Heuristics for Implementation of Wiki Technology in Higher Education Learning

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Abstract. This paper discusses the use of wiki technology in higher education. Wikis are simple online information systems which often serve user communities. In higher education, wikis have been used in a supporting function to traditional courses; however, there is little research on wikis taking on a larger role as learning environments. This paper explores how wikis support goals of constructivist learning environments, especially communal constructivism theory. Further, it summarizes results of current research using wikis in the classroom and considers elements which can improve the use of wikis for learning. The paper concludes with a proposal of nine guidelines to improve the use of wiki technology as learning environments in higher education.

Keywords: Wiki, Wiki Learning, Wiki Learning Environment, Communal Constructivism.

1 Introduction

Time Magazine made a surprising choice for the 2006 person of the year: "You". With this choice they described the shift of computer users from consumers to producers of internet content with community and collaboration reaching a scale never seen before [1]. Wikipedia, YouTube, MySpace, and Facebook are examples how web technology supports this shift and how technology provides an opportunity to build a new kind of understanding from the contributions of millions of people [1].

One technology, the wiki, is emerging as a potentially powerful learning tool. Wikis are simple online information systems (databases) providing a collection of user editable web pages which are often used to serve user communities [2]. Wikipedia exemplifies that with access to a computer comes access to information and access to experts, but also the ability to provide information and to be an expert. Research shows that wikis have been successfully used to support learning techniques such as interdisciplinary discussions, knowledge base building, collaborative learning, collaborative writing, peer mentoring, inquiry-based study, and learning community work [3-19]. However, developments in social constructivist theory and improved

access to the internet by most citizens permit the wiki to become more than an instructional support tool. This paper discusses the use of wikis as learning environments considering communal constructivist learning theory. It describes the features of wikis that facilitate the fundamental elements of communal constructivist theory and concludes with a list of recommended features for wikis used as learning environments.

2 Wiki Technology and Communal Constructivism Theory

Wikis offer collaborative, student-centered learning environments. They support goals of constructivist learning environments by providing dynamic repositories that allow students to learn by constructing knowledge based on their experiences in a self-directing manner; becoming active contributors to each others' learning; and developing a sense of community ownership of this content [17, 20, 21]. These features support recently emerging learning theories like communal constructivism, distributed cognition, and connectivism, which address the shift to networked knowledge and community learning [17, 20-24].

Wikis are especially well suited to fulfill the requirements for communal constructivist learning environments. Communal constructivism builds on constructivism theory. Students construct their own knowledge as a result of their experiences and interactions with others, but in addition are afforded the opportunity to contribute this knowledge to a communal knowledge base for the benefit of existing and future learners [22]. Holmes et al. [23] describe six features of a communal constructivist learning environment: (1) adaptive ICT, (2) peer tutoring, (3) publishing, (4) non-traditional roles, (5) assessment, and (6) continuity.

2.1 Adaptive ICT

Holmes et al. [23] suggest that the course delivery method must be adaptive to support a diverse range of techniques -- peer tutoring, project based learning, cognitive apprenticeship, and year-to-year transfer of knowledge -- as well as diverse data -- audio, video, text, pictures and databases. Moreover, the ICT must be flexible because as the community shapes the knowledge held within the ICT they may also shape ICT itself [23].

A wiki is, by design, a flexible learning environment. A wiki page can take on any form including threaded discussions. A wiki can contain most file formats-- audio, video, text, or picture; or it can link to sites that support other features such as databases. The learners themselves organize the wiki structure and can link to other pages or outside resources. Thus the flexibility of the wiki learning environment, meets the changing needs of the community of learners for long term use.

2.2 Peer Tutoring

Peer tutoring is a valuable tool of communal constructivism. There is evidence to suggest that when producing knowledge with and for peers, students return to their work to make sure they have mastered the topic [25].

An interesting feature of a wiki learning environment that supports peer tutoring is the version control system. The wiki keeps track of changes that are made to the page. A learner can review the changes that were made in order to see advances in the content, changes due to mistakes, or additions to information that may have been made. In addition, there is a threaded discussion that is associated with every page, which is often related to changes that are made to a page. Learners can review the discussion to understand the processes that contributed to the changes; this allows for peer tutoring among current learners as well as between learners from past to present years.

