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# Usability of Web-based Knowledge Portals to support Research Organizations

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## Abstract

Usability refers to the effectiveness, efficiency and user satisfaction of a designed product or system. One of the most of productive ways of measuring usability goals is through questionnaires and surveys. In this paper, we discuss usability related issues from a users' perspective in the design analysis of a web-based knowledge portal that was developed to support the knowledge management activities of an educational research organization. The original portal system initially experienced high levels of user participation. However in recent times, this trend had been reversed with flagging log-in access rates. Consequently, a criterion-based usability survey instrument was designed and implemented online to gather users' responses and comments. The survey outcomes indicated that a large number of respondents used the portal sporadically with a significant number being completely unaware of many of its services. Thus based upon this feedback, the existing portal was revamped to ensure a more user-centric design model that focused on the cornerstone aspects of user control, ease of navigation, personalization services and clarity in visual presentation of information.

**Keywords**: Application sin subject areas, knowledge portals, architecture for education technology systems, web-based design.

## Introduction

The Centre for Research in Pedagogy and Practice (CRPP) is housed within the National Institute of Education in Singapore. The Centre brings together researchers, educators and administrators to research into and develop new and innovative ways of teaching and learning. The Centre's key research goal is to redesign pedagogy in order to enhance instructional practices and make learning within schools a more stimulating process. With these objectives in mind, the Centre provides evidence as the basis for future educational policy and decision making in Singapore.

The Centre as part of its efforts to provide reports about its research and timely information launched its web-based knowledge portal in August 2003, called the CRPP knowledge portal. This portal was designed to create and share research based information amongst its distributed teams of academics, researchers and school collaborators. An elemental goal of the portal development was to create a central repository that could capture, store, and disseminate the empirical findings and intellectual input of its various stakeholders. The conceptual design of the portal was done by an instructional design team, supported in its efforts by the management staff of the Centre. The portal was developed by a third party vendor. The conceptual design of the portal was based upon the heuristics of a functional framework that intended to:

a) Capture and document the knowledge generated from the Centre's more than 60 research projects
b) Systematically organize and make accessible the different projects' proposals, its cases for support, research designs, findings and pedagogical implications
c) Share and dispense other relevant information that is collectively for and by the teams

Building upon this foundational knowledge management structure, the portal also has an open discussion forum where both CRPP's working staff and invited members of the public could participate in contributing ideas of mutual concern that have an impact upon the educational fraternity. Each research project has its own private collaborative work space with controlled access where team members could upload working documents, share content within these documents with fellow team members, solicit constructive feedback in improving content and ultimately have the documents assessed by project investigators or managers to ascertain if the documents can be published in the public domain for public viewing. Within each of these project workspaces, discussions forums were embedded to engender a communicative milieu, one that promotes dialogue on project updates and progress between team members who due to their busy schedules might otherwise not have sufficient time for face-to-face interactions. An additional service provided in the portal was a listing of the profiles, biographies, publication and contact details of CRPP's working staff. Yet another section in the portal disseminates information on upcoming events such as workshops, conferences hosted by CRPP. This information is vital for the general teaching community in keeping abreast of recent research developments in the education field. There is also a section that advertises career opportunities within CRPP and this can be viewed by the general public as well. The large database of information hosted by the portal is searchable using a basic search function that allows users to easily retrieve required information.

While the portal was designed so that key stakeholders could put their reports and public information directly to the general public accessed website, the concern for data security the individual decision making was turned off and only the IT administrative staff could post to the public site. The overarching concern for maintaining the accuracy and appropriateness of content posted on the public CRPP portal, the initial design modified and the portal's locus of control largely concentrated in the hands of the small administrative IT team. Thus most of the described features and services were largely managed by the IT team and information was normally updated on a periodic, just-in-time basis. While each staff member of the research centre was individually assigned a username and password to access the system, they could

only post to the sections not on public access and only to the sections where they were project team members. The portal was accessible anytime, anywhere and its users could access the organization's data remotely.

