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Sakai: An Environment for Virtual Research

Introduction

The range of electronic resources and tools available to researchers has increased far beyond even what early enthusiasts such as Howard Rheingold envisaged when they described how the internet would put the catalogues and contents of the world's libraries on one's desktop (Rheingold, 1993; 90-91). Research projects are increasingly using network technologies to improve communication between project members, to safeguard data, and to engage with the 'users' of their research. This has led to the emergence of models of "e-Research" which are perhaps best developed in the context of international scientific collaborations in fields such as particle physics and astronomy, and specific projects such as the Human Genome Project. At the same time, other, domain-specific versions of "e-Research" are developing, with different foci and characteristic patterns of collaboration.

In the field in which we work, educational research, even small-scale publicly-funded research projects are already expected to publish electronically their findings and other research outputs and have a responsibility to archive their original data. But with an eye to the future, there have been calls for an increased role for electronic networking for communication, collaboration and dissemination as part of a commitment to sector-wide capacity building. McIntyre and McIntyre (1999) and Dyson and Desforges (2002) suggest both that expertise needs to be both shared between established researchers and that development opportunities need to be provided for practitioners and new researchers. Training for individuals needs to be complemented by strategies which foster institutional and sector-wide capacity to conduct research, undertake analysis, engage with users and develop innovative approaches.

These changes have been accompanied by the development of thinking about 'networks' and 'networking' (in some cases, importing models of networks from the world of internet communication) which has had an impact on expectations of how research is conducted and disseminated. Networks are increasingly seen not only as providing access to resources, but also represent sites for knowledge construction and the development of new professional practice. Rather than developing 'best practice' and then attempting to transplant it to a new context, the network metaphor suggests that knowledge construction and dissemination requires a shared frame of reference. The question then becomes how to ensure that this shared frame of reference is preserved and knowledge embedded across a distributed organisation (see Hakkarainen, Palonen, Paavola and Lehtinen, 2004; 73+ for a fuller discussion).

In this article we will describe Sakai, a novel electronic collaboration environment designed to support e-Research, and will reflect on some of the issues which have arisen from the first year of our using this platform in our own work and to support other collaborative and distributed research projects in the UK.

The SAKAI Virtual Collaboration Environment

As Wenger states in his review of 'community-building' technologies, "ideal systems emerge from combinations and convergence" (Wenger, 2001; 5). Sakai responds to the demand by offering a modular architecture in which various 'tools', services and resources can be combined within a single, access-controlled framework (Fraser, 2005). The system is web-based and users require no special software other than an up-to-date web browser.

Sakai emerged from the world of Virtual Learning Environments (VLE) and as such can be configured to support e-Learning and Distance Learning, with (for example) schedule, syllabus, assignment and gradebook tools. Alternatively, it can be set up to work primarily as a personal information management (PIM) system

for secure online access to a personal file store and other productivity tools. Our interest, however, has primarily been in its configuration as a Virtual Research Environment (VRE), in which tools for collaboration within and between groups of researchers take precedence over other functions. Our experience has been gained in three arenas: the Applied Educational Research Scheme (AERS) of Scotland; in our work with a number of pilot projects at the University of Cambridge; and in an evaluation of SAKAI being undertaken as part of the Joint Information Services Committee (JISC) Virtual Research Environment Programme. This programme involves a range of UK Universities in development and evaluation activities across different disciplines: Social Sciences; Arts and Humanities; Medicine; Technology and Science.

The key unit within Sakai is the 'worksite' – a group of tools and resources with a specific membership. Individual users can be 'subscribed' to any number of worksites, each of which may have different sets of tools and within which they may play different roles. An individual may be the 'maintainer' of one worksite, meaning that they manage membership requests, moderate discussions and email lists and make announcements to the group, while simultaneously being a member or other worksites in which they are simply contributors to discussions and readers of others' work. They can also be an 'accessor' with much more limited access to tools and resources. However, it is possible to adjust the permissions of both maintainers and accessors to reflect the needs and purposes of the group using the site. Looking across the range of Sakai users with whom we work, we see everything from open-access groups with hundreds of members to small, temporary teams of two or three researchers working on specific and private tasks such as writing or analysis.

