Collaboration and reflection using peer reviews and public wikis

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INTRODUCTION

In the last 40-50 years there has been a huge interest in using technology to enhance teaching and learning. In the same time span, there has been a shift away from a behaviourist view on learning, a term introduced by Watson [1], to a more constructivist view (or rationalist as it is called by Greeno et al [2]). As a consequence, technological tools to support a pedagogical design with its roots in constructivism are being developed.

Many tools associated with the recent development of the web can be used as teaching tools. Web 2.0 tools are characterized by ease of use and rapidity of deployment, making possible powerful information sharing and straightforward collaboration [3]. One of the major components of web 2.0 is a wiki. Adie et al ([4]) defines a wiki as "*a type of website that allows users to easily add, remove, or otherwise edit all content, very quickly and easily, sometimes without the need to be a registered user. This ease of interaction and operation makes a wiki an effective*

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tool for collaborative writing. Wikipedia itself is perhaps the prime example of a wiki." (p. 5).

Wikis have been used in many courses (see e.g. [3], [5] and [6]). Most of the uses have been in distance education, but wikis have also been used in more traditional face-to-face courses. Parker & Chao ([7]) have a good overview on different uses of wikis in an educational setting.

Biggs [8] has elaborated on the terms "deep" and "surface learning", a term introduced by Marton & Säaljö ([9]). Further education typically aim at deep learning, in the SOLO taxonomy [10] this means the learning outcome is at least at the relational level. One way teachers pursue deep learning is by the use of peer assessment techniques such as students grading other students or students giving feedback on other students work [11].

Pairing wikis and peer reviews is therefore obvious and has been used in several cases (e.g. [12]). In this paper we present and evaluate an approach where the combination of these two elements is put to use in a software-engineering context. The focus is the peer review in itself, the wiki in itself and the combination where students give, receive and can be inspired by other students' solutions and reviews during and after their own solution.

To evaluate if this pedagogical design improved learning, a study was carried out amongst 3rd semester students at the Aarhus School of Engineering in the course embedded software development.

1 APPROACH

1.1 The Wiki and Review setup used

The analysed approach is used in a 5ECTS point Embedded Software course involving obligatory almost weekly hand ins (ten hand ins in fourteen weeks). To qualify for the end of semester oral exam, eight out of ten hand ins must be approved.

The course has been taught for several semesters. It has two hours of lectures and two hours of labs each week for 14 weeks. The goal of the course is the following:

- Explain the principles behind an OS and its kernel.
- Explain problems inherent in multithreaded systems.
- Explain and apply OS facilities for process and thread synchronization and communication.
- Design and implement programs with multiple processes/threads
- Implement and use a general OS-API as an interface between program and OS.
- Explain the challenges with the use of dynamically allocated memory.

At the start of the semester the students are divided into groups of 2-3, to foster discussion and collaboration amongst the students and thus enhance learning. The hand ins are of a complexity suitable for this group size.

A hand in consists of two parts, the first being a lab challenge (see http://goo.gl/PMBT0 for an example) and the second being the review a group conducts on another group's work. Lab challenges are to be written using the group's

own wiki and reviews are to be comments on the exact same wiki page that is being reviewed. This ensures locality and a certain degree of publicity for both parts. To ensure the public nature of the wiki and the accessibility for reviewing, a central spread sheet containing all students, their groups and associated wikis is maintained and made publicly available to the class.

Consequently a hand in is completed in two phases; the first phase is the lab challenge and the second is the review. For the first phase the students are allocated two weeks, whereas they have four days for the second phase. Prior to the second phase a review group is found. The group is chosen at random and such that no group reviews the same group twice.

The lab challenges are typical in the sense that they serve to get the students acquainted with the given topic using hands on experience. Lab challenges are very heterogeneous ranging from getting acquainted with Linux and basic OS / Kernel knowledge, understanding race conditions when using threads, implementing threads via the C POSIX thread API to designing and implementing message parsing in an Object Oriented OS API programmed in C++. All implementations are followed up by questions that dictate reflection answered in an essay style. To further enhance learning, the group must determine which three subjects they consider to be the prime learning points for the said lab challenge whilst completing their lab challenge.

