

Repositories of Teaching Material and Communities of Use: Nifty Assignments and the Greenroom

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ABSTRACT

Teaching material can be time-consuming and difficult to develop, even for those with experience. Teaching repositories permit the sharing of material and can thus potentially save time and enable re-use of good material. Many teaching repositories have been created for this reason, but they often see limited use and we believe there is a missed opportunity to learn lessons and improve the design of repositories accordingly. This paper reports an investigation of the use of the “Nifty Assignments” repository, in an attempt to discern reasons for the success and failure of teaching repositories to enable effective sharing. We go on to discuss the design of a new online community, the Greenroom, for teachers using the Greenfoot environment. The Greenroom attempts to focus on personal interactions and collaborative development of resources in order to increase engagement and sharing, rather than the traditional download-upload models of other repositories. The comparison and contrast of these two approaches reveal interesting insights about techniques which can contribute to the success of repositories.

Categories and Subject Descriptors

K.3.2 [Computing Milieux] Computer and Information Science Education

General Terms

Design, Human Factors.

Keywords

Nifty Assignments, Greenroom, repository

1. INTRODUCTION

Making teaching materials available for sharing is not straightforward, although it often appears to be so. There are several “repositories” of materials which intend to support teachers of computing. However, few are as successful as their originators intend, and the ways in which they are problematic are similar. Each of the following aspects represents an important challenge for content repositories, and many existing repositories struggle with several of them.

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Curation Although it is easy to start a collection, it is often more difficult to maintain it. For instance, the *SIGCSE Educational Resources* site [1] “is a collection of resources maintained and shared by SIGCSE members to support computer science education”. The content is broad, covering many topics, but seldom updated. The *Kinesthetic Learning Activities* wiki [2] has a narrower focus, in that it only contains “physically engaging classroom exercises” but the content is (in 2010) effectively static.

Once material is in a repository, it typically has to be maintained to remain useful. Over the years, external links often break, content becomes outdated, file formats change, etc. Only few resources remain fully useful over a long time without requiring updating. The question of who takes responsibility for this maintenance is difficult, especially since – over a long time period – contributors disappear, lose interest or forget about resources.

Content Some repositories emerge from an existing collection of material. A typical motivation was illustrated recently on the SIGCSE mailing list: “Now that we are in our sixth semester of teaching Python in CS1 we have amassed a pile of programming assignments -- we do ten or eleven new ones each semester. It seems a shame to not share them” [3].

Others are arranged around a theme: *Nifty Assignments* [4] contains only work set for assessment. *Technology the Educators of Computing Hail* (TECH) [5] deals only with technologies that support teaching. *Computer Science Unplugged* [6] provides “an extensive collection of free resources that teach principles of Computer Science... through engaging games and puzzles that use cards, string, crayons and lots of running around.”

Still others are created as general one-stop-shops, for example the *Computing and Information Technology Interactive Digital Educational Library* (CITIDEL) [7] created as “a resource to discover Computer Science education and research materials” and its successor, ENSEMBLE [8] a “distributed digital library for computing education”.

The focus of content, aimed broadly at a discipline or narrowly at a specific area, seems to have a significant impact on the severity of the challenges in all other aspects. The broader the focus, the harder other aspects become.

Contribution Especially in cases where the content is not built around existing material, all these initiatives share the problem of contribution. “In the surveys we have done, we find a contradictory set of opinions: professors want resources to use, but they are not willing to share back the modifications they make to these resources. And the effort it takes to get a resource published is often ignored, so most people just don’t do anything to publish things on the web in a way that it is truly useful”. [9]

For some repositories there are different categories of contributor – those that generate content, and those that comment on it, or rate it. For both categories, incentive to contribute and reward for doing so are issues.

Community The altruistic impulse to create a common resource – a place where people can gather and share materials on a common topic of interest – is often tempered by the reality that such repositories are little used. In 2005, Susan Mitchell [10] conducted a survey from a combination of attendees at the Network Community for Software Engineering Education (SWENET) workshop, an e-mail to the SIGCSE list, and individually solicited Community College faculty. The survey was a 27-question instrument covering the type and scope of materials educators sought, their search methods and the sources they consult.