When configured as a VRE, we characteristically see groups of researchers (who can configure their 'worksites' to match their needs) using a a range of tools offering project planning and management (Schedule) synchronous and asynchronous communication (Chat, Discussion, Email Archive, Announcements) to document sharing and storage (File Store, Email archive, Web content tool) to co-authoring

and analysing documents and data (Wiki). Figure 1 shows a typical Sakai worksite with multiple tools.

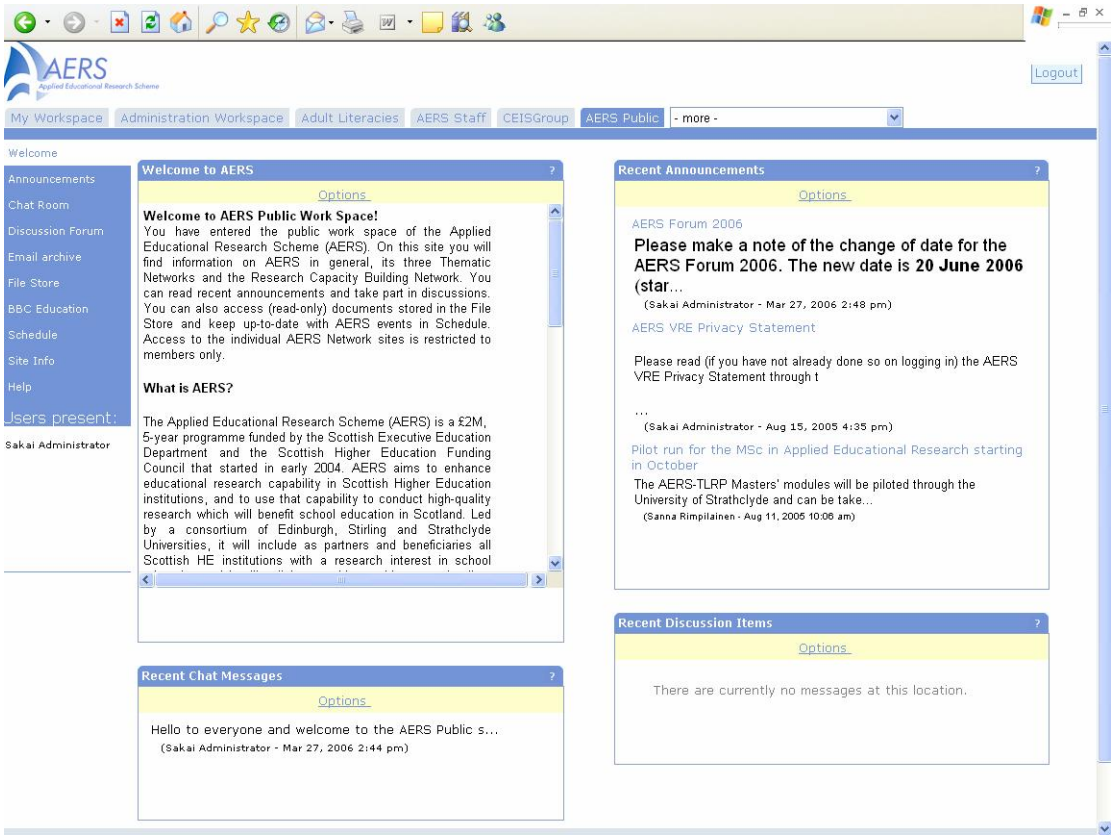

Figure 1: A Sakai 'Worksite' showing multiple collaboration tools. Visible are 'panes' with worksite information, recent announcements, discussions and chat. The left menu contains links to other tools and shows which members of the worksite are currently logged in.

