MATH LEARNING WITH WIKIS

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Throughout the last years, Web 2.0 has made it easier to create and change content in the WWW, especially in Wikipedia. In this paper we discuss the usage of Wikis for students who study to become a math teacher. In our study, project based learning groups were using the wiki-software Mediawiki for realising projects with mathematical content. Mainly, the Wiki should be used by the students as a communication platform for sharing ideas, creating, editing and discussing content. After the students had finished their projects the content was analysed and questionnaires were filled in by the students (n=30). We come to the conclusion that there must be specific conditions (e.g. animate students to discuss) to show a possible positive effect of Wikis on reflective learning.

LEARNING WITH WIKIS (THEORETICAL FRAMEWORK)

Wikis have a lot of potential (e.g. virtual collaboration by creating and editing content over the web easily, fast publishing, sharing information). The best example is the online-encyclopaedia wikipedia (see http://wikipedia.org). There, people write articles and discuss content with each other. But Wikis can also be used for learning (Klampfer 2005, Himpsl 2007). Hence, it is not surprising that some teachers are already integrating Wikis for learning mathematics in schools[1]. Furthermore, Wikis are used in different scenarios at university level (Fountain 2005). It has to be considered that the use of new media does not improve the learning results per se. Rather, new technologies must be embedded into lectures carefully (Bescherer, 2005) to be helpful. Using new media for teaching has implications on the structure of the course, on teaching methods and on students' learning style. To improve academic writing, Wheeler et al. used a Wiki. They come to the conclusion that their "findings indicate that most students raised their skill level in writing as a result of using the Wiki space" (Wheeler et al., 2007, 2009). A draft for a three stage model for seminar courses as a new way of teaching and learning is outlined by Spannagel (Spannagel, 2009). Here, stage 0 equates to a "traditional" seminar course where students prepare and give presentations. At stage 1 the participating students are more active and involved to a greater extent. At stage 2 project based learning takes place with external partners using web 2.0 tools actively.

In this paper we want to discuss conditions for using Wikis for realising project based learning in mathematics successfully without external partners at lecture training activities. The main difference in comparison to WebQuests is that there is no focus on internet research and no selection of links which should be visited. Thus, this pre-selection in WebQuests limits the complexity.

1. See http://wiki.zum.de/Mathematik-digital , last viewed 26.4.2009

PROJECT WORK WITH A WIKI (STUDY)

Composition of the lecture and method

The lecture in which the students used the Wiki for collaborative learning, was called "Project based learning and Modelling in Mathematics". On the one hand the students were taught in theory, on the other hand they had to work on projects beyond the regular lecture which took place once a week. For the project work students were required to use the Wiki as an integral part of their project work. After having formed project groups of 3-6 persons and having chosen a mathematical topic the students were introduced to possibilities of using the Wiki (e.g. collection of links, project diary, documentation, brainstorming) as well as they were shown how to create and edit pages.

In total the students had twelve weeks for realising their projects. Among others, topics were chosen such as "golden section", "outdoor geometry (measurement)", "parabola", "probability calculus", "symmetry", and "percentage calculus". In the end the students had to present their results. We analysed the content created by the students as well as a questionnaire which was filled in by the students after the semester. The response rate was 30 whereas 40 students attended the lecture. All of the students have been studying for one and a half year at least, 84 % of the students were male and the average age was in the early twenties.

Preparation and progress

For showing, creating and editing Wiki-pages each student had to log in with his or her own account. Hereby "vandalism" could be avoided. Furthermore, we were able to find out which team members edited specific articles. Besides, we installed Mediawiki-extensions which enabled the embedding of videos, adobe flash, dynamic geometry applets, footnotes, and mathematical formulae.

The Wiki was pre-structured in the following way: on the main page there was a tutorial about the wiki-syntax including some hints. A page "community portal" was used to link to the specific project pages. In addition, a sandbox was provided for testing and experimenting with the wiki-syntax. But this sandbox was used only twice.

The first task for the students was to create their own user page with the aim to make them more familiar and less intimidated by the Wiki. The user page should contain text as well as a picture. We figured out that after one week, only 50% of the students had fulfilled this task. After reminding them, 75% of the students used the Wiki actively until the following week. The usage of Web 2.0 does not seem to motivate the students per se at the beginning. One week before, after and during Christmas vacation (9^{th} project week) hardly an article was edited (see figure 1). This result is astonishing because there were holidays; and one big advantage of Wikis is to work collaboratively, time independently and mobile. All in all, most page edits happened after the lecture at the same day the lecture took place. On Saturdays the fewest page

edits occurred. Otherwise, page edits were distributed nearly uniformly throughout the twelve weeks.

