Personalised Peer-Supported Learning: The Peer-to-Peer Learning Environment (P2PLE)

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Abstract

The Peer-to-Peer Learning Environment (P2PLE) is a proposed approach to helping learners co-construct their learning environment using recommendations about people, content, and tools. The work draws on current research on PLEs, and participant observation at the Peer-to-Peer University (P2PU). We are particularly interested in ways of eliciting explicit, coded, user feedback, and in monitoring the transitions from state to state within the PLE. We discuss the ways in which these ideas can inform the design of a platform for peer-supported study of university-level mathematics.

Keywords

Peer Learning, Personal Learning Environments, Feedback

I. Introduction

The Personal Learning Environment (PLE) lies at the forefront of personalised and self-regulated learning online (Chatti, M. et .al. 2007) The use of online forums, blogs, social networks and other Web 2.0 tools for learning purposes is also increasingly typical, even among co-located groups.

In this paper, we will investigate design issues around personalised and peer-supported learning, drawing on participant observation in a new learning-oriented online community, the Peer-to-Peer University (P2PU)[1]. We will make use of the existing PLE literature, and walk through an extended thought experiment where we look at how our ideas could be applied in a mathematics learning context.

The main idea we investigate in this paper is that of the Peer-to-Peer Learning Environment (P2PLE). Our thought is that since learners typically work through tasks together, or with a degree of peer support, they would benefit from access to a sophisticated, personalised, socially-aware task tracking system.

We are agnostic as to whether this system is closely integrated with a given online community, or makes use of the Web-as-Platform model. Part of the view of PLEs is that learners will make use of a wide range of tools and interactions in any case (Willson et.al., 2008). Features of the P2PLE could be implemented in either scenario, and, indeed, we have already seen proofs-of-concept for both (we will discuss this in the following section).

Both self-directed learning and peer collaboration are already quite strongly supported in Web 2.0 environments. What remains to be seen is how to improve the learning experience by making use of this data as we move towards platform with stronger support for semantics (Web 3.0). The P2PLE proposal indicates the scope of data that we can usefully gather, and makes some initial recommendations for how to use this in the concrete instance of mathematics learning.

II.Background

Personal Learning Environments (PLEs) have shown evidence of facilitating learning and addressing the current limitations of Learning Management Systems (LMS). A PLE can be broadly defined as a facility for an individual to access, aggregate, configure and manipulate digital artefacts of their ongoing learning experiences. Compared to a typical LMS, where the learner is restricted by the lack of adaptability and responsiveness of the learning environment, the PLE follows a learner-centric approach. It allows the use of lightweight services and tools that belong to and are controlled by individual learners. Rather than integrating different services into a centralised system, the PLE provides the learner with a variety of services and hands over control to her to select and use these services the way she deems fit (Fiedler and Väljataga, 2010; Zimmerman, 1989).

For example, n the context of the European project ROLE (Responsive Open Learning Environments - www.role-project.eu), we are supporting learners for lifelong and personalised learning within a responsive open learning environment. Figure 1 shows a PLE developed by the ROLE project for the Open University. The purpose of this PLE is to support students in studying climate change and

[1] http://p2pu.org

sustainable energy by providing them with a set of learning tools in the form of widgets. Within this environment, learners use a search widget in order to find learning materials from a variety of repositories, including OpenLearn (www.open.ac.uk/openlearn), iTunes U (www.apple.com/education/itunes-u), Wikipedia (www.wikipedia.org), SlideShare (www.slideshare.net), and YouTube (www.youtube.com). Learners also collaborate with their peers via widgets offering videoconferencing and real-time document editing functionalities. Learners can personalise this environment by adding tools from third-party widget providers, such as the Google gadget directory (www.google.com/ig/directory).