Provided that the research team makes the VRE their primary locus of interaction (Wenger 2001), the environment helps to create a continuum for collaborative work and communication between face-to-face meetings, and generates a record of communications for future reference. By providing a distinctive, common workspace for the team, the VRE can also reinforce the group's identity by shared ownership of the worksite and its contents. In our experience, not all research groups make this qualitative change to their working practice; for some, the availabilty of a specific tool within an access-controlled environment is sufficient reason to use Sakai. In other cases, project members who already use specific electronic tools are cautious about making the VRE their sole locus of interaction,

and may continue using tools such as email lists, instant messenger or local file stores alongside the new environment. At its most prosaic level, the VRE has been seen by as a convenient way of addressing the requirements of funders to have a presence on the World Wide Web, a 'communication strategy' and a means of archiving project data and documentation.

In some cases, individuals who have limited time have been happy to support deployment of the VRE but have been only peripherally involved in online activities, or have delegated others to play more active roles. We have found that the most pragmatic approach to adopt is to support those individuals and projects which see the VRE a way of addressing specific needs and demands, while at the same time encouraging those who might use the VRE as their main locus of interaction or to develop novel patterns of work and collaboration.

Sakai as a Virtual Research Environment. Some Examples

In this section we will describe how three research groups have configured and used the SAKAI platform in support of their research activities. These are drawn from amongst the projects of the UK's ESRC Teaching and Learning Research Programme (who participate in the evaluation programme mentioned above) and the Applied Educational Research Scheme.

Project A: The first example is a research project investigating the 'learning biographies' of adults in the UK; it involves researchers from four geographically-distributed universities who are collecting survey data from a large population and addtionally developing detailed case studies of a smaller number of respondents. For this project, it was important that reseachers had opportunities to 'iterate' between quantitative and qualitative data in the analysis process, so a priority was the development of a structured archive of research data accessible from all the research sites. At the same time, it was essential that data remained confidential and that access to data was carefully monitored. What emerged was a configuration of

the VRE in which only a limited set of the tools – those concerned with data storage and project news - were used to any great extent and membership was restricted to project researchers.

Project B: Our second example is a research project based at a single UK university but involved in a set of related research activities. This project began using the VRE from the outset, and as a result much of the early activity involved project management, the development of research instruments, and the negotiation of access to research sites. As such, a wider range of VRE tools were used: document storage was important as research instruments were developed and literature reviewed; but at the same time synchronous and asynchronous communication was important, with 'chat' playing an important role both as a means of maintaining contact between project members and producing a record of decisions taken. This project was quick to see the potential of the VRE for engaging users with the work of the project, and set up multiple worksites for public access, the project 'advisory group' and each of the subgroups within the project.

Project C: A final example is rather different in that it uses worksites specifically developed to support research communities whose members include researchers in Higher Education, policymakers, teachers in schools, and school students. These owe much to the concept of the 'Community of Practice' (Wenger, 1998) in which a community of people engages in shared activities and practice and have a 'shared repertoire of resources' which develops over time. With their emphasis on developing knowledge rather than the preservation of practice, they have much in common with the 'Innovative Knowledge Communities' described by Hakkareinen et al (2004).

These communities use the VRE in ways designed to strengthen community identity, encourage discussion, and co-construct and share knowledge. When members come from different backgrounds and have varying degrees of expertise in the area of enquiry, they bring new perspectives and themselves to the group and have to accommodate those of others. A collaborative process may then evolve in which participants have changing roles within the work of the group depending on

the phase the project is at. In our experience to date the work of the group has been governed both by the individuals' expertise that they have been able to bring to that particular phase of the work and crucially by other factors which have determined by the capacity and ability (most importantly time constraints) to participate, which the VRE has significantly increased.

The VRE worksites are characterised by a high and sustained use of discussion tools; collaboration around writing tasks and use of the file store tool to maintain a record of developing knowledge. Another characteristic is that members of these worksites have 'permissions' set so as to encourage the discussion and contribution - rather than having a small number of 'maintainers' and a larger number of 'accessers' (as explained earlier), roles are shared and responsibilities distributed across the membership.