For the second phase, the review, the aforementioned three subjects serve as an aid. In particular they act as cornerstones in assessing whether the group, being reviewed, has done an adequate job. The required length for a review is set to be between 5-15 lines. In reality the reviews were 174 words long in average with a standard deviation of 110. For a lab challenge to be considered acceptable, two out of three subjects must be completed satisfactorily. If it is deemed passable the reviewing group states an ok otherwise they state external review, meaning that a course instructor must evaluate as well.

1.2 Data collection

To ascertain the perceived experience by the individual students a questionnaire was formulated. It served to ask questions related to the use of wikis and reviews. The questions have had three focal points, one being related to the wiki technology, the second being reviews and the third being a combination of the two.

Eleven questions were designed and a Google form was developed to be the medium by which the students would present their feedback. Each question consists of two elements: a 5 point Likert scale [13] and a comment field. To ensure as many responses as possible, all 11 Likert scale questions were mandatory, whereas none of the comment fields were.

Two former students piloted the questionnaire and provided feedback before the class was asked to complete it.

25 students have completed the form equivalent to half of the class.

2 RESULTS

The results have been divided into three overall parts: review, wiki and the combination of the two. As written above, the results are based on students' answers to a questionnaire, not an examination of the solutions or reviews

2.1 Perceived benefits regarding reviews and reviewing

In figure 1 the students characterise the reviews they received as having an average quality. This is an important statement since it acknowledges that the reviews were created with an adequate quality to be worth using. Interestingly, but not surprisingly, discrepancies exist between the perceived quality of the created and received reviews – the students find the quality of their own reviews better than the received ones (figure 2).

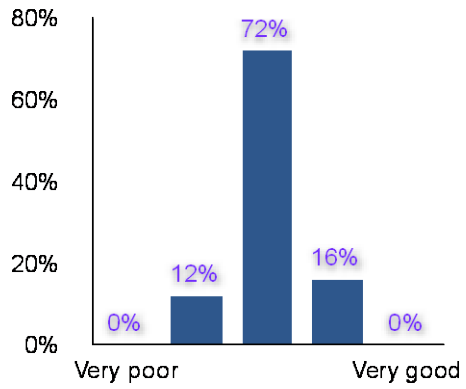

Fig. 1. Student perception of reviews made on their work

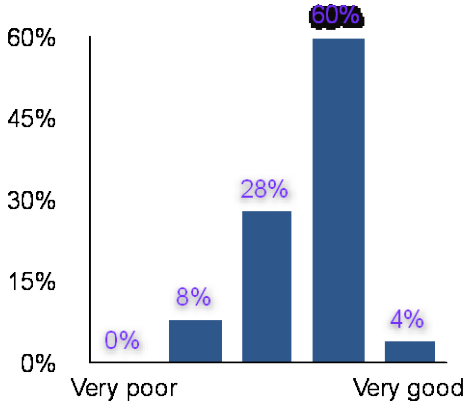

Fig. 2. Student perception of their own reviews

When asked in the questionnaire, the students found it clear what was expected of a review in form and contents (in average they answered fair) and it was considered fairly easy to give reviews from a professional point of view.