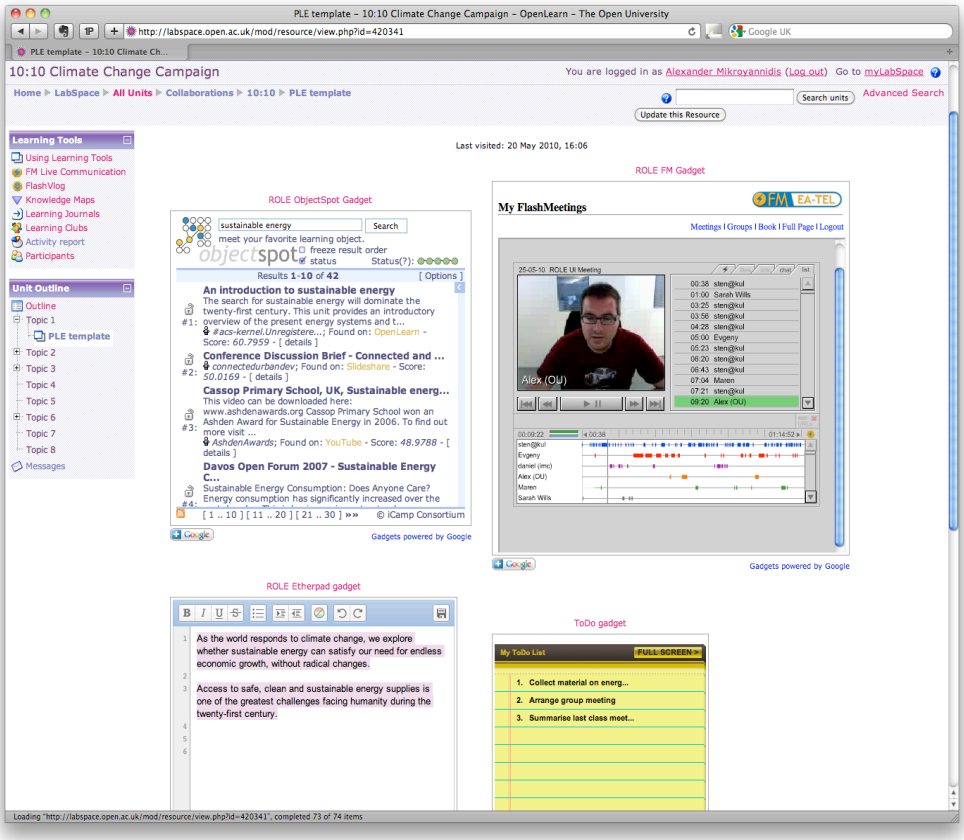

Figure 1. A PLE for finding learning resources and collaborating with peers

How do we think about quality in a PLE? Studies can have been made to determine whether people like their experiences working with a PLE, and the tools can be adapted accordingly; this approach is the state of the art in PLE research.

However, a PLE is all about live, interactive adaptation to the needs of the user. Accordingly, there ought to be a way to measure various aspects of quality within the PLE itself. Here we suggest a lightweight approach to user feedback that uses distributed evaluations of all of the components and activities that comprise the environment.

How might this work? We know that a PLE user assembles various components and performs various activities with these tools. Many of these activities are social – collaborating on a project, giving feedback to one another, and so forth.

Importantly, objectives are selected from a larger set of possible objectives, tools are selected from a larger set of possible tools, peers are selected from a larger set of possible peers, and so forth. Each of these choices represents an implicit judgment about quality – such choices have the potential to be particularly revealing when they change over time.

However, there is a degree of implicitness here that confounds things. Unless we have a way to make the judgments explicit, we won't know whether someone is moving on from a given activity because they are finally satisfied with the results, or because they have grown hopelessly frustrated.

Within the current conception of PLEs in the ROLE project, an explicit evaluation or reflection phase is introduced, which can make more of these judgments explicit – see (Fruhmann, 2010) which builds on the theory of self-regulated learning developed in [8]. Here, we look for ways to wrap evaluation and reflection even more tightly into use and participation.

This requires lightweight ways to communicate sentiments about activities. For example, in response to a given blog or forum post, a reader might say "This blog post was exceptionally well-written, I learned a lot from it", or they might say, "You know, this post was interesting, but it happened to lead me off on a direction that wasn't really relevant to my learning project" -- or they might say, "Reading this post was a waste of my time." In the case of blogs, feedback of all sorts is currently handled through the comment system.