Initially the take-up rate of the portal was encouraging with the frequency of visitations and log-in access of the various features of the portal, especially by CRPP staff steadily increasing over the months. The portal experienced considerably large amounts of web traffic in the early phases of its rollout. However eighteen months later, there has been a reversal in this trend with the usage rates sharply declining despite an exponential rise in CRPP's staff strength.

Although the portal was deemed to have been developed based upon a user-centric design model, when it came to sustained, regular usage there appeared to be some critical dissuading factors. Sensing that something was amiss, the management of the Centre initiated a usability evaluation study to investigate the actual reasons behind the waning usage rates of the portal. The primary goal of the study was to suggest improvements, if necessary to the current portal design, in alignment with user satisfaction feedback to better promote the portal's role as the main knowledge management platform for the Centre.

## The concept of usability

Bailey and Pearson (1983) examined the causal relations of user involvement on system usage and information by means of an empirical study. According to them, user involvement in the development of information systems enhances both system usage and user's satisfaction with the system. They measured user satisfaction on Internet portals using a 5 component scale whose elements were content, accuracy, format, ease of use, and timeliness. They recommend that future research could identify additional components of satisfaction that are specific to web-based environments or work-related environments.

There is a growing need for evaluating web usability in general and user satisfaction in particular. One of the benefits of this approach is that it helps design teams plan for usability as part of the development lifecycle, by setting and measuring usability goals for the product they target to design. Web usability specifications describe how it can be applied to specify and measure the usability of products. For this reason, companies and designers have realized that usability studies (also called usability testing or evaluation) are an essential part of the web development and implementation processes. Usability studies enable designers to learn from representative users if the site performs in anticipated ways.

According to the International Standards Organization, (ISO 1998, 9241-11) usability is defined in terms of efficiency, effectiveness and user satisfaction. Bevan (1997) similarly defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (Bevan, 1997). Key amongst these three constructs is user satisfaction since it is an indirect measure of the other two characteristics. User satisfaction is measured by users giving feedback and is instrumental in continuously improving and reworking on the design and content of a system.

One of the most productive ways to gauging user satisfaction of electronic information systems is through surveys and questionnaires. Slaughter, Harper and Norman (1994) showed that online surveys produced valid enough results and these surveys encouraged participants to return valuable comments. Their Questionnaire for User Interaction Satisfaction (QUIS) focused on user's perceptions of interface usability as is expressed in specific aspects of the interface functionalities. It was administered using standard HTML forms that let users select items from pull-down lists, click on check boxes and radio buttons, and enter text and comments into text areas. Such a presentation and layout style is similar to the paper version of the questionnaire, in displaying multiple questions per page and comment areas at the end of each section. Testing was done on the World Wide Web (WWW), with data being collected for reliability and

validation assessments. In addition to being effective and returning valuable user data, studies have shown that online surveys are cost-effective as well since the participating users choose to electronically access the surveys at any time and from the convenience of any location.

## Methodology

A critical attribute of the effectiveness of technology adoption and web systems usability is users' perceived levels of satisfaction with the systems with which they are interacting (Zazelenchuk & Boling, 2003). A review of some of the available portal usability survey instruments such as the Questionnaire for User Interaction Satisfaction (QUIS) though informative and insightful, did not comprehensively address all the specific needs and issues involved in wanting to conduct a usability study on CRPP's knowledge portal. None of the surveys completely matched the range of web usability requirements and specifications involved in testing CRPP portal's robustness and efficacy. Thus these surveys could not be used in their entirety and consequently there was a need to develop a more context-specific web usability questionnaire that would pertinently address issues related to evaluating CRPP's portal. Items in the reviewed survey instruments which were found to be relevant were extracted to construct the usability survey for this study. While some of the items were used directly several were adapted and modified.