Sakai as a Developing Platform for Collaboration

Sakai is not only a comparatively new software environment, but is also a 'community development' project involving teams of developers spread across a large number of institutions. As with many developing pieces of software, there have ‘teething problems’, exacerbated by the fact that the projects we describe here were all ‘early adopters’ working with versions of the platform which lacked the full functionality of what is now (summer 2006) a better developed and more stable environment. In some cases, users with experience of other software (Virtual Learning Environments, discussion tools and digital archives, for example) found the feature sets and ‘affordances’ of specific tools disappointing; for others with less experience, it was the apparent complexity of the web based environment which provided the greatest challenges.

Other issues, some of which are now resolved, have been related to the community development process: there are some differences between tools developed by different teams (for example, some have integrated search facilities while others do

not) and some combinations of tools 'play together' better than others. In addition, there have been times when the priorities of the developer community have seemed not to align with the needs of specific projects - for example, when developer priorities to develop the underlying infrastructure of the platform has taken priority over the development of specific tools. At the same time, the community development model does allow groups of users to 'lobby' for the inclusion of new tools and the development of new features in a way which would be much more difficult if Sakai was a 'closed' proprietary product. This has led to user suggestions being taken onboard by the developer teams when possible and are being addressed in major upgrades of the software, which come out approximately every six months.

The greatest challenge for the maintainers of the research sites, then, has proved to the activation and motivation of users, encouraging them to see past individual or localised problems and make an informed assessment as to what Bereiter and Scardamalia (1993:133-152) call the ‘promisingness’ of the VRE as a strategic development. The embedding of project worksites within a broader Sakai community with many users and groups allows the identification of opportunities to deploy tools in support of their research activity. This means that another important role for administrators is to set up 'sandbox' and demonstration worksites so that existing and potential users can see what others have done with the Sakai 'toolkit' and consider how it might impact upon their own practice.

A good example both of the responsiveness of the developer community and of the means by which new tools are disseminated is the uptake of the 'wiki' writing tool. The development of this tool was informed by a need for a collaborative writing environment (in most cases, as a replacement for project members sending documents with 'tracked changes' to each other by email). Once the wiki tool was made available and its existence publicised, individuals and project teams were quick to identify ways in which they might employ it; not just for collaborative writing of abstracts, papers and reports, but also in collaborative analysis, in

biographical research and for the compilation of glossaries, bibliographies and literature reviews.