However, feedback could easily be coded. We can start with the popular idea of bookmarking or "starring" content, but we suggest that stars should be used to give feedback, and not simply as bookmarks (Figure 2). In other words, starred content should also show up in the profiles of the people who contributed the content. The set of codes should be expanded, providing readers with a set of ratings that convey significantly more than just "thumbs up" or "thumbs down". The "superstars" lab feature recently mainstreamed in Gmail gives an idea of what the UI might look like (but Gmail doesn't currently propagate information on which posts have been starred back to the content creators).[2]

In a learning context, detailed feedback would be particularly relevant to (peer) producers of content, and also to educators or technologists who are building tools. A peer learner might, for example, request evaluation along a certain set of dimensions: "I'm really trying to work on my writing quality, please let me know if you find my argument cogent or not." A technologist might be happy to learn about novel uses for the tool they've developed.

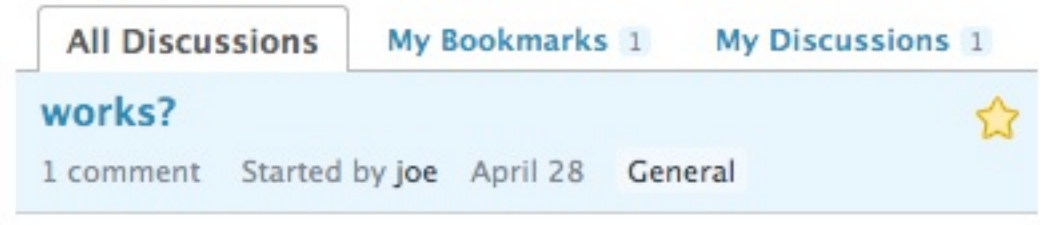

Figure 2: We start with the popular idea of starring content, but suggest that stars should show up not just as "my bookmarks", but also in the profiles of people who contributed the content.

[2] http://gmailblog.blogspot.com/2011/05/3-labs-graduations-1-retirement.html

Thus, a targeted set of feedback options could be requested in addition to open feedback. (Targeted requests for feedback are known to work well in writers' workshops, for instance!) As proof of concept, we note that multi-dimensional judgments have been used to good effect for years in the Slashdot community, while the Facebook "Like" button is a more recent example showing that light-weight quality judgements can be widely distributed.

Of course, such judgments can be applied to all aspects of the learning context: tools, objectives, activities, peers. There is wide precedent for various sorts of feedback presented by technologies ranging from UserVoice to LinkedIn. The real question is how feedback is going to be used. This is the main issue we take up in the rest of the paper.

III. A simple scenario

Anne, Betty, and Charlie are working together on a paper they plan to present at a conference. Betty and Charlie have a good collaboration session drafting some initial content -- but it turns out that Anne can't make it to the scheduled meeting. She shows up later and does some editing in place, finalising the text. Betty later adds some diagrams. Anne then decides to put together a short film to accompany the presentation. Finally, it happens that the conference is near Charlie's hometown, so he's the one who makes the presentation.

This simple scenario shows three axes: People, Tools, and Activities. The range depicted in Figure 3 is meant to suggest a small slice of data about a much larger environment: in general, there would be more items along each of the pictured dimensions, and more dimensions as well. In particular, here we've aggregated activity over a certain short period of time.

Looking at other slices along the time dimension might reveal that our protagonists collaborate like this frequently -- or perhaps we would learn that they end up collaborating in a similar way, but with other people.

What we don't know just from looking at this picture is how the presentation went, or how any of the protagonists felt about any of the steps in the process. We would need another dimension to learn that Betty and Charlie do indeed find Etherpad to be an effective tool, or that Anne actually prefers it when she gets more help with her video work. But these sorts of judgements could be added as extra dimensions.