Analysis of 119 responses led her to conclude “1. awareness of course material repositories is low, 2. even if faculty are aware of repositories, they seldom use them, 3. when they do use them, they are typically dissatisfied, and they are happy with the methods that they currently use to find materials (mostly Googling)”[11]. She explored four categories of resources: “physical materials (e.g., textbooks), physical repositories (e.g., a department’s collection of materials), online repositories, and Internet sites (e.g., an individual’s course website)” and found that textbooks were by far the most commonly consulted resource with non-repository websites second in popularity [10].

In other community driven endeavours, such as open source software communities, reward is often received through peer recognition from fellow community members. In many online teaching repositories, community recognition is low or absent.

Catalogue Once materials are gathered together, there has to be a way for users to locate the item that is most useful to them for their current need, or allow them to search for it easily. For the repository owner this entails decisions regarding metadata, about how to “label” content effectively. The UK Jorum repository [12] for example, has contributors (which they call “depositors”) add metadata at the point of deposit: title, free-text description, descriptive words “to act as reference points to enhance user searches” together with the name and institution of the creator(s). Additionally, depositors are asked to nominate a subject-based collection with which the new resource should be associated. This quality of metadata obscures the scale of the resource – which could be as small as a one page quiz or as comprehensive as a set of lecture materials – if they are not already familiar with the resource they seek. The Kinesthetic Learning Activities wiki provides a design pattern-style document as a template which includes more contextual detail, including: Learning Goals, Course and Level, Class Size, Preparation Time and Execution Time. They also have a section for “Feedback and use notes” for comment.

Cataloguing content remains, however, a challenge, be it for browsing or searching. Problems include availability, consistency and currency of metadata, categorisation ambiguities and the dynamic nature of cross referencing.

Control All repositories grapple with issues of control: who can contribute, who admits the contribution, and how the quality of contributed material is assured. Some systems use a gate keeper approach, where material is reviewed before acceptance. The most extreme form of this is the Nifty Assignments repository, which only accepts submissions once a year by a process of competitive

review. This maintains consistency and quality of the stored resources, but creates a bottle neck that limits the flow of potential contributions and may cause frustration. Others, such as the *SIGCSE Educational Resources* site, allow free submission, but with no guarantee of quality. This makes it hard for potential adopters to rely on the quality of different materials from the same repository.

The other aspect of control is control of materials going out. Especially for educational resources, if plagiarism is to be discouraged, there are issues of access to solutions for submitted problems/assignments. The Greenroom, for example, limits access to teachers only.

In this paper, we will discuss two repositories with different solutions to these issues in more detail and compare how each of them addresses these challenges. One – the Nifty Assignments repository – is a selective repository with central control that ensures quality of contributions using a strict gatekeeper approach, while the other – the Greenroom – offers wiki style contribution methods to a broad membership and aims to use community activity for quality assurance.

Discussing these two different systems highlights the common goals and problems that form the challenges for these and other repositories, while describing their different approaches points to different possible methods to address these.

2. THE GREENROOM: MOTIVATION

The Greenroom [13] is a platform for sharing and discussing teaching material for the Greenfoot system [14].

Greenfoot is an educational IDE for the teaching and learning of introductory programming at high school and college level. Compared to existing systems, Greenfoot allows a significantly different approach to the teaching of programming, and thus shares a fundamental challenge with many other educational software tools: Existing teaching material does not transfer easily to the new system.

For would-be adopters of new teaching tools the problem of acquiring teaching material is significant. New tools often require new teaching styles, new assignments, new project ideas, and sometimes a substantial redesign of a whole course. Few teachers have the time, energy or skills to create all of these.

For developers of educational software tools, this is a difficult hurdle to overcome. The software tool itself, however well designed, has little impact if it does not offer accompanying teaching material. Good teaching material is what makes adoption easy – or indeed possible – for a broad user base.

If the audience for the materials are school (rather than university) educators, the problem is compounded by lack of time for the development of teaching materials, and often a lack of expertise in the subject matter. Additionally, if the producers of the material (the developers, in this case) are not in direct contact with the target user group they may not have experience in creating material for primary or secondary school level. It is therefore not always feasible for the developers of a tool to create a range of teaching material suitable for these audiences.

Using a community supported repository of teaching material is one answer to this problem. Thus, the Greenroom is a repository that aims at soliciting and collecting a range of Greenfoot-related resources in a manner that makes it feasible for a broad range of

instructors, including school teachers and university lecturers, to contribute to the collection.