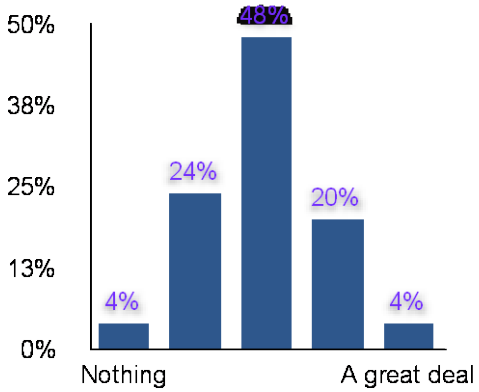

Fig. 3. Student rating of perceived benefit when being reviewed

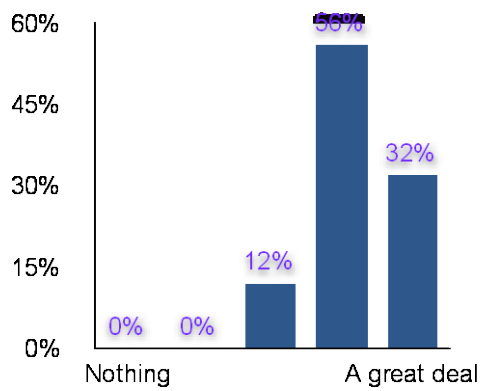

Fig. 4. Student rating of perceived benefit when reviewing others

Figures 3 and 4 indicate that the students perceive both reviewing and being reviewed, as elements that benefits them. According to figure 4 this is especially the case for the reviewers, which is affirmed by their comments. The principal point made in said comments is that in order to perform proper reviews an in-depth inspection is necessary. In avertedly this fosters a comparison between the work to be reviewed and their own. This comparison promotes reflection thus engaging the student in deeper learning.

A principal point is the amount of reflection a student does based on received reviews. From figure 5 this proves to be a significant number, only 16% have *not* reflected on received reviews. This is strengthened by the fact that 60% (figure 6) actually utilises the feedback and alters their lab challenge after they have received the review.

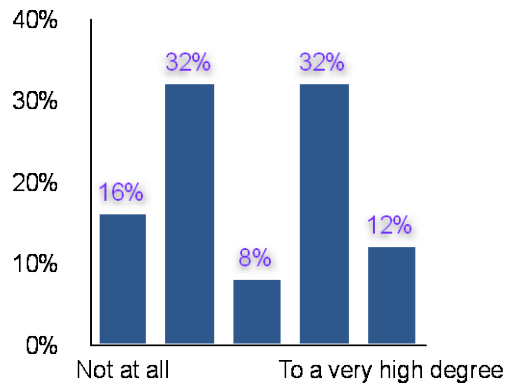

Fig. 5. The degree of reflection individual students have done due to the received review

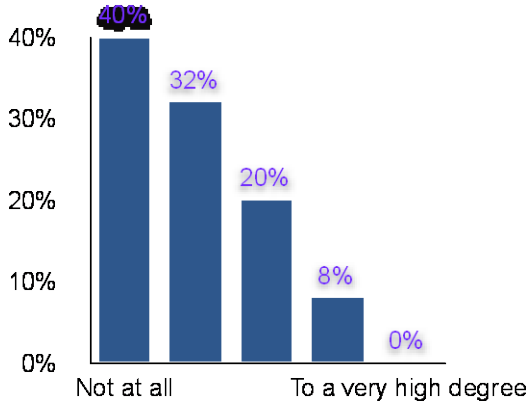

Fig. 6. The degree by which students have changed their lab challenge based on the review given / received

2.2 Perceived benefits by using Wikis

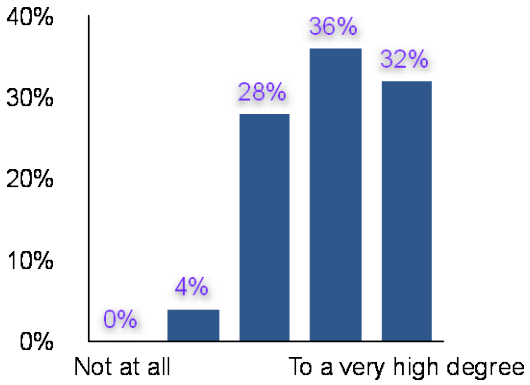

Fig. 7. To what degree have you utilised that lab challenges have publicly been accessible via Wikis?

One of the cornerstones in the proposed concept is that of the wiki and the fact that the lab challenges the students complete are made public. This is contrary to having students write a PDF file containing their solution and handing it in at the designated deadline. Inspecting figure 7 as well as the student comments, it is accentuate that the concept is in fact very viable.

Even though the current generation of students are used to Web 2.0 technology, their feedback indicate (figure 8) that the use of wikis present a moderate amount of extra work. One must therefore incorporate this when planning the complexity and extent of the lab challenges.

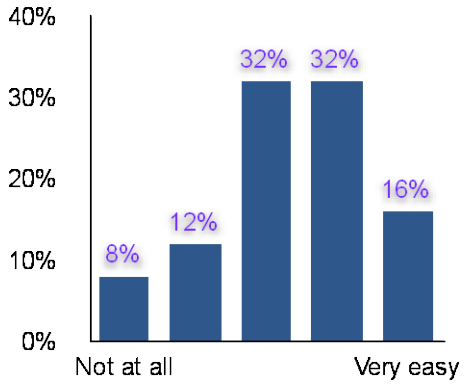

Fig. 8. Has it been easy to give reviews from a technical point of view (has the wiki technology been easy to use)?