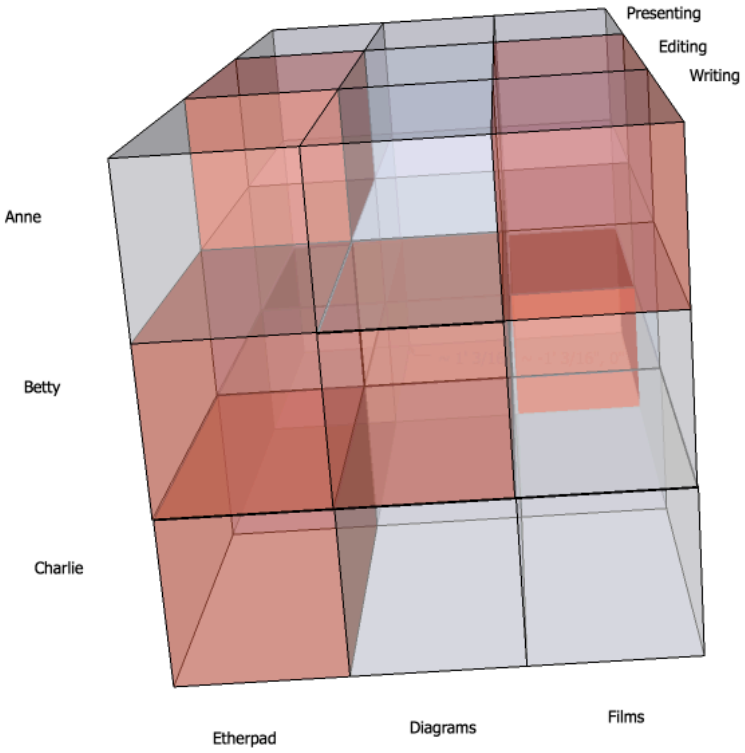

Figure 3: A 3-dimensional grid showing people, technologies, and tasks

IV. Requirements for Peer Learning

We begin with a couple of basic axioms about feedback.

1. Feedback doesn't do much good if the agent(s) receiving the feedback can't use it.
2. Giving feedback tends to be an "extra step", so we should make it useful for people to give (or they won't do it).

An example of (2) that we discussed above: "starring" items is useful in approximately the same way that bookmarks are useful, but if handled properly, the starring action can provide feedback to content creators. The rest of this section looks at different transitions that can happen in learning. This section is based on recent observational study at P2PU (Corneli,J. and Danoff, J., 2011), in which we developed a framework of five principles that describe successful peer learning experiences. Here, we reframe these principles in active terms, looking at what changes ("Deltas") take place in peer learning.

1. Changing the nature of the space: "changing context as a decentred centre").

This could happen at a technological level (e.g. an administrator or programmer adding a new feature to the platform), or, importantly, on a qualitative social level (e.g. by a user making a comment that changes the tone of the conversation).

2. **Changing what I know about myself : "meta-learning as a font of knowledge").**

Users can be kept accountable for their actions and celebrate their contributions by means of a record kept on their user profiles. A user profile that keeps track of things I rated highly, and ratings of my contributions (or recommendations of me) from others would be very useful. In response to changes in my profile, I may update the criteria I'm asking for feedback about.

3. **Changing my perspective: "peers provide feedback that wouldn't be there otherwise").**

Users can have constructively critical views on technology, strategy, or content. Sometimes actions speak louder than words.

4. **Changing content or connectivity: "learning is distributed and nonlinear").**

In a peer-managed environment, "design" can happen on an ongoing, ad hoc, basis. Without changing the "nature" of the space itself, it is possible to change the content, for example by adding or removing a given feed or tool.

5. **Changing objectives: "realize the dream if you can, then wake up!").**

Individual and collective goals and objectives are important as a way to discuss and critically examine progress. Since goals and objectives change (particularly once they have been achieved, but for other reasons as well), there should be ways to users to adjust their goals. Changes to shared goals and objectives should typically be negotiated.

V. Support For Interpersonal Communication

Is a social context, the five different kinds of changing features discussed in the previous section are workflow and communication issues, *par excellence*.

The various transitions could happen quickly (e.g. by adding a particular tag to some piece of content), or build up more slowly (e.g. by continual feedback from peers about a given topic).

It is important to note that a given piece of content -- like a person -- can be in several categories at once. This leads to the idea of remixing content by sharing it between several courses or groups at once. This idea is akin to the concept of "internationalization", insofar as we consider content that be immediately used a range of "locales".

In this view, a given discourse context, such as a development project, is akin to a simple "language". Indeed we might find many development projects that are mostly distinguishable by their language choices. Until the learning environment supports content that is adaptable in this manner, the environment may suffer from an unnecessary degree of balkanisation.

Since the P2PLE adapts content bi-directionally between several sources, constructive activities can take place in different locales or peer groups, and share across boundaries. Importing changes can be selective based on local evaluations of quality (it's OK if other people use the content in a different way).

The next section will look at a concrete case.