3. THE NIFTY REPOSITORY

Nifty Assignments is one of the more successful repositories for computing-related educational material. Its mission is “gathering and distributing great assignment ideas and their materials”. The assignments it collects – often introductory programming assignments – can make use of different programming languages although use of specific software tools is seen as a disadvantage.

Material is added to this repository once a year via a competitive process, and typically six submissions are accepted per year.

We undertook an investigation into the use of Nifty. Our motivation was both very specific and quite general: very specific in that the ACM Education Council were in the process of building a new repository and wanted to see how existing repositories were used; quite general in that there has been little user-centred exploration of how computing educators use on-line resources. Lack of such user-centred data denies an important category of information for system designers.

3.1 Methodology

The study was conducted in two stages. First an e-mail was sent to the SIGCSE list, asking three questions:

1. Have you used the nifty repository?
2. Did you take something that you saw presented in a SIGCSE session, or pick a resource up “cold”?
3. Did it work for you?

Twenty six responses were received and analysed in respect of the questions asked. Additional categories emerged in the analysis process, which were taken forwards to the second phase. In the second phase of the study, those respondents that had used a “nifty” assignment in their classes were contacted and invited to a semi-structured interview at the SIGCSE symposium in 2009. Nine interviews were conducted. There are obvious biases in the selection of respondents/interviewees, but this selection method guaranteed a sample of educators who had actually used the repository, not just browsed it. Interviews were transcribed by a professional service, coded in respect of the previous categories identified and simultaneously open-coded to allow common usage issues to emerge. In the rest of this section, quotes are verbatim from interview data, interviewees are anonymous, people mentioned by them (often Nifty contributors) are given pseudonyms which are preserved across respondents.

3.2 Nifty Contributions

Nifty overcomes the problem of **contribution** in that all the ideas (assignments in this case) are first presented at a session at the annual SIGCSE Symposium. Thus the contributor is “rewarded” with a conference presentation and associated credit. The online repository contains full details – “handouts, starter source code, data files, and other ancillary materials” – for each presented assignment.

Nifty is a Symposium institution,

“you know, I mean, you go to Nifty – you don’t want to be programmed against Nifty Assignments at SIGCSE, because everybody goes there.”

But what happens after the session – who uses the materials the repository contains? And when? And why?

3.3 Nifty Usage

As observed above, even if educators are aware of repositories, they often do not use them, preferring general web searches to specific repository browsing.

The presentational aspect of Nifty is clearly an important part of its success. There is a category of users who are generally “on the lookout” for new materials and new ideas.

“Oh, yeah, I hear about them. You know, I almost always attend the session here at SIGCSE, because I’m always interested in looking for new ideas.”

“I go in and look at what John’s doing, and I go look at what Fred’s doing, and I go and I look at what Barney Smith’s doing. So I just – they’re people who I know who are always up to good, and that I’m always kind of have my ear to the ground on what they’re doing.”

“Some of the assignments I saw presented at SIGCSE and then went to the repository, but once at the repository, I looked at others.”

“The Nifty assignments panel is one of my favourite sessions every year at SIGCSE.”

“I’m a rabid nifty reader.”

There were other ways in which people used the repository. Some were looking to fill a short-term need, and were attracted by the completeness of the resource.

“I don’t come here often. I come here at the time that I realize Ooh, I need an assignment on inheritance, and I need it in a week or two, and I’m tired of coming up with interesting ideas of my own, and so I’d like to see if somebody else has done something that I can just snag.”

There were others who mined the resource heavily, but infrequently. These were characterised by long-cycle needs, one-off redesigns or curriculum reviews.

“I’ve probably been there a handful of times when I needed new things. Pretty heavily about four years ago when we redesigned our intro class. We went through and picked out several assignments that we’ve adapted.”

“I know that about five years ago we designed a new set of first-year courses, and this idea of having the big simulation and then of having this generate the test data occurred to me.”

Others visit regularly, but more-or-less in synchronisation with the annual cycle of submission

“And it doesn’t change all that often, so I mean – Once a year’s enough.”

“I don’t go there very often, no. I mean, I’ve gone there in the past, and I usually, maybe about once a year check things out.”

As well as these targeted forms of searching, at times of defined need, there are more generally opportunistic users, and different qualities of the repository attracted them. Rather than the comprehensive nature of the resources, they were more interested in the “nifty” features of the assignments.