As many CRPP staff normally function on tight schedules, having to juggle a number of research-related work activities to ensure that project deadlines are met. With this constraint in mind, the survey was deliberately kept short and succinct to encourage widespread participation amongst staff. A total of ten quality items were thus framed. Though Likert scales are commonly used in administering questionnaires (Burns, 2000), in the case of this study they were not used since they do not yield the expected precision in empirical findings to determine patterns and preferences of usage of the various constituent components of CRPP's portal. To better measure the construct of web usability, in particular, user satisfaction, the responses to some of the items in our survey were choices that were frequency counts of actual usage. A few other items sought to elicit users' perceived ratings of levels of importance to intended enhancements in a revamped portal design. Interspersed within the survey were open-ended response questions to gather participants' opinions on the individual functions available as well as desired functions within the portal.

The survey was administered online for a period of three weeks to encourage all staff to access the survey at convenient times to post their responses and comments to the various criterion-based items framed in the survey. An online survey was deemed to be the most effective way of reaching out to and capturing feedback from as large a possible number of scattered staff members who work at various locations and on different projects and schedules. Out of total registered staff strength of 90, 55 users responded to the survey. This translates to an acceptable return rate of 62%. The appendix includes the survey questions and a summary of the responses.

## Results and Discussion

The majority of the users who participated in the survey were researchers in the organization (58%) and about 23% were academic staff. 29% of the respondents said that they accessed the portal 1-2 times a month, 36.5% said they accessed it several times a month. and 5% said they accessed the site on a daily basis. The envisaged target when the original portal design was being framed was that of staff logging into the portal daily to conduct their project related knowledge activities and be informed of updates of happenings in CRPP. The surveyed access rates clearly emphasize the need to probe deeper and examine the causes for the lower rates of system use in recent times.

The users gave some positive feedback on the portal's current utility, mentioning the usefulness in accessing research project information, getting to know more about people, courses and updates on projects of CRPP, storing and sharing information, accessing work-related resources, reading more on CRPP publications and gathering information on conferences. Despite listing these services and functions as being beneficial, intriguingly the majority of respondents accessed them infrequently. On average, only 9-12% of polled users used key features such as project discussion forums, resources, publications and search functions on a daily basis. Even for a more achievable access target rate of weekly logging-in, a meager 10-13% of users only did so. Notably, a high percentage of about 18-30% of users were not even of these vital services. Some of the reasons that staff attributed to for the disappointing levels of usage of the portal were slow speed, uncertainty and difficulty of access when it comes to uploading and downloading information from the web site. They also pointed to the inactive state of the forums. In addition, users were frustrated with the numerous links they needed to access to locate deeply buried documents. This dissuaded them from wanting to use the portal as the default knowledge management tool to storing and sharing project-related information. Rather they preferred using thumb-drives and removable hard-discs as the easier alternatives to information storage.

When asked to indicate a wish list of things that they would like to see in future in the remodeled knowledge portal, an overwhelming majority mentioned a more user-centric design that included incorporating more user-friendly feedback and response-gathering mechanisms, empowering users with greater degrees of autonomy and injecting more flexibility in allowing principal investigators and project managers to independently maintain their project workspace sites and documents housed within them. A few also desired better search functions to streamline the process of finding documents, links to other international sites and library catalogues. A few users mentioned that the CRPP website needs a site map for ease-of-navigation and effective location of links and web pages. Repeatedly, a number of users advocated more accessible, better advertised discussion forums that rouse users' motivation to participate as well as prompt news updates to be posted on ongoing research projects' progress, staff biographies and reports on completed research projects. This will ensure that users are kept well-informed of research developments and staff movements within their own organization.

A significant number (50%) of users rated personalization services as important for them in the revamped portal. More than 50% of users also rated the organization of projects according to subject disciplines and research specializations as significantly more important. 65% of respondents requested provision of online materials such as standard procedures and instructional manuals on using software and hardware. This is significant in a research organization where the needs of users of technology may differ markedly and might require differentiated technical guidance and support. About 55% of users desired that CRPP projects and related information be displayed according to classifications based upon disciplinary specializations and subject focus. This would ease the searching for and locating specific research projects to access relevant information.

