Research Methods for Eliciting e-Research User Requirements

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Abstract

e-Research is a relatively new and expanding means of undertaking multi-disciplinary on-line research. As such, the needs and requirements of the e-Research community are not yet fully understood and it is evident that it needs further investigation and study. This paper aims to provide basic guidance on the research methods that will be useful in order to gather information from the users of multi-disciplinary e-Research-based projects. The paper discusses quantitative and qualitative research methods with examples that have been drawn from social and computer science. We show that there are many ways of gaining information from users, but when used appropriately qualitative methods give more depth of information, whereas quantitative methods are scalable to the whole community.

1. Introduction

The need for interactive user surveys has been identified as the best means of accelerating the adoption of e-Research and ensuring the tools developed for the programme are more effective. This need is based on the opinion of consumers of e-Research resources, who wanted to alert others about matters from a user’s point of view [1]. To incorporate user suggestions and requirements into projects a number mechanisms are needed for gathering information from the user base. Therefore, a discussion about the different methods available is essential. For example, Nielson [2] in experiments found that the difference in the choice of methods plays a large role in the quality of the findings. He evaluated a user interface, with three subjects. The test reported back five or six interface problems with well-suited methods used. However, the same evaluation would return only two or three usability problems with a poorly chosen methodology [3]. Similar results are expected for user enquiries.

Lederer and Prasad [4] report, in a study concerning the problems of cost estimations in software projects, that the four most cited reasons for overspending in projects were changes by users of the final software artefact; tasks that were left unobserved, users were not able to understand their own needs and there was a mismatch between users and programmers.

Part of the Sakai Virtual Research Environment (VRE) Demonstrator project [5] is investigating methods to gather information from the user community. This paper looks at research methods that can be used to gather focused user requirements information. Research work from the social science arena has been used to establish the basis of the methods employed. The computer science field was then investigated for examples of the adoption of the methods discussed. Finally, conclusions are made about the methods that appear to be most suitable for gathering focused information for the requirements of e-Research projects.

2. Research Methods

There are several methods possible for collecting information from a user base. They are generally split into two sub-groups. The first encompasses quantitative methods, such as user surveys. The second is based on qualitative methods, such as user interviews [6, 7].

2.1 Quantitative Methods

Quantitative methods are based on the collection of information in a numerical format that helps express the association between the real world and a theory or a thesis [6]. This can be split into two categories: first the experiment and second the survey [7]. Experiments are the defined treatment of variables and the measurement of the outcomes. This is seen as the grounding on which a cause and effect
relationship can be established, and, as a result, the outcome can be measured [8]. One example of this is to measure a new system’s performance in relation to an existing system. This is known as a comparative experiment. Another option, which is named an absolute experiment, would be to test a system in isolation [9]. The measurement base here could be the time to accomplish an exercise that needs to be undertaken within a programme. For example, there are two groups, whose members can be argued to be similar to each other in certain characteristics. If one group learns to use a computer programme faster than the other, the experiment should allow the assumption that the programme used one group is easier to learn. In this example the variables are defined to be similar (group and task) and the measurement base (time to learn the programme) is the difference. The cause of this difference is the intuitiveness of the programme interface.

There are critical views towards the use of this theory. For example, Faulkner [9] quotes a study of ‘morphic resonance’, where the outcome of the experiments contradicted each other. Two researchers planned and conducted the experiment together, but started with opposing views of the outcome. The outcome of the experiment was then published in two contradicting papers. Faulkner [9] argued the reason for this was that the two individuals “hung on” to their opinions rather then to accept an interpretation that may destruct a view that one may be personally attached [9].

Surveys typically use questionnaires or structured interviews for the collection of data. They have a common aim to scale up and model a larger population [7]. Therefore, a survey can be seen as a set of questions creating a controlled way of querying a set of individuals to describe themselves, their interests and preferences [10]. Questionnaires are the most structured way of asking questions of participants. This is because the designer of the questionnaire decides upon the options for the answers. For example, a Yes or No; or tick one of the answers given. These multiple-choice answers make the analysis of the responses easy for the researcher [11]. Indeed, when it is seen in more detail this is not a very straight-forward approach, because as Kuniavsky [10] points out the questions have to be phrased in a correct way to avoid misunderstandings or double meaning. He uses the example of a financial Web page where the owners want to query how often their users purchase new stock. This may be well understood for most of their users. However, some people may talk about goods in a shop when using stock. Additionally, offering multiple-choice answers can be rather dull for the participants, because there are only pre-selectable answers [11]. This may be overcome by using multiple indicators, semantic differential scales or ranked order questions, which are often referred to as the Likert scale [7, 9].

There are also other tools like the semantic differential scale, in which the respondents get the task of ranking their opinion according to their importance. For example, using opposing terms like clumsy and skilful to indicate how these are perceived by the respondents [9]. Ranked order questions are another option for a questionnaire. The researcher here gives the option of ranking, for example, of importance of a programme on a PC. Options would include: a browser, word processor, image enhancer or messenger. The participant can then choose which option is the most important or the lesser important to the users.

Sample size
With surveys or structured interviews the sample size can be large. In many studies the sample size does not have a direct impact on the cost of the project, because the surveys can be sent via e-mail and the interviewer does not have to attend the filling in of the survey.

Bias
Bias is argued to be low when using quantitative methods. This is mainly reasoned with the absence of an interviewer, who is not able to influence the process. Also important is that the participant is guaranteed anonymity, which may prevent a bias in the response.