“... when I’m more in this more vague, like, just trying to kinda solve a more open-ended problem, it’s nice to go to a

place that has a lot of stuff to kinda get your creativity going.”

“There definitely are times when I feel like I have something I really want to fix. In this case, I would say I was not unhappy with what I had, but I saw an opportunity. When he showed it to me, I said, ‘That’s better than what I have’ ... And so then it got me sparked to go off and figure out how to integrate that idea.”

“I liked that it used the real data from the Social Security, the names. I like that. I thought it would be something that students would really enjoy, and I saw it as sort of a capstone assignment in our CS1 class ... GUIs and drawing and arrays and all the things that we do in that class, so I really like that it sort of tied all the pieces together.”

The aspect of “niftiness” as an attractor for users relates to the aspect of (real or perceived) quality of material in the repository. Here, the expectation that material presented is of good quality, and worth using, is clearly a motivator to visit, and strengthens the usefulness of the repository to potential users.

3.4 Searching

Mitchell observed that most academics like to find material via Google [10] “entering some key words and barrelling in sideways. (That’s what “googling” means, isn’t it?)” [15] – Nifty, in this respect, is inimical to their preferred search strategy.

Nifty’s organisational principle, by year of presentation of the assignment at the Symposium, with a one-line description of the course the assignment was designed for, was often not considered helpful.

“And the first thing that happens is I come here and I go, ‘Why the freak is it organized by year?’ This helps me not at all, okay?”

When quizzed further, two distinct organisational preferences emerged. One was for organization by pedagogy or pedagogical concepts.

“I find the lack of teaching hints to be troublesome ... Briefly, I would like to see more information on how the material is presented and introduced, with potential benefits and pitfalls. This is more useful to me than specific handouts, since I will probably adjust those to local norms anyway.”

“... need a screenshot. I need a screenshot telling me what they’re gonna produce, and, you know, in this program, students are asked to override four methods. Three, four bullet points, something like that. I need to know what textbook he used. I wanna say – c’mon, he can tell me easily: ‘We were using the Savitch textbook; they had read up through this chapter, and that’s what it did.’ Now, even if I’m not using the Savitch textbook, I’ve probably got a copy on my shelf; I can go online and look, and that would help me.”

The other was for organisation by disciplinary content:

“I would be nice if the repository were searchable. I would have liked to query for all assignments relevant to *binary trees*; instead I did a lot of surfing.”

“I think the biggest issue is finding something that really matches the appropriate course.”

“So it needs to be organized by course maybe, but I don’t even really want it by course; I want it by, like, concept and “Java versus C versus ...”

“The one criticism I have of it, is its organization. My students (from a small state school) are often about half a semester behind those at Stanford or other institutions that are more selective. Thus, organizing by topic (array assignments, greedy algorithm assignments, etc) would be more useful than organizing by course.”

“Like, **everything** is listed as CS1 and CS2 ... I wanna know ‘needs 2-D array’, ‘emphasizes index-out-of-bounds errors’, because that’s how I think about my assignments.”

Support for systematic browsing and searching is clearly important to users, and this aspect grows in importance as the amount of material in a repository grows. Borgman et al [16, 17] in a study of geography educators’ use of the ADEPT repository [18] found that whilst they transferred some information-seeking behaviour from their research activities “all ...mentioned the need for more conceptual or thematic searching capabilities”. In similar fashion, CS educators want to search for material by disciplinary context (queues, stacks, arrays, binary trees) or pedagogic concept.

However, organising material into categories can be problematic. For example, a programming assignment covering collections and loops may be categorised under “assignment” or under “loops”. Alternatively, supporting search based on pre-defined metadata or a taxonomy of content description may describe features that are not, in fact, shared with – or valued by – the user community.

3.5 Adaptation

Despite the Nifty emphasis on presenting a “whole package” that can be picked up and instantiated with little effort, almost every respondent described changing the materials.

“Everything I have used required significant customization and modification.”

“So, far, I have adopted only one nifty ‘as is’ for a course ... That is, I used the assignment as designed by the original authors, but I created my own handouts, etc.”

“Yes, it worked for me though I had to tailor it some to our environment.”

“Yes, but I almost always modify the assignments to meet my course’s needs.”