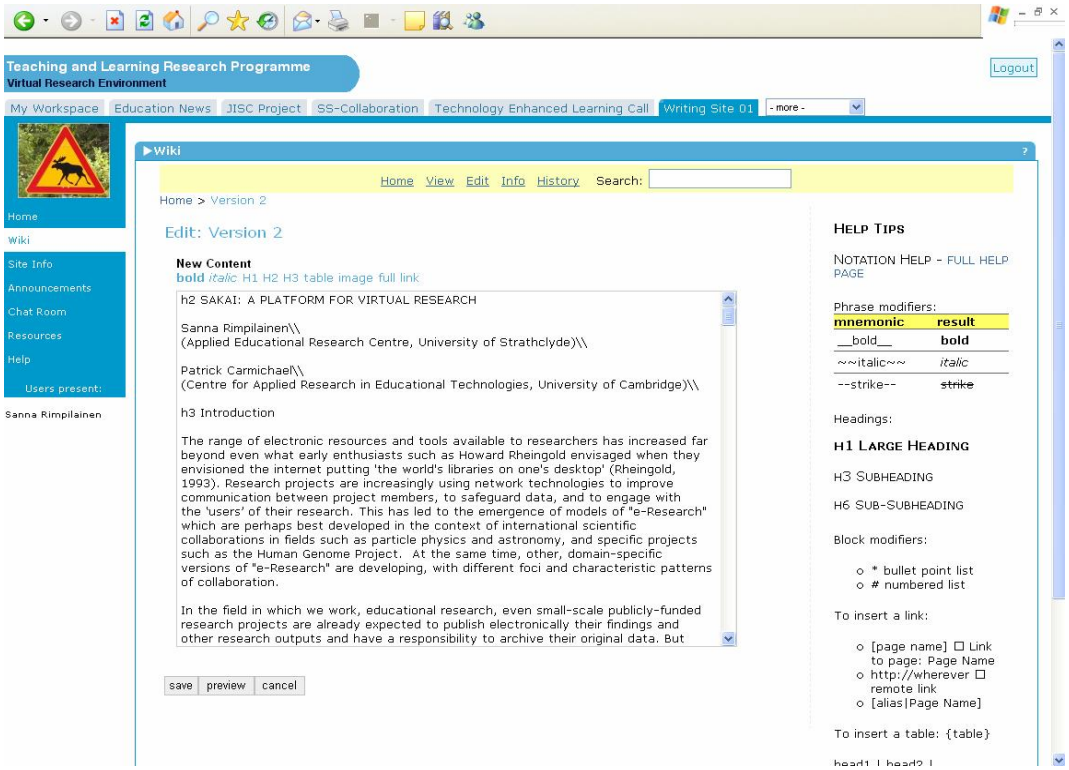

Figure 2: The Wiki Tool within Sakai. A wiki allows members of a worksite to work together on a document, editing and elaborating it through a standard web browser; any user can see the 'history' of the document including which edits have been made by different users.

Emerging Issues and Implications

We asked researchers in the projects described above to reflect on their characteristic and shared repertoire (Wenger, 1998), 'ways of thinking and practising' (Entwistle et al. 2002; Meyer and Land, 2003) and barriers to collaboration. We also encouraged researchers to identify in what ways they were or were not supported by existing electronic tools and platforms. This process frequently brought to light issues which were not necessarily spelt out in project designs and publications, but emerged as a result of collaborative and collective elicitation of participant 'tacit knowledge' within a structured activity, the value of

which is highlighted by Nonaka and Takeuchi (1995) and Engeström (1999). Even at this early stage in our work, the potentially transformative impact of the VRE was becoming apparent.

The examples we have drawn on in our descriptions are all from educational research projects, and so reflect some of the specific concerns and characteristic approaches of that domain. However, what McAteer, Crook, Macleod, Tolmie & Musselbrook (2002) call the 'issues to manage' in the context of online communities transcend disciplinary boundaries. The key issues and associated questions and decisions with which the TLRP and AERS projects have engaged will face researchers in many contexts. Indeed, in the deployment of SAKAI to diverse groups at the University of Cambridge, we have found that the following issues have meaning and relevance across disciplinary boundaries.

The first issue was what we came to refer to as the *'focus' of collaboration*, the key activities or points in the 'workflow' of the project where collaboration was most evident, or was an important or essential element of a broader process. In some of the projects much of the collaboration was focussed on elaborating project designs, developing research instruments and reviewing literature in order to develop research questions and working hypotheses. But we also saw collaboration once projects began to collect and analyse data, and we found that this collaboration manifested itself differently in different contexts. Some projects had a clear commitment to expose their entire data set to a wide audience while others restricted access to some data, citing reasons which ranged from issues of respondent anonymity to purely pragmatic questions of workload and lack of time. We found it useful (given the educational context of our study) to relate this back to Stenhouse's (1978) distinction between case *data*, the case *record*, case *studies*, and *analysis*. While in some projects this focus was indeed the 'raw' case data, in others, collaboration was focussed on data selected by an individual or group within the project, or even on cross-case analyses, with researchers not revisiting original data at all.

The second issue is that of *participant roles and responsibilities* and the *expectations that participants have of each other*. We found a range of organisational and management structures within projects and widely varying roles for research participants. Several of the projects with whom we are working are now considering how the VRE can support distinctive elements of their research designs including extended relationships with respondents in longitudinal studies, participants who themselves are generating reflective accounts or 'action research' projects, and those which are concerned with the expression of 'student voice'.

A third issue is *how the group relates to larger groups* and particularly to those to which they report or have other responsibilities. Altrichter (2005; 22) describes how much educational research takes place in 'small collegial groups' protected by 'special conditions of confidence' and in which it is possible to test and develop arguments and prepare for a 'public' that is one step 'bigger'. Several of the groups who are using the VRE have responded to this need to address 'graded publics' by developing multiple worksites with different memberships, together with workflow processes by which resources are transferred from one area to another. This, of course, presents another dilemma - whether to *engage* with graded publics through a process of inviting them 'in' to the VRE or to use the VRE as a base from which to *address* them - what McQuail (2000; 129-132) characterises as 'consulation' and 'conversation' as opposed to 'allocution' or 'broadcasting'.

