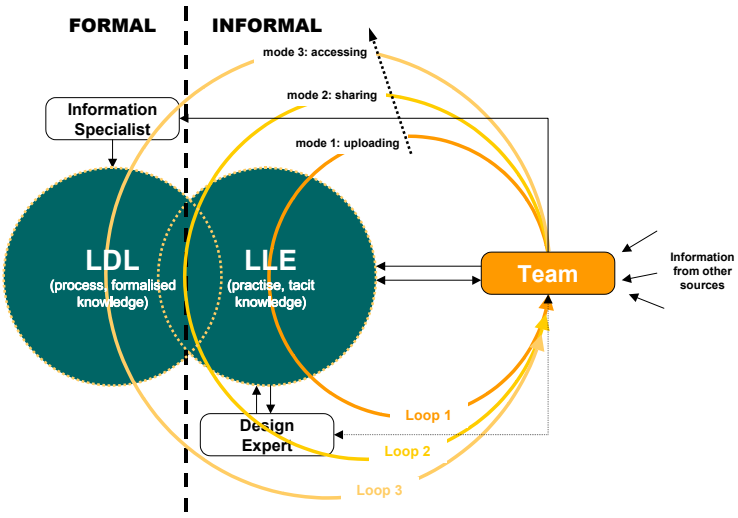

Figure 1. The Design Knowledge Framework after [9]

3. EVALUATION

Since this paper is concerned with how students interact with the digital library, therefore it is accessing mode which is relevant. Both logs of system activity and questionnaires have been used to garner feedback for this, and the results are discussed below.

3.1 Data logs

Throughout the project, student interactions with the digital library were logged by the system, allowing research and teaching staff to monitor searches (terms, fields, additional elements) and browsing (by Inspec terms, class, year, resource type) activities in detail (Fig. 2). Previous research [8] indicates that student design engineers prefer to browse rather than search for information. Analysis of the system logs illustrated a relatively low level of usage. However, the results did follow the expected pattern, in that browsing was more popular than searching for the duration of the project. It was found that the level of activity peaked in Week 3 when the students were concluding their information gathering stage, dropped off as they undertook concept generation, and increased again towards the end of the concept development phase. Although the number of downloads was also recorded, it was not possible to establish clear patterns due to insufficient data.

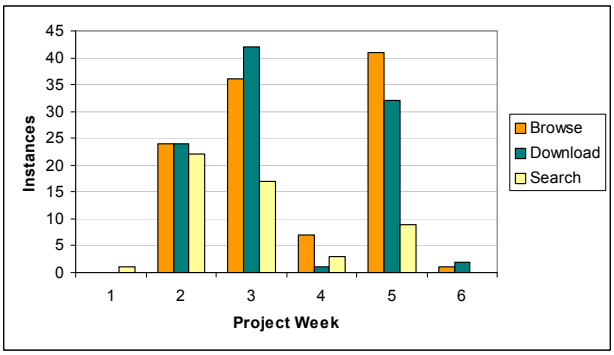

Figure 2. System logs for the 6-week project

3.2 Questionnaires

Questionnaires were distributed to garner student opinion on the usability and usefulness of the library, including preferred mode of navigation, quality of resources and ease of use. The two key questions were:

- Did you use the digital library? When?
- Were the overall resources beneficial? Why?

The low level of usage by students of the digital library was reflected in the response of the students. Various reasons were given , the main one being the perceived convenience of the system when compared to Google. "Easier" resources were cited as being more useful and more readily available, in particular Google or other web searches. These were regarded as "quicker to access" and "sufficient" for the needs of the project. This was generally not reflected in the quality of material gathered by the teams, which was on the whole variable, with only a couple of teams producing excellent resource repositories. Generally, feedback indicated that students searched the library during the research stage, with a limited number using it toward the end at the project hand-in. No-one responded that they used it in the second project phase.

The resources available on the library drew a mixed response. The students who had spent more time doing searches and browses found the material was useful and relevant to the project – there was one comment that pertinent information was there "without having to search" i.e. the material was closely related to the project being undertaken, and that being able to view exemplars provided "insight", i.e. was useful for identifying and stimulating ideas. There were, however, observations that specific searches proved problematic, giving unexpected or unwanted results. Also, some students felt that the library contained insufficient material, and again the internet was cited as a bigger resource where material could be found more easily. The time needed to access and use the library was highlighted as a problem.