## Design Implications and Recommendations

### User control and ease of navigation

One compelling issue raised by the respondents was the large number of staff who did not access the various component features of the portal at all or were not even aware of these features. Public forums and project forums especially had low participation rates and this finding was disconcerting in light of the fact that the original portal design had extensively built-in forums within all project workspaces to foster a more interactive online environment. These forums were envisioned to encourage team members to contribute innovative ideas on research progress directions and future development of projects. Furthermore such forums help to

circumvent the difficulties faced with project staff being located in a number of physically different locations. Many of the research projects had stakeholders, who were located in different physical sites such as in schools, the ministry of education and university campuses. The forums were targeted to serve as the focal platforms for encouraging interactions and social bonding in advancing the goals of the research projects.

Another intended strength of the current portal system was its structural design that allowed research staff to upload, share, access and publish documents within their respective project workspaces. This was meant to facilitate consolidation and augmentation of individual project's intellectual knowledge capital. Again this facility was largely under-utilized. One staff member commented on the "clunkiness" of the system and the lack of flexibility it afforded in uploading and publishing documents, especially in the public domain of the portal.

One underlying reason for the sharply declining usage rates for CRPP's portal was the dilemma over the degree of control that could be devolved to users to autonomously manage and use the portal's functions. The tension arises over the Centre management's prime concern over maintaining the integrity and confidentiality of the documents being circulated within the portal system. Due to the highly sensitive nature of the documents being circulated, there was a need to ensure that there is no unauthorized access to these documents. Thus many layers of control were factored in the original portal design which inevitably constrained user autonomy and made navigation within the portal structure more difficult. Inextricably, portal productivity and ease of usage was compromised, contributing to flagging interest levels in utilizing the portal as the medium to conduct projects' knowledge management activities.

The revamped portal design strives to strike a more healthy balance between the need for tight controls in ensuring content security and the calls for greater flexibility in self-managing the portal's features. Accordingly, discussion forums in the project workspaces which are hosted within the private domain of the portal will be moderated and managed independently by project investigators with team members having a free reign in posting comments, responding to discussion threads and uploading articles and documents for discussions. However the main discussion forum in the public domain would continue to be regulated and monitored by the IT administrative team to ensure that postings conform to normative codes of ethical, professional conduct and do not undermine the high quality of work being carried out by the research organization. Similarly, controls in uploading, editing and sharing documents within project workspaces would be relaxed in the new portal design with all members having equal rights to performing these activities. However rights to publishing documents in the public domain would again be kept in the hands of the admin IT/management team to maintain the integrity of information being made accessible to the general public.

**Personalization features**

Personalization features probably account for most of a portal's ability to attract and retain users (Zazelenchuk & Boling, 2003). Taking into account the predominant majority of polled staff (70%) who strongly favoured personalization services, the new portal was programmed to automatically send out periodically portal updates to users' email accounts on CRPP events, projects and conferences. This would encourage users to revisit the knowledge portal and log-in on a more frequent basis to access the details of these updates. To allay the concerns of some who felt that this might clog-up limited email spaces, only brief statements of updates on key events and conferences would be emailed out. Moreover, the modified design of the portal was orientated towards a Wikipedia style format which empowers staff to promptly update their own biography (inclusive of publication listings) and project description web pages without the need for final approval from the admin IT team. This ensured that these project web pages would have updated information for public user viewing.

### Classification of project listings

The original portal design had all the projects lumped together and listed in alphabetical order. As the number of approved research project grew bigger, the listings became more unwieldy in terms of ensuring good organization and visual clarity of project-related information. This shortcoming was identified through the user survey and rectified with a more improved layout format where projects were listed according to two broad layers of categorization. The first layer consist of three main categories comprising of on-going core research projects, specific focus projects and completed research projects. The core research projects were further thematically sub-divided according to the different component panels that focused on various research strands. The specific focus projects were also similarly segregated but according to their specializations of subject disciplines such as language & literacy, mathematics, science and ICT. Such a presentation mode of displayed information allows users to more easily search for relevant projects as well as ensure less cognitive overload on users in accessing and processing information.