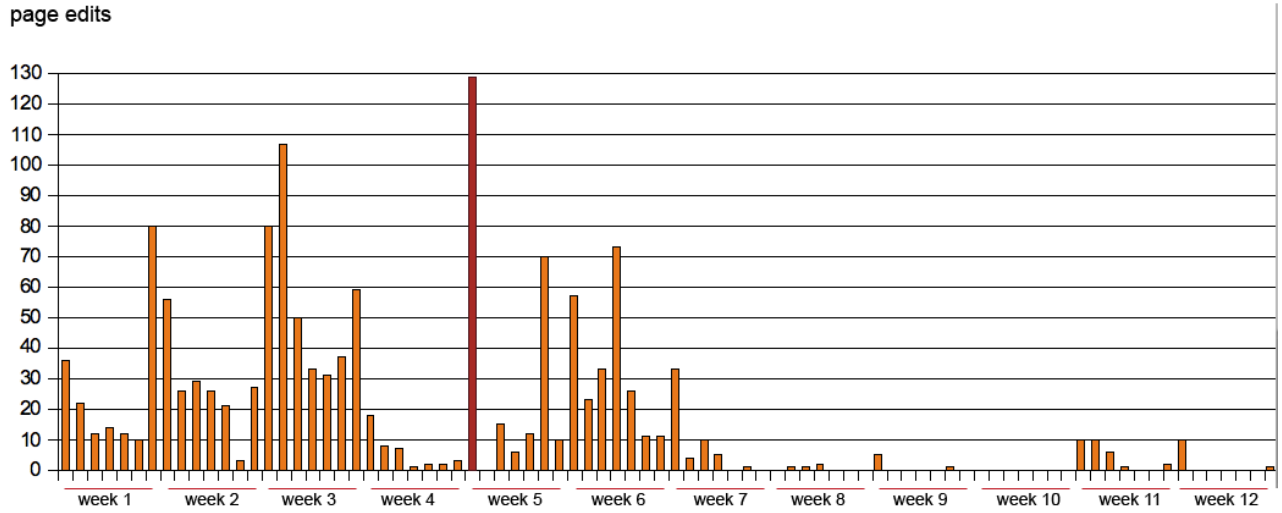

Table 1: amount of page edits per day.

As mentioned before, students were using the Wiki in addition the weekly lessons. Nevertheless, during one particular lecture the students were working at their projects in class as well. During this lesson the lecturer worked as an advisor and helped the students in strategic and mathematical questions. Specific mentoring enlarged the usage of the Wiki weighty (see peak in week 5 in figure 1). Throughout the second last week of the project hardly any page in the Wiki had been edited. We assume that the students preferred face-to-face interaction in order to prepare their final presentations.

Example: project "lottery"

In the following we will describe the project "lottery" exemplarily. The results agree with the other projects to a large extent. The project group lottery consisted of 3 students who considered the implementation of a lottery game at a school party. Besides, this group asked pedestrians about their estimations concerning the probability of winning the jackpot in the German lottery "6 of 49". Furthermore, they studied tip strategies, lotteries in other countries and the calculation of different lottery games. First of all, the entry page "lottery" was created and a link was set from "community portal" to this article. In the end, six articles and two discussion pages were set up by this project group. Discussion pages which exist for every article were used mainly for technical questions. Also, the user page of the wiki-administrator was taken advantage of. Interchange of project groups through discussion pages did not take place until it was initiated by the lecturer. The phenomenon that discussions with regards to content happened very rarely is also described by Bescherer (Bescherer et. al. 2004).

CONCLUSION AND OUTLOOK

All in all, the Wiki was mainly used to store gained information and to document the progress and the process of the project. This included collecting links and embedding images. Videos and Adobe Flash applications were integrated hardly ever. Dynamic geometry applets were embedded not at all. Even though the editor for mathematical formula producing LaTeX was not used very often, it turned out to be very helpful for some of the groups. On the contrary, extensions for inserting footnotes were used frequently. In the project "lottery" the calculation of the probability of winning the jackpot first was written by hand, scanned and then uploaded into the Wiki. Only after a discussion about the advantages of using LaTeX instead of scanned images the formula editor was used for calculating. Nearly every project group used a mind map to give an overview. Therefore, we would suggest including an extension to create and edit mind maps collaboratively.

Concerning the teamwork the development of the articles showed us that it was rather cooperative than collaborative. This means that the students divided the work into different areas and dealt with their topics on their own. Collaboration, for example developing and editing content in the Wiki by different students iteratively, did not take place. In the project "lottery" collaboration was limited to correct misspellings. Research is needed to determine the conditions which foster discussions on content amongst students. The rare occurrence of discussions in the Wiki can be explained by the reason that the students were talking to each other almost daily. Therefore, it was easier to clarify questions face-to-face or using ICQ than posting questions in the Wiki. Other obstacles which were mentioned in the questionnaire were that students did not get an answer from their fellow students and that some of them had the impression that not everyone was using the Wiki regularly. Due to the few discussions which took place in the Wiki, definite indications about how the use of the Wiki advanced reflective learning cannot be made. There are hints, also based on the questionnaire, that reflection is not initiated if the Wiki is used for documenting the process of the project only. Indeed, documentation can be one reason to deal with the subject more intensively because other people have the opportunity to read and to observe the process of the project. But it cannot be declared that the Wiki assisted the students on reflecting their own learning. Further studies are needed to find out how lecturers can trigger students' willingness to reflect on their own learning.

Nevertheless, the authors believe that using a Wiki as a platform for mathematical projects is adequate. From the technical view the installation of a Wiki is very easy and a short introduction of 15 minutes how to use a Wiki is sufficient. To tap the potential of Wikis it is necessary to point out the advantages of collaborative work and the usage LaTeX to the students. Settings like working with distant people and using discussion pages for questions which are relevant for the whole group seem to be useful to foster collaborative work with the help of the Wiki. To sum up, through using Wikis this way, students are getting familiar with appropriate e-learning scenarios.

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