4. DISCUSSION

The relatively low level of utilisation of the LDL was not altogether unexpected. The short project duration meant there was insufficient time to have a detailed session on how to use LauLima, and especially the digital library component: it was merely highlighted as a tool which could be used. Sessions providing exercises in looking for material which relates specifically to the project being undertaken are crucial to illustrate to students the benefits .

There was a common perception amongst students that the Internet and Google in particular was more convenient to use. Convenience was perhaps confused with familiarity, as when searching for specific resources, students generally failed to make use of any of Google's advanced search features. The LDL had a search facility similar to this, yet students felt it was troublesome to do an equivalent search. In part, this can be attributed to the interface, which is still in its early stages of development. On entering the search feature, the number of options is intimidating. The browse feature, for example, contains a high number of categories and terminology which are not very transparent, and require further investigation to reveal content. The development team is addressing this issue in the short-term.

When they did use the system, students favoured the browse over the search feature. This could be attributed to a lack of knowledge of information literacy and searching strategies,

where browsing is preferred to having to identify and combine appropriate search terms. Parallels can also be drawn to the visual and non-linear nature of creative design work – browsing through category lists and thumbnails is a convenient way to view diverse material and can spark new directions of thinking. Another contributing factor was the size of the library. Staff are continuing to populate it, but it remains feasible to browse through lists rather than conduct a search. Although there was no specific feedback from students on the browse categories used in the LDL, they seemed effective in this case. A mix of broad and specific terms were made available, reflecting their evolution from material gathered from this particular project context; highly suited to the design of crushing devices, they may require revision when the library is applied to other projects, and will require further evaluation.

System logs showed the library was used principally at the start of the project and again towards the end. There was a "ramp-up" as students were made aware of the library and asked to build information resources. This was anticipated, as it is the key point in the project for gathering new resources. Activity then dropped away as students entered the concept generation phase of the project. This activity traditionally takes place in the studio on paper, with designers sketching, comparing and improving ideas. It can be postulated that better integrated conceptual design tools, such as digital sketching pads, may have been helpful in allowing the retrieval of images of past work and relevant information. There was then another flurry of activity as the concept evaluation deadline approached and this suggests examples of past student work were being used for reflective purposes before the final hand-in.

As the project progressed, it was assumed that students would search for more precise information. Instead, the number of browse instances actually increased. The limited data set means that this issue requires further investigation in another project context. The data was also insufficient to reveal the types of resources which were accessed at different stages of the project. An advantage of the student-generated material contained in the library is that it provides valuable contextual information which is relevant throughout the design process and not just at one particular point. The activity prior to the project deadline is indicative of this, and methods of actively encouraging consistent use of the library is another topic for future investigation.

Student responses indicated that the material was generally useful. Currently, the bulk of material is related to crushing devices as it has been populated with material from previous classes. This provided an incentive to the students as they knew there would be highly relevant material they could use. However, the examples of good work, mistakes, key decisions and rationale are applicable to many design contexts. This material is broader than specific design data or information, and it is hoped that as the library is made available to other classes they will be able to make use of it in different project arenas.

5. CONCLUSION

This paper has highlighted some of the problems of encouraging student engagement with a digital library; new techniques are required to encourage the design team to engage with the information while continuing to work effectively in studio-based practice. From the IDP there were several key findings. It was found that adequate time must be allocated for information literacy tutorials and support, preferably with tailored exercises, to familiarise students with any library and its features. This is necessary to overcome the tendency for

students to fall back on Internet search engines, as these are perceived as more convenient, despite often being used ineffectively. The proximity of the LDL to the students' collaborative and sharing tools of the LLE gives the LauLima system an advantage in this regard, but use of the digital library component still suffered due to the short project timescales. Students principally engaged with the library through browsing, mirroring the type of activities undertaken during a creative design project: an iterative, non-linear process suited to viewing a large amount of visual material. It was found that the library was used primarily at the start of the project, indicating that students regarded the library as a source of fundamental design information. There was then a lull, suggesting that information could be more integrated into the process through digital sketching, or other similar, tools. Use of the library at the project end indicated it was used for comparative and reflective thinking. The student-generated nature of the material in the LDL means that it contains a lot of contextual, process related resources. In summary, the ultimate academic aim of university education is to encourage autonomous learning, and it is hoped that the rich source of student-generated material provided by the library, which encourages learning from examples, by mistakes and by building on existing ideas, is an effective way to develop this mode of thinking, and one which will provide resources students find useful throughout the design process.

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