“I definitely have not (and have trouble imagining being able to) use a nifty assignment directly from the repository without any substantial amendment. There’s just too many details of my own institution/courses that I have to deal with.”

This is not surprising, given other work on “transfer of practice” [19] which shows that “borrowing provokes invention”.

The Nifty repository has no mechanism for feeding back modifications or information about them. Other systems, such as the Kinesthetic Learning Activities (KLA) repository, provide a mechanism for allowing this feedback. In the case of KLA, this is achieved by basing the repository on a wiki model that allows community members to edit existing material. In addition to the ability to edit, KLA provides an explicit section in a provided template titled “Feedback and use notes”, encouraging users explicitly to supply this information.

However, if most users will modify material to their needs, feeding back those modifications into a repository (or information about them) might increase the usefulness of the resource. For instance, it might be of value for potential adopters to know how much effort it took someone else to adopt it to their local needs. In addition, the adaptations might in themselves be useful to others. For example, if someone translates a resource into another language, this adaptation may serve as a much better starting place for some other users.

3.6 Stealing ... and Attribution

There was little distaste – indeed, some enthusiasm – for the re-use of pedagogic materials.

“I’m surprised more people don’t steal other people’s stuff. I’m always wanting to steal people’s stuff. I wish there were more stuff to steal, right? ... There’s not enough hours in the day to do everything I want to do, so I want other smart people to do things I can steal”.

“He said, ‘My brother uses – developed – a Nifty assignment, and it’s called Critters.’ I said, ‘Critters sounds good. Is it graphical?’ And he said, ‘Yes, and at the end, they run a Critters tournament.’ I said, ‘Great. Lift it from your brother’.”

Attribution was as common as re-use; every interviewee added attribution to the originator on their versions of the assignments. There were several distinct reasons for this. One was that it was “for the students”.

“I also think in a way it is kinda being honest with the students too. I mean, I think it shows for them – it just demonstrates what’s appropriate about stuff. You’re preaching to students that plagiarism’s inappropriate. You want to give credit where credit’s due.”

“It’s for the students. ... I’ve said in class that we are using an ... assignment adopted from the University of Washington. Our students, being at a top institution, like knowing that they’re doing stuff that students at other top institutions are doing. They find that – they’re very proud.”

“Right, so the students are the only audience really that reads that”

“I mean, it’s for the students. I suppose it’s for Frances or whoever. I mean, if she were ever to look at my page, she would expect to be attributed, and that’s the normal thing we do.”

However, there were other audiences identified, too. One was other staff:

“... in some sense I think it’s just for our community of educators to realize that we build on each other and that we respect the work that went into creating something new.”

“Or if someone else is just looking around for assignments, I want them to know it’s not mine, you know, some other faculty member or something.”

Some added attributions for moral reasons:

“Well, it’s the right thing to do.”

Attribution may also contribute to reward through peer recognition, if they are fed back to the repository and details of use and attribution are made visible.

3.7 “Library” may be the wrong metaphor

Repositories tend to share metaphorical characteristics with libraries. Indeed, several have been supported from streams of funding explicitly earmarked for “digital libraries”. These shared characteristics include metaphors of centralisation, reference and authority: not attributes which are characteristic of teaching, which is local, contextualised and adaptive.

A frequently-mentioned feature of the Nifty collection was that it wasn’t uniform, or uniformly quality-controlled (notions associated with libraries and librarians). The social nature of its generation, its situation within a community and the reputation of the contributors, were all considered important.

“I mean, repositories of stuff are hard. I mean, the AP has this giant repository of stuff ... my impression is that they have some things on the official AP site and then it links to a bunch of other people’s unofficial sites, and I think that at some point the navigation gets hard. And keeping your kinda mental map of where things are and whatever, you – I would expect that users would say, ‘Okay, here’s Mike Smith’s site. I know him. I’ve seen his stuff. I’ll remember that. Here’s John Jones’s site. I don’t –’ You know, whatever.”

“It’s a little bit more hit-and-miss in that kind – you’re searching around. You’re talking to people, and you’re just sharing stuff. I mean, I had dinner last night with some people... we were talking about a programming language last night ... I’m gonna be sending that to him in the future, so I mean, that’s how a lot of the stuff happens...”