2.3 Publishing

Communal constructivism requires that students publish their work for use by students in subsequent years and for inspection by a wider community [25]. Therefore, students work for two audiences, the first audience is student peers and instructors; the second audience is interested parties beyond the school community. The body of literature reports that the wiki format has been used for collaborative work and publishing [4-6, 11-19]. Additionally, wikis have been used in IT journals to change the peer review process [13].

There are several features of wikis which will support input from within and outside a school community – page editing, hyperlinked pages, threaded discussion forums and page locking. Once a page is posted any registered member of a wiki can edit a page. However, the student who created the wiki page retains "ownership" of the page. As owner, the student is notified of changes to their page. This allows the owner to learn from contributors and to correct any incorrect information that is posted. The owner or any another member of the community can link the page to other pages. These linked pages can extend or clarify the current page. Additionally, associated with each page is a discussion area, which traditionally provides an area to discuss changes that need to be made to a page. A wiki supports the communal process of editing published pages better than traditional software (e.g., word processors) because the wiki locks a page as it is being edited by a learner/contributor. Therefore, if the page is unlocked a contributor can be assured that they are working from the most current version.

2.4 Non-traditional Roles

Wikis support learners as well as instructors in non-traditional roles by inviting contributions by every member of the community and storing the knowledge in a user controlled environment. Students can use knowledge published by instructors as easily as instructors could use contributions made by students. Every member of the community is at once an instructor and a student as the focus moves away from specific content knowledge and moves towards the process of building a knowledge community.

2.5 Assessment

Communal constructivism requires a rich assessment process such as portfolios or continuous assessment [13]. The wiki becomes the repository for the learner's final

published work; this work can be assessed as part of a portfolio or as an individual artifact using a rubric or checklist.

Wiki usage data and revision tracking features facilitate the rich assessment process and overcome common student complaints regarding collaborative work. A common concern of students working collaboratively is that their individual contribution to the group work will not be recognized [26, 27]. Wiki software tracks changes to wiki pages by individual users which permits the instructor to view all contributions made by each student. Several studies reported higher student satisfaction in group work because of the capability of individualized assessment in wiki learning [5, 28].

Attempts have been made to automate the assessment process in a wiki but these attempts were not successful [28]. Therefore, the assessment process is still a labor-intensive process on the part of the instructor.

2.6 Continuity

Continuity allows for a body of knowledge to be used, reorganized, and built upon so that progress made from prior years is not lost [23, 25]. The wiki knowledge base can be continuously updated and augmented to include the most current information available [5, 13, 15, 18, 19]. This continuity is especially important in rapidly changing fields. Science, technology, and pedagogy are three fields that require a knowledge base that can be revised and reorganized with up-to-date information.

Most research studies used wikis only for one semester; however, the wiki environment supported by communal constructivism would be used over many semesters to maintain continuity among learners. The wiki knowledge base would retain not only current knowledge but would also provide a historical record of the development process. Future learners could benefit not only from the current knowledge contained in the wiki but from an understanding of the thought processes used to shape the content of each page.

3   Limitations of Technology

All of the reviewed studies used wikis as a supporting tool and observed several limitations. These limitations included that the technology was difficult to use; students did not actively participate when the assignment was voluntary; small communities did not engage learners; students were reluctant to edit each other's pages; pages were formatted inconsistently; pages were mostly text; and switching between course management systems and wikis was cumbersome.

The most often cited limitation in the literature was that the technology was too difficult to use [5, 6, 10]. There are two types of user interfaces for creating and editing pages. The first requires users to learn a special wiki mark-up language. However, Cubric [5] documented users had trouble with this difficult wiki interface. Some wiki engines have a WYSIWYG (What You See Is What You Get) interface with a spell checker. This allows the user to compose information within the wiki site and use similar formatting features that they currently use in their word processor (i.e., bold, italics, font size, color -- all from icons, or drop down menus).

Another common problem when using wikis was that students did not participate if the wiki was voluntary [6, 8, 10, 19]. This limitation only becomes an issue when the wiki is used as a support tool. When the wiki is used as a learning environment all students will be participating. Full student participation is important because small communities participating in wikis might not produce a useful wiki. In one study the authors attributed the failure of their wiki learning environment to the small size of the community [10]. No clear recommendation of optimal size can be found in the literature, more research is needed to determine a good guideline.