2.3 Perceived benefits from the combination of the two

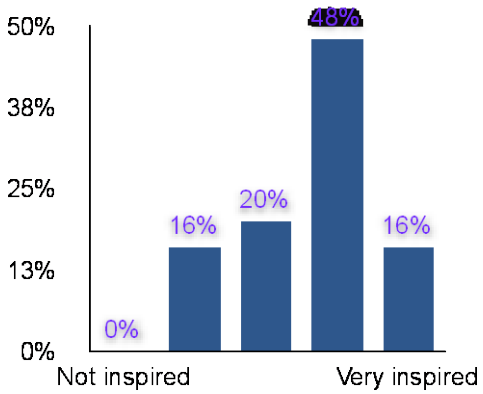

Fig. 9. To which degree have you been inspired by solutions made by others?

Figure 9 relates that the combination of the collective influences from performing reviews, receiving reviews and having solutions from other groups that are available continuously makes for an environment that stimulates the individual student to seek inspiration from others. In fact all were inspired to some degree and more than 64% were significantly inspired.

3 DISCUSSION

As can be seen from the analysis, the students found the pedagogical design supporting their learning in a commendable way. In the following, we will discuss some aspects of the design and results.

3.1 Inspiration

The students found the publicity of the wiki combined with the peer review very inspiring. In total 64% of the students answered either inspired or very inspired. The fact that the students have access to the partly solved challenges (the solutions are written on the wiki from the start) have been supporting their learning process.

From the answers to the comments in the questionnaire we find that the students have a sensible attitude towards the publicity. As one of the students write: "*I have*

used it [the solutions from another group] if I got stuck"[2]. Another student note: "*Sometimes one sees a smart shortcut in source-code. The inspiration I get by others' solutions when I see their wikis during work on the assignment teaches me a lot.*"

The students have used the wiki for guidance thus freeing the teachers time: "*If I get stuck, the first step need not be seeking guidance from a teacher ... it is a good help to self-improvement*"

The topic at hand involves a great number of details. Many students find it hard to remember them – here the wiki comes in handy, since they have a natural place to look for them. "*I have used it to compare my solution to other solutions. I am sure that others have watched our wiki and I think this is very fine since there are so many things to remember, and it is nice to find concrete help in a wiki*"

In general small suggestions for change from the review or by performing the review did not inspire the group to change their solution: "*The parts I found totally wrong I changed*"

3.2 Technology

Surprisingly the students found the used technology problematic. The possibility for review was supported by a plugin in the wiki used[3]. It seems like it is not the wiki in itself but small problems like remembering to include the plug-in at the bottom of the solution page and the formatting of the page that was a problem. As one of the students note: "*There were some start-up challenges with the wiki, but since then it has been a good tool*"

3.3 Plagiarism

Having all the solutions public available invariably makes it easy to plagiarize. However, the set-up proposed discourages it by the fact that everyone has access to all solutions. A group has no knowledge of who observes their solution; if they copied (part of) a solution from another group, the other group could notice it (and they could even be reviewed by them, since the reviewers are chosen at random). One student note: "*It was often possible to see other solutions for inspiration when solving the lab challenge. However, we preferred to try to get as far as possible by our self before using this possibility. But a couple of times it was other solutions that got us unstuck*"

4 SUMMARY AND ACKNOWLEDGMENTS

In this article we have evaluated the effect (seen from a student's perspective) of the combination of wiki technology and peer assessment.

We know that peer review fosters deep learning. In traditional settings, the solution and the review are only available for the solving and reviewing group and only after completion. By using wiki technology, we maximize the timeframe in which inspiration can be achieved. We can see this has a very positive influence for learning, since more than 50 % changed their solution even though it was already accepted.

The authors wish to thank all the students who answered the questionnaire.

[2] Comments translated from Danish by the authors

[3] The wiki used was Trac (http://trac.edgewall.org)

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