A fourth significant issue relates to the *nature of the research group* itself. The educational programmes to which we have deployed the SAKAI VRE are large and complex organisations. While they are both involved in the coordinate research activities, they are organised in slightly different ways; the TLRP is a 'coordinated research programme' within which there are projects of varying sizes, thematic groups and seminar series and a small number of research fellowships held by individuals. AERS is organised into 'thematic networks' within which are projects and individual research fellows. Both the TLRP and AERS are also keen to support the development of individual and institutional capacity across the wider educational research community beyond the networks they facilitate and the

projects they fund. When we came to design VRE worksites as the 'virtual' manifestations of these various groupings, however, we became aware that the notion of the 'project' in particular conceals a very wide range of organisational and collaborative configurations. Many of the projects represent temporary coalitions of individuals based in different institutions. In some cases these individuals have a previous history of working together, but in others 'the project' represents a first attempt at collaborative activity. Even then, 'project' organisation varies widely. Some projects only convene meetings attended by all members once or twice each year, or arrange these to coincide with other events such as conferences. Others invest considerable time (and money) in maintaining a regular 'cycle' of meetings every month, or even more frequently. Another area in which there is a wide variation is the extent to which the project is centrally managed; some have an established 'management group' which oversees activity in participating institutions and research sites, while others have looser 'federated' structures with minimal central coordination.

Any successful deployment of an application as the VRE, then, needs to consider the organisational form of the group to be supported. While we have talked about 'communities' in the broad sense, most of the projects we currently support are in fact similar to what Swaak, Verwijs, & Mulder (2000) describe as 'task groups', with external funding and reporting responsibilities and (to a greater or lesser extent) an externally defined research agenda to address. As the VRE platform has becomes more established and users more confident, we have noted that there has been a tendency for groups to establish worksites for specified purposes rather than to provide an online 'home' for an entire project. Small groups set up worksites to analyse data, engage with specific users and to write documents, apparently without any expectation that these will continue to exist beyond the life of the activities concerned. These self-directed, temporary groupings seem to correspond more to the 'knotworks' described by Engeström, Engeström & Vähäaho (1999). Individuals and groups may need to work together to identify what organisational and network forms are best 'fit for purpose' for their intended research activities; deployment of the VRE may represent an opportunity to 'leverage' discussions to

this end. A challenge at programme and institutional level then, as Swaak, Verwijs, & Mulder (2000) suggest, is how to embed knowledge and useful practices, introduced developed within these task-oriented groups within a broader, long-lived and self-regulating community.

Concluding Remarks and Acknowledgements

We have been promoting and supporting the use of Virtual Research Environments for some time now. Looking back over the past year (2005-2006) what we now find is that individuals and groups do not simply identify those tools and services which address specific and predefined project 'needs'. Increasingly, we also find them discussing the potential of new tools to qualitatively change their ways of working; their relationships with research participants; and role of the VRE in ensuring the sustainability of their research activities. Our longer-term interest is in exploring to what extent use of appropriate technologies can not only support established 'ways of thinking and practising', but how they can support different kinds of research activity and new relationships between researchers and research participants.

The authors themselves have made progressively more use of the VRE. This article was written collaboratively in a specially-configured VRE worksite using the 'wiki' tool, with one author based in Cambridge and the other in Strathclyde. For this reason amongst many we would like to acknowledge the efforts of the Sakai developer team at CARET in Cambridge who were responsible for building that particular tool. We would also like to thank members of the SAKAI community and the participants in the TLRP and AERS research programmes who have participated in the development and evaluation of the Sakai VRE as a whole. Of these, we would especially like to acknowledge the contribution of the Learners, Learning and Teaching Network of AERS in the creation of innovative ways of using the Sakai VRE.

If you are interested in seeing what the Sakai software looks like in real life, you can register to test drive the environment at http://www.sakaitestdrive.com/. Once you have registered please wait for an email confirming your registration and follow the link provided.

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