Another limitation that might be encountered was revealed in a study by Tal-Elhasid & Meishar-Tal [19]. In this study students were reluctant to edit each other's work. The authors of this study suggested that part of the assignment should include edits. While edits are not essential for learning to occur, they are essential to harness the full potential of the communal learning environment. As students contribute to the work of other students they build upon the knowledge available to all students.

Another factor that might affect the usefulness of the wiki is the format of the individual web pages. One study, in which the wiki served as a collaborative research database between students and professors, documented difficulty in efficiently retrieving information that appeared in different locations on each page. The final analysis suggested that a database with a unified format was easier to use [29].

Easy access to the material is provided through the search function of the wiki. While this easy access is a strength of wikis, it is also a limitation. One study suggested that the wiki did not appeal to all learning styles because it was too text dependent [8]. This is a difficult limitation to overcome while still providing easy access to information. The wiki environment supports the use of video and audio files; however, information in this format is not searchable.

4   Recommendations

Based on recent research using wiki technology in the classroom, several technical requirements have emerged that must be met for a wiki to be used as a learning environment. The following list is description of recommended features for an effective wiki learning environment. The wiki must support

- **User authentication system.** To account for copyright and student privacy laws and to provide for accountability, it is important that the wiki require a username and password for access to the learning environment.
- **Popular browsers such as Internet Explorer, Netscape and Mozilla, and Safari.** In order for all students to participate in the learning activity they need to be able to access and edit the wiki. This is only possible if all popular browsers are supported.
- **Thread mode.** Direct interaction among students can occur in threaded discussions that are linked directly to each student's webpage. This facilitates a dialogue among students about the information found on their web pages.
- **Image and video uploads.** This is important in a learning environment because images and video can sometimes illustrate a topic better than pure text does. In addition video and images differentiate the content to accommodate diverse

learning styles. It is possible this differentiation could influence the success of the learning associated with the use of a wiki.

- **Tracking portfolios of edits and updates tied to individual users.** When an authentication system is used, this statistical information about sessions, and pages (created, modified and visited) allows the instructor to monitor student use of the wiki. It permits the instructor to see how long the users are spending online, which pages they visit most often, and qualitative and quantitative data on each user's contribution to the wiki. Because the revision tracking system does not account for many users working together from a single computer, this should not be the sole source of data for an individual's contribution to the collaborative work.
- **WYSIWYG (What You See Is What You Get) editor.** Many wiki engines use technical language for formatting web pages. This wiki syntax can vary between wiki engines. For ease of use, the wiki engine should include a WYSIWYG editor.
- **Page locking system.** When a user is editing a page, it is important that the page be locked so no other users can edit the page. This ensures that there is only one valid version of the webpage.
- **Help link.** A link to a help file with information about how to use the functions of the wiki is vital. Students may have questions about how to use the wiki. To deter students from contacting the instructor with technical questions, a help file should be accessible.
- **Searchable audio and video.** In order to support search of multimedia formats, the wiki should support audio and video search by keywords.

Furthermore, directions for the assignment, templates for the page layouts, guidelines for postings, and the assessment criteria should also be included. Many wiki engines currently incorporate these recommendations and are free or of little cost to the educator or learning institution. A good comparison of wiki engines can be found, appropriately, in Wikipedia [30].

5   Conclusion

Wikis are well suited to support recent emerging learning theories addressing the shift to networked knowledge and community learning. Communal constructivism supported by a wiki learning environment offers students the opportunity to be active learners by facilitating the students' contribution to the learning of others. Wikis used as learning environments facilitate communal construction of knowledge that not only benefits the author but the audience as well. The heuristics developed in this paper were developed considering recent research on communal constructivism learning theory as well as recent research on using wiki technology in the classroom and should be tested and refined. More research is needed to determine best practice for the use of wikis as primary learning environments. The optimal size of the community has yet to be determined. Furthermore, effective time efficient methods need to be developed for instructors to participate in the learning communities and to assess their students' work. A future project is planned that will test the guidelines by applying them to a current course at this university.

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