“Nifty’s nice, whereas you can go out and find all sorts of stuff on the Internet, but it’s just so much to sift through that it’s hard to find something that’s worthwhile, and so that’s why word-of-mouth at a conference like this is helpful.”

“If I were to go to the Nifty page, it’s because I wanted assignments to fill some niche, to fill some bill, and so then I scan through to see if I could find one to do it and see if I know some of the people who presented, so that sort of is an extra entrée, helps me know – helps me gauge the potential quality or potential interest.”

There was also a recognition of the negative side of the social nature of Nifty:

“I’m concerned about the severe filters on the Nifty archive. If the curator doesn’t like you, you don’t get in.”

The importance of the social dimension points to an opportunity to improve repository design by explicitly integrating functionality for social interaction.

3.8 Nifty wish lists

When asked what would improve the usefulness of the repository, many responses focused on knowing and connecting with the extended community of users, sometimes in relatively straightforward Web 2.0 ways, such as rating and recommending:

“I like the connections, you know, the people liking this and not like this; people who looked at this ended up picking this. You know, I mean, I find all those connections really very interesting. It’s not that they will always tell me what to do or not to do, but they’re pointing me in directions that are likely to be fruitful, as opposed to just kind of the haphazard searching I would otherwise be doing, right?”

Sometimes the vision represented a more a more sophisticated contextualisation of the resource:

“Well, I’d be much more likely to pick something if I saw six people had adapted it, and I’d be even more likely if under there I could see that ... if I could even find out what institutions they were at, ‘cause if Jane Stevens has adapted it, then I know I can run it at my institution because we have the exact same sorts of setup and timeframes and all sorts of stuff. That would be a huge help to me.”

3.9 Some Implications

Reflecting Susan Mitchell’s findings, the users of the Nifty repository do not appear to want library-type resources. They do not feel the need for **catalogues**, they are content with the current *methods* of searching, but would like the metadata associated with each resource extended to (potentially user-provided) tags/multiple indexes.

In terms of **content** they are not looking for a one-stop-shop with a comprehensive set of resources and the heavyweight “authority” of editorial constraints (like CITIDEL). Nor are they especially interested in the comprehensiveness of the content of the resources as they recognise that they will have to adapt anything to local context.

The question of **control** is interesting, since users express competing concerns. On one hand, they value the assumption of “niftiness” – that content was carefully selected to provide value – as it helps finding useful material. On the other hand, some saw the hurdles to contribution as frustrating.

They do seem to value an identified owner for a themed resource. They are anxious for **curator**: a baseline functionality – no broken links – with few constraints on the original material. They would seem to value curators above librarians.

There was also recognition of the value of **community**, of Nifty residing within a community, but also the presence of an (effectively invisible) community of educators who were using the same resource, adapting it separately. This secondary community is not currently engaged, but notions of their **contribution** of rating, and tagging are clearly valuable, as well as more complex ideas of “joining the club” of people who use, for example, David Levine’s *Test Me* assignment.

4. THE GREENROOM

The Greenroom is a community web site for teachers using the Greenfoot software. It provides functionality to support a community of teachers in developing, sharing and discussing resources and their teaching.

Several differences to other repositories of teaching material give the Greenroom a significantly different feel. These differences include a *community* model of interaction rather than the usual *repository* model, moving from the metaphor of a library to one of a conversation.

4.1 Community focus

The most significant feature that distinguishes the Greenroom from other resource repositories is the top level interaction design. The most common interactions have been designed to be between people, not between a user and teaching materials. The metaphor employed in the design of the site is that of a community of people gathering in a place (such as a teacher common room), rather than

that of a repository of things (such as a library or a database). The intention is that this leads to a different relationship of users with the site, and to different sorts and qualities of interaction.

While most repository systems use their entry page to list resources or categories of resources, the Greenroom lists actions undertaken by people. These actions may well be related to resources (“has posted a resource”, “has edited a resource”), but they may also convey other information (“has joined the Greenroom”, “has started a discussion”, “has marked their position on the world map”).

All notifications of actions are accompanied by the person’s real name and an image. The picture may be a default, but users are encouraged to set their own. This may aid recognition of other members and their contributions when browsing the site, helping to build a sense of community. Currently about a third of all users have uploaded a personal picture, and the majority of users who have contributed to the site have a personal picture.