VI. Peer Interactions in a Mathematics Learning Environment

There are any number of websites that offer help with or learning resources for mathematics. One has been well studied is the Math Forum, where "virtual math teams" have received particular attention (Stahl, 2009). Another more recently developed site is the Kahn Academy, which provides videos and sequenced review problems. At present, Kahn Academy materials do not incorporate peer interactions explicitly, but peer support has been used to good effect in classrooms where the Kahn materials have been deployed.

However, these, and most, mathematics learning platforms focus on pre-university material. We will look back at the ideas generated in earlier sections and think about how they would apply in a P2PLE for university level mathematics.

We will look at the project underway to add facilities for problems and solutions to PlanetMath.org, a community-produced mathematics encyclopedia. This will be viewed through the lens provided by the five points discussed above.

1. Changing the nature of the space

As technological facilities develop, new features will be rolled out regularly, moving from basic support for adding and discussing problems and solutions, to automatically linking the problems to related articles in the encyclopedia, all the way through to a recommender system that will mine previous user interactions to suggest useful problems or readings to try next. Although problems will be separate from the encyclopedia, their introduction will change the nature of the space: people will now be able to ask "Which encyclopedia articles are missing problems?" or "Are the encyclopedia articles that are connected to the current problem well-written?", for example. Looking at expository material as part of an ecosystem that contains problems and solutions adds a very useful check on quality. Small independent changes to encyclopedia articles that adjust them to serve the needs of learners are expected.

2. Changing what I know about myself

As individual learners accumulate a track record of uploading and solving problems, asking for and offering help, giving feedback on and modifying encyclopedia articles to suit, etc., they should get a better sense of how they learn best. They should be able to ask for specific kinds of feedback and see how their progress improves (e.g. in formulating proofs or demonstrating an understanding of the concept of a limit). They should be able to keep track of particularly helpful and particularly non-helpful suggestions offered by peers or by the recommender system.

3. Changing my perspective

Hopefully, peer mentors -- and system developers -- will be able to learn from learner feedback about what's helpful and what's confusing. Feedback should be particularly valuable to learners ("Wow, I didn't even know there was such a thing as spherical trigonometry!"). Ideally, giving and receiving feedback will be comfortable for all involved.

4. Changing content or connectivity

In addition to peer-producing mathematical content, our hope is that learners and other contributors will be able to develop their own semantic queries. Such queries could be used to identify holes in the corpus, or interesting relationships between activity patterns. Not everyone needs to be able to build these queries to use them, e.g. to generate a feed showing all the latest additions of problems having to do with tori or klein bottles.

5. Changing objectives

A shortcoming that was noted in the previous decade of PlanetMath's existence was that support for individual "projects" was not particularly strong. For example, a project to improve the entries about real numbers chose to base its operations on the organisational wiki rather than in PlanetMath itself.[3] Content quality in PlanetMath has so far been maintained using a "correction system" that points out places where individual articles are mistaken or could be improved. In order to support the production of educational content, it would be good to generalise the correction system to include ranges of content (sub-collections of the encyclopedia or sub-areas of mathematics).

VII. Conclusion

We have discussed a model of learner interactions that takes into account people, tools, activities, and other dimensions. In particular, we have focused on feedback about these items as an ancillary set of dimensions. Time is one of the most important dimensions, and, in some cases, we may be able to infer judgments from time-delineated data -- however, we've focused on ways people can get and give explicit feedback, keeping in mind two axioms, that the feedback should be useful to both receiver and sender.

We've examined general-purpose criteria for peer learning environments, which have arisen in the context of P2PU, and applied them to generate some initial design requirements for an ongoing to convert a peer produced mathematics encyclopedia into mathematics learning environment.

The thought we wish to conclude with is that in today's global context, we are often in touch with peers from all over the world. There is an increasing need courses that cross natural language boundaries, and for specialized technical literacies. But our ability to understand one another well depends partly on the means that we have to express our thoughts, ideas, and concerns.

Technologies that are able to provide learners with feedback on their expressions – whether coming from a peer, or from an algorithm – can support the learning process. Following the outline of the previous two sections, our suggestion would be to focus on developing technologies (ranging from light-weight mechanisms like rubrics or rating systems, to sophisticated text mining tools) that learners can use to detect, highlight, and share information about the changing nature of the space, its content and connectivity, and their own self-knowledge, perspective, and objectives. We look forward to future work on these issues, building on the ideas in this paper.

Acknowledgement

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