Quality of questioning:
The questions have to be short and precise. They have to be phrased very carefully so as not leaving room for mis-interpretation. As a result, to phrase the question in a certain way may have a negative impact on the answers.

Data quality:
The data quality is provided by the design of the questionnaire. When the questionnaire is designed, the answers are fixed and will be the ones counted. Therefore, there will be no room for further insight into causes or processes. Obviously, questionnaires can be poorly designed and may not gather useful information.

Negative Bias:
Bias may be introduced through selection of participants that make up the sample group. Also the phrasing of questions and the time and location may have an impact on the answers given, and perhaps introduce negative bias. For example, Jacobs et. al. [12] chose to use surveys
because their subjects where not accessible for direct interviews. Their study subjects where high level members of staff in an international organization.

2.2 Qualitative Methods

Qualitative methods contrast greatly with quantitative ones. Qualitative research is defined as a methodology that allows the interpretation of data more then counting predefined answers [6, 8, 13]. Quantitative methods may take longer and/or involve intensive contact with the situation of study. The situation of study can be real live situation, single or multiple people, organizations or populations [9]. The task of the researcher is to capture a situation in its full complexity and log the information found. The analysis then includes investigating the topics or subjects found and interpreting or concluding on their meaning from a personal as well as from a theoretical point of view [6].

It is however sometimes stated, that qualitative methods are not straight-forward and are often seen as more unclear or diffused as quantitative results [13].

The main methods for the collection of data are participant observation, qualitative interviewing, focus groups and language based methods [6, 8].

1. Participant observation is defined by an immersion of the researcher with the subject into the situation to be studied [8]. This will allow the collection of data in an unobtrusive way by watching the behaviour and activities of the subject. Observation is often used in user interaction studies, looking for example at Human Computer Interfaces [13].

2. Qualitative interviewing can be defined as a dialogue, where one of the participants (the researcher) is looking for answers from a subject [14]. Qualitative interviewing is often split into unstructured and semi-structured interviewing. In the unstructured case the interviewer is only equipped with a number of topics that should, but do not have to be, discussed in the interview. Whereas in the semi-structured case the interviewer has a series of questions, which should be addressed, but the sequence may be varied. Most importantly, compared to quantitative interviewing, both interview types allow additional questions on the basis of the response to a question [8].

3. Focus groups consist of a small number of people, chosen to participate in an informal discussion guided by a moderator. The group’s task is to discuss defined subjects, opinions and knowledge [15-17]. The advantage of this kind of interaction is that the opinion of one individual can cause further dialogue from others. Moreover, a larger number of opinions, attitudes, feelings or perceptions towards a topic are voiced by the participants, this provides a broader overview of the discussed topic [11, 13].

4. Language-based methods, such as content and conversation analysis; work on the basis of a newspaper article or transcribed conversation. Their main aim is to uncover lower level structures in conversations or texts [8]. This, however, is not considered here, mainly because there were no examples found of this method.

Qualitative methods bring forward positive and negative aspects to the research conducted using them. Accounts of the positive aspects are the depth and the quality of information [6, 15, 18, 19] gathered. As Punch puts it, “qualitative interviews are the best way to understand other people”. Therefore, perceptions, meanings, situations descriptions and the construction of realities can be best recorded in a qualitative setting [9]. A negative impact is the dependency on the moderator, who is seen as important in the process of asking the questions and interpreting the data [6, 16]. Holzinger [20], for example, used forty-nine participants for a study looking at the creation of an interface using mainly qualitative methods to gain information from the users. The researchers described methods as useful for identifying the users’ needs. Rose et. al. [17] reported on using focused interviews and focus groups to investigate the use of a medical decision support tool. The focused interviews where used to identify tasks and their goals and the focus groups to investigate in which situations the tool would be used. Konio [21] concludes on the comparison of three software projects, which have been based on using focus groups, that the outcome was positive. However, they point out that a focus group needs to be run by a trained person. Similar findings where reported by Wilson [22]. His team has been conducting focus groups to gain information about a VRE [22].

3. Conclusion

As outlined in this paper, there are a number of approaches for gaining information from the e-Research community. In the case of gathering information about requirements towards a VRE, aspects of bias, sampling and quality of the
information gathered have to be taken into account. Furthermore, quantitative findings are not as dependent on the moderator as quantitative methods. However, the depth of information given by the quantitative methods is not as elaborate as qualitative methods, because of its predefined questions and answers. Moreover, when using quantitative methods there is normally not the option to elaborate on questions. Therefore, the developers would have to have thought about all the requirements needed by the user group beforehand, which can be strongly argued to be unlikely case. Therefore, quantitative methods can restrict the enquiring requirements of the e-Research community.

When looking at qualitative research methods, there are opportunities to ask groups of users or individuals. This provides the opportunity to understand and query in detail, what functionality they want from their project. Therefore the outcomes will give more information about the background and reasoning of user requirements. This depth and quality of information would not be achievable using quantitative methods due to the fixed questioning structure. When examining the difference between individual qualitative interviews and group inquiries, the discussion evolving from the group will enable to greater detail to be recorded and individuals can clarify requirements by discussing them with peers rather than with an IT specialist [16, 18]. This may prevent the changing of ideas over time. Through the multiplication of focus groups, the importance of functionality can be verified and therefore arguments can be cross-referenced as described by [8]. The arguments above qualitative methods seem to be the best path to pursue for the user needs gathering in the VRE programme. However, it is acknowledged that if the enquiry is done with a low level of motivation and attention to detail, the information gathered may be bias and therefore the tasks will not be well informed through the users.

3. References