The site also provides a map that allows members to mark their own geographical location. If they choose to do so, their location on the map is marked with their profile picture. Currently, 40% of Greenroom members have set their location on the map.

4.2 Access

If members of the Greenroom community are to feel comfortable sharing material, especially in the knowledge that it can be edited *ad lib* by others (see 4.4, below), then they need to have confidence in the members of the community, both their status and their intentions. Open access online communities are plagued by inappropriate interventions and often hijacked for other purposes or none at all; gated communities with open-signup (unchecked registration) typically contain trolls.

To address these problems, the Greenroom community is closed with entry controlled by a small group of gatekeepers. Applicants for access are asked to demonstrate their credentials as a teacher, either by referring to a web page from their institution on which their name and status appears, or by dialogue with one of the gatekeepers. Members know that each other have gone through this process, which has a levelling effect in interactions between them – there is no need to establish credentials in individual interactions – as well as in the form of the dialogues which occur, which are necessarily teacher-to-teacher. This mechanism also ensures that members are identified as real individuals (not by pseudonyms), encouraging them to take responsibility for their actions.

Importantly by excluding students from membership it also facilitates the sharing of assessments and their solutions. Eventually, of course, there can be no guarantee that solutions will not leak out. Once resources are online elsewhere they will eventually be discovered.

4.3 Quantity and Richness of Interaction

In traditional resource repositories, interactions are between a user and a resource and are limited to;

- a user uploads a resource, or
- a user downloads a resource.

The Greenroom model encourages more interactions of a richer variety, of higher value to members and the community. Instead of restricting the interaction to a browse-download-evaluate sequence, the community-focused interactions (starting and responding to a discussion, leaving comments for resources) have the potential to spark new ideas, new initiatives, collaborations and other actions

that would not result from an upload/download-oriented interaction model. The process of creating and adapting resources is explicitly exposed, making resource sharing a human interaction.

The member profile images, use of real names and geographical map play an important role in supporting the emphasis of personal interaction. Providing real-life information (such as the image and geographical place) serves to humanise the interaction. Electronic communication can easily be abstract and disembodied in group forums, when other participants are represented only by an alias, leaving users with a feeling of being alone in an anonymous group of people of unknown size and character.

4.4 Contributing Resources

In contrast to many other repositories, the Greenroom has neither gatekeepers nor review process for new resources. Any teacher who is a member of the Greenroom can upload a resource. The original creator remains identified, but has no distinguished role with regard to the resource thereafter. The Greenroom permits all members to edit all resources: a wiki-style model of participation.

The benefits are three-fold. Firstly, allowing all users to create and edit resources removes barriers to participation. Often users hesitate to contribute because they worry that their resources are not of sufficient quality: the Greenroom description explicitly encourages users to upload unpolished resources and to contribute by polishing such resources when uploaded by others.

The second effect of allowing all users to edit resources is that it allows modifications to be easily contributed back to the site. These may be improvements, but may also represent customisation to particular needs. This unrestricted editing can be unexpected. At least one user expressed surprise about being able to edit any resource, wondering whether they had accidentally been awarded administrator privileges. In other cases it has worked well: for example, we have seen impromptu contributions of German translations of resources added back to the original resource.

One user was worried about vandalism if everyone can edit any resource. We believe that the latter concern is unfounded due to the closed nature of the Greenroom and the open identity of participants – to date, there are more than 450 members subscribed in the Greenroom and we have not yet encountered any problems with vandalism.

The third goal of using the wiki-style edit model is to support collaborative development of resources. While feeding back improvements, corrections, comments and adaptations of resources is a useful way to involve other community members, truly collaborative development adds yet another dimension that may allow the creation of resources that might not have been created at all by single contributors working in isolation. In an ideal setting, the community as a whole can act as more than the sum of its parts and may produce material beyond the reach of individuals. The Greenroom provides tools to explicitly support collaborative development, such as versioning, rollback of versions, and *diff*-views, highlighting changes made by others.

Due to the short time the Greenroom has been available; we do not yet know whether this form of collaborative development will succeed in practice. Successes in other contexts, such as the creation of Wikipedia, are generally encouraging, but whether such a model can successfully be transferred to a closed teacher community is an open question.

4.5 Visiting / Revisiting

Many users of the Nifty Assignments repository visit fairly infrequently, and are prompted to visit by either a special event (in the case of the Nifty repository, the annual presentation at the SIGCSE Symposium) or in the context of low-frequency intrinsic need, such as a course redesign in their institution.