**Figure 1. Welcome page of modified CRPP knowledge portal**

### Conclusion

CRPP's web portal has been developed and designed to share and manage a central knowledge database where information could be consolidated and distributed to all its members and the general public-at-large. It also allows users to easily access and retrieve relevant information online. The current portal design has in recent times failed to fully realize the knowledge management goals it set forth to achieve and it has suffered declining rates of usage. In order to effectively encourage the adoption of the portal's use among its members and to make it more relevant to their needs, the usability survey was conducted to improve upon its design. This is a positive step towards making a portal more successful in terms of usage and application. Knowledge portals can become confusing, complicated and people may become averse to using them if users find them difficult to navigate or find their content uninformative.

This in turn can curtail the portal's growth and risk the eventual adoption of the same. To stimulate users' interest in wanting to pervasively embrace a technology-mediated knowledge sharing workplace culture, CRPP sought to have a more informed understanding of users' needs and address their requirements. This feedback and action developmental loop driven by the findings of the usability survey was a first positive step attempted by the research organization to improving the integrated design of the knowledge portal and encouraging downstream knowledge dissemination.

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ANEXO

**Survey Results and Tables:**

**Table 1**
**Association with CRPP**

| | Frequency | Percent |
|---|---|---|
| Full time academic staff | 2 | 3.6 |
| Seconded academic staff | 13 | 23.6 |
| Project manager | 3 | 5.5 |
| Research assistant/associate | 32 | 58.2 |
| Administrative staff | 4 | 7.3 |
| Others please elaborate | 1 | 1.8 |
| Total | 55 | 100.0 |

**Table 2**
**How often do you use the CRPP portal http://www.crpp.nie.edu.sg/welcome?**

| | Frequency | Percent |
|---|---|---|
| Everyday | 3 | 5.5 |
| Several times a week | 8 | 14.5 |
| Once a month | 4 | 7.3 |
| Several times a month | 12 | 21.8 |
| Once or twice a month | 16 | 29.1 |
| Once or twice a semester | 1 | 1.8 |
| Rarely | 9 | 16.4 |
| Never | 2 | 3.6 |
| Total | 55 | 100.0 |

**Table 3**
**How often do you access the following services and features in portal**

| Feature / Frequency | Daily % | Weekly % | Monthly % | Not at all % | Not aware of service/feature | Once or Twice a year % | Total % |
|---|---|---|---|---|---|---|---|
| 1 Completed Projects | 1 | 7 | 28 | 6 | ___ | 13 | 55 |
| 2. Current Projects | 9.1 | 10.9 | 29.1 | 14.5 | | 36.4 | 100 |
| Publications | 10.9 | 10.9 | 29.1 | 23.6 | 9.1 | 16.4 | 100 |
| Journals | 9.1 | 9.1 | 29.1 | 21.8 | 16.4 | 14.5 | 100 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Resources | 7.3 | 12.7 | 36.4 | 20 | 16.4 | 7.3 | 100 |
| Conferences | 12.7 | 5.5 | 30.9 | 14.5 | 10.9 | 25.5 | 100 |
| Courses | 9.1 | 5.5 | 20 | 29.1 | 21.8 | 14.5 | 100 |
| Public forums | 10.9 | 3.6 | 9.1 | 45.5 | 20 | 10.9 | 100 |
| Project forums | 9.1 | 1.8 | 12.7 | 43.6 | 27.3 | 5.5 | 100 |
| Staff listings | 5.5 | 23.6 | 29.1 | 7.3 | 3.6 | 30.9 | 100 |
| Visitors' listings | 7.3 | 5.5 | 14.5 | 40 | 27.3 | 5.5 | 100 |
| Public Calendar | 9.1 | 3.6 | 16.4 | 50.9 | 10.9 | 9.1 | 100 |
| Project Calendar | 9.1 | 7.3 | 14.5 | 41.8 | 21.8 | 5.5 | 100 |
| Basic Search Function | 12.7 | 7.3 | 23.6 | 40 | 5.5 | 10.9 | 100 |
| Advanced Search Function | 10.9 | 1.8 | 14.5 | 54.5 | 10.9 | 7.3 | 100 |
| Logging in to access/share/upload additional resources in project folders | 7.3 | 3.6 | 34.5 | 36.4 | 10.9 | 7.3 | 100 |
| Logging in to access/share/upload forms | 16.4 | 1.8 | 21.8 | 32.7 | 9.1 | 18.2 | 100 |

In summary,

The domains/pages that were more frequently accessed were Current Projects, Publications, Journals, Conferences, Staff Listings and logging in to access/share/upload additional resources in project folders.