For individuals, regular visits to the site may lead to more timely information about new resources and developments, more participation in discussion, more answered questions and a regular flow of new ideas. For the community, regular visits of community members ensure better support, quicker replies, more lively discussion, and faster and more comprehensive feedback for resources.

The Greenroom employs a number of techniques to facilitate and encourage more frequent interaction. First, some interactions are designed to be fast and lightweight. A ‘Quick Edit’ function present for all parts of a resource (title, description, tags, cross references, etc.) makes small, targeted edits easy and quick to do. Thus, fixing a spelling error or adding a tag is a useful contribution that can be made with little effort. This provides a form of legitimate peripheral participation – it requires neither large investment of time nor a high level of expertise, yet represents a genuinely useful contribution.

Following Howard [20], Greenroom discussions are retained for three months only, and no older archive is provided. Thus, discussion of topics is encouraged even if that same topic has already been discussed some time ago. Despite the danger of testing the patience of more long term members, this more closely models a social situation in a real world community space. A new teacher in a common room may ask a question, even though another teacher asked the same thing last year. This has the benefit that conversations are revisited at a new time, with new information, often new aspects and new participants. It is clearly beneficial for new members, and may add new information even for older community members.

Lastly, an email notification mechanism presents additional prompts for users to revisit the site. Users can individually control the level of detail they wish to be notified about, including the posting of new resources, edits of existing resources and starts of new discussions.

4.6 Presentation, browsing & searching

Users of repositories need to be able to identify and locate resources in a way that is meaningful to them, and that reflects the type and extent of their knowledge of what they are looking for. Recognising the problems inherent in fixed taxonomies and category-based indexes, the Greenroom has adopted a tag-based browsing system.

A Greenroom resource consists of a title, a description, an image, uploaded files (which constitute the content of a resource), as well as tags, a comment trail and “see also” links. All of these items are editable.

The use of tags and “see also” links is intended to support creation of a folksonomy for the site, allowing the users to catalogue and structure the collection of resources. The Greenroom currently has no explicit mechanism by which to rate the quality of resources. The fact that resources can change at any time presents a problem for rating a resource, because a rating may become outdated by future changes. That aside, viewing the “most interesting” or “most popular” resources is a quick way to form a view of the overall quality of a repository.

Resources should ideally be evaluated after using them in the classroom: a rating from merely browsing the resource is worth very little, but feedback based on use in a real classroom is very valuable. We would ideally like users to contribute reviews containing experience of using the resource with their students, but this may often incur a time-delay from the resource's addition to the site.

4.7 Credit and incentives

Credit for Nifty Assignments is given via authorship credit in the publication, as well as on the Nifty website. This is a significant incentive for academics, but less so for school teachers for whom publication is not a career-goal. Peer recognition remains important, hence the Greenroom preserves the identity of the original contributor of a resource as well as later editors.

We “feature” contributors on the front page of the Greenroom, to acknowledge and promote particular contributions. Additionally “badges” are automatically awarded for volume of activity in initiating and editing contributions, and in contributing to discussions. These both acknowledge status within the community, and act as tokens of which the holder can use as evidence of activity in, for example, performance reviews. Unfortunately, the closed nature of the Greenroom community means that these tokens can't be directly seen by outsiders.

4.8 Observations

The Greenroom replaced a temporary Google discussion group which had been in existence for six months, attracting 170 members in that time. After six *weeks* the new Greenroom had over 300 users (although only around 70-80 of the original group members transferred), and after three months this number had grown to more than 450. Additionally we saw greater participation in resource development with four times as many resources in the Greenroom despite the shorter time frame. We hesitate to draw any firm conclusions from this, but take this data as an encouraging sign.

5. CLOSING REMARKS

In this paper we have discussed common problems with teaching resource repositories and the observation that simply placing some resources on a web page is usually not sufficient for effective sharing. We have presented two repositories focussed on specific resources and areas of activity. Both address the common issues that repositories face (curation, content, contribution, community, catalogue and control), which reflects the generic nature of these challenges. However, each of the two repositories chooses distinctly different mechanisms to overcome potential problems. This illustrates that different approaches can be made to work, but result in different characteristics of the interactions of users with the repository.

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