**Question 1: What kinds of information do you typically look for online at CRPP portal?**

Some of the popular responses:

- Staff and current projects info
- Biographies and contact details
- Research reports and presentations, occasionally publications
- Manuals, workshop materials and resources such as powerpoint slides of presentations
- Forms and room booking
- Info on admin procedures
- Schedules of talks on CRPP projects and CRPP events updates

**Question 2: What is most useful to you on the current CRPP web portal?**

Common responses:

- Accessing staff bio-data and project information
- Getting to know more about people, courses and updates on projects of CRPP
- Storing and sharing information
- Accessing work-related resources
- Getting staff contact details such as telephone numbers
- Reading more on CRPP publications
- Getting forms
- Information on conferences
- Comprehensiveness, ease-of-use

**Question 3: What do you least like about the current CRPP web portal?**

Common responses:

- Slow speed of network in uploading and downloading info
- The clunkiness, uncertainty and difficulty involved in uploading, publishing materials
- Inactivity in forums and lack of visibility of forums
- The need to click on many layers and inks to find documents
- Font size is too small
- Project folders have documents with backdated info and with empty links
- Interface – need a site-map
- Too localized – need links to external sites

**Question 4: What kinds of information or services would you like to see on the new CRPP web portal that is not currently there?**

Common responses:

- Putting up samples of completed projects including CRPP standard forms, cases for support, budget proposals, breakdown of funds, etc.
- More autonomy and accountability for PIs and RAs to maintain their project sites and documents hosted within them
- Instead of flooding e-mail boxes, put up info on courses and workshops on CRPP portal
- Conference info, published research papers and seminar slides and PowerPoint

- Better search functions to find documents according to different categories
- Links to other sites such as library catalogues
- Forums for public for discussions
- Up-to-date forms, detailed admin procedures and minutes of meetings
- Info on feedback, and responses to CRPP projects

**Question 5: If you could upload your personal biography information and project related information such as descriptions, reports etc directly into the portal and thereafter edit accordingly as the need arises, would you use this service?**

| | Frequency | Percent |
|---|---|---|
| Very likely | 16 | 29.1 |
| Somewhat likely | 23 | 41.8 |
| Somewhat unlikely | 5 | 9.1 |
| Very unlikely | 7 | 12.7 |
| Not sure | 2 | 3.6 |
| Total | 53 | 96.4 |
| Total | 55 | 100.0 |

**Table 4: How would you rate the level of importance if the following services and features are made available in the revamped portal?**

| Feature | Not important | Low priority | Important | Very Important | Total |
|---|---|---|---|---|---|
| Personalisation services in receiving monthly updates on CRPP events, projects and conference updates | 12.7 | 16.4 | 52.7 | 18.2 | 100 |
| Project calendar to inform members of project specific events and meetings | 20 | 9.1 | 49.1 | 21.8 | 100 |
| Online materials such as IT services and procedures and instructional manuals on softwares and hardwares usage | 12.7 | 21.8 | 47.3 | 18.2 | 100 |
| Classification of CRPP projects according to subject disciplinaries and research specializations | 10.9 | 7.3 | 54.5 | 21.8 | 100 |

**Question 6: Please share any other ideas you have about improving the usefulness of CRPP web portal**.

Some typical suggestions:

- More accessible and better advertised discussion forums
- Wikipedia style layout
- Information on how to do research, researchers' experience, practical do's and don't's of conducting research
- Website needs a more user-friendly, less technical, interactive look
- Updated info on projects progress, staff biographies and minutes of meetings