

Collaborative Writing Tools in Engineering Education: challenges for knowledge management and sharing

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Along with the change of the internet paradigm to Web 2.0, it exists huge and varied online applications for several aims, in which the user faces a stimulating environment to produce information. Within this scope, collaborative writing tools as wikis have shown advantages for a variety of different uses in educational contexts. Wikis are already used in many countries, which means that schools and companies have adopted them whether to share or to manage knowledge. In Engineering Education, this tool becomes helpful in the development of projects, ideas and assistant management, as it stimulates collective cooperation and intelligence.

Keywords Wikis, Internet, Cooperation, Projects

1. Introduction

The profile of engineers has been gradually changing, which means that nowadays professionals have to dominate more competences and technologies in order to have a multidisciplinary and transversal curriculum. This professional uses a variety of information and communication technologies (ICT) that use the Internet to perform or complement their daily activities.

The first generation of the Internet had as main characteristic the amount of available information. However, the user's role in this scenario was only of viewer of what was happening in that particular web page, as he didn't have authorization to change or edit the content. In the first stage, the services available on the Internet appeared and spread fast, creating new jobs and economic markets. One example of this is the e-commerce, which developed a new business pattern as it made companies triple their profit. This stage can be called Web 1.0. Web 1.0 was very expensive to users, because most services were paid and controlled through licences; the systems were only available to those who could afford online transactions and buy software to create and maintain sites.

Web 1.0 led to great advances in accessing information and knowledge, but the philosophy behind the global network concept was of an open space, without "owner" or person who controlled the access or content. The idea of making this a democratic environment was always present and the technological evolution allowed an increase in the number of users only possible due to the increase of the network bandwidth, the possibility to publish information on the web in an easy, fast way, regardless of specific software, programming language or additional costs.

Along with the changes of paradigms to Web 2.0, it exists a huge and varied online applications for several aims, the use of these resources grows as the users produce information, sharing their knowledge through the Internet, in an easy, fast way. Within this new generation of the Internet called Web 2.0, concepts like Blog, Wikipedia, Podcast, Orkut, Del.icio.us, Skype, Messenger, LinkedIn are a few examples of tools of systems available on the global network [1].

Many users didn't notice that the Internet had changed its paradigms, due to the fast change process. The philosophy with Web 2.0 is different as people create their own documents and automatically publish them on the web, without having knowledge of programming or of computer environments.

A wiki is a website for collective work of several authors; it is similar to a blog in its logic structure, but it also allows adding, editing or removing content created by other authors [2]; [3]; [4]. The wiki is already used in several countries and for several purposes, which means it can be used in schools or in companies for share or knowledge management. The wiki concept became popular with the creation of Wikipedia that grows everyday with the voluntary contribution of specialists in various fields and according to [5] has 3,5 millions of articles and more than 720 million words in 205 languages and dialects. According to the same authors, its content is voluntarily created and modified. Although there is a lack of "top-down" quality control and a strict hierarchy, many articles have good quality, which was proved by Nature magazine. This British magazine submitted 50 scientific notes of Wikipedia and Encyclopaedia Britannica to be evaluated by specialists, who came to the conclusion that just 10% of more than a thousand of doctors or researchers connected to Nature had written to Wikipedia. Through this analysis it was also possible to assume that people without any technical knowledge had written the majority of the notes. But the research had 42 corrections, showing a rate of four incorrect notes

in Wikipedia and three incorrect ones in Britannica. The specialists also found four serious mistakes in each encyclopaedia, 162 omissions and false truth in Wikipedia and 123 in Britannica. These results confirm that both are very similar regarding mistakes and reasons.

In this chapter, we present the context for the new profile of engineers, pointing out the technological transformations and the effect that the Internet has on teaching and learning activities. Within this scope is the wiki, as it is an advantage when creating or managing information essential to the success of engineering projects.

2. Wikis

To [6] wiki is a Hawaiian word “wikiwiki” that means “too fast” or informal. In 1995, Ward Cunningham created the wiki, imagining a web page where it was possible to have a cooperative and open edition. Following this idea, it was built the first wiki software as well as other similar actions.

Wikis can be of a commercial or open source (open code) type. Most companies prefer to work with the commercial software as, in an Intranet environment, only those who are logged on the wiki can access contents and data is secure against losses on the company servers. Some of the commercial software’s are:

- Confluence Enterprise Wiki [<http://www.atlassian.com/software/confluence/>]
- SocialText [<http://www.socialtext.com/>]

Some of the open source software’s are:

- Wiki.Com [<http://wiki.com>] works as a search engine of other wikis and as an environment to create free wikis. It is part of google
- MediaWiki [<http://www.mediawiki.org/wiki/MediaWiki>]
- Twiki [<http://www.twiki.org/>]
- Wikispaces [<http://www.wikispaces.com/>]
- Wikia [<http://www.wikia.com/wiki/Wikia>]

[7] defines a wiki as a “free expansive collection of web pages connected in an hypertext system to store and modify information – a database, where each page can be easily edit by any user with a browser”. The main idea of a wiki system is to change any original text, so new knowledge can be added to the existing one, which means that in an open wiki each person can edit a page. In wikis with a restrict access, only the persons logged on or having the manager’s permission can add new contents or new texts.

The wiki allows the user to add or modify posted texts and every time there is a new post, all users can insert notes or correct it. They don’t need to ask for the author’s permission as they are invited to give their contribution and the final result is collective.

In practice, it is a website that can be directly edit from a navigational structure, such as Internet Explorer or other and it allows the creation of new web pages only by clicking on certain buttons to write a text, as if it was a word processor. Wikis allow publishing and sharing content on the web in a very easy way.

The search for knowledge is the main reason for the existence of wikis and the willingness to share it led to databases with information that can be read and modified by those who know about a specific subject. These databases are important to the persons who participate in a wiki and they are important when all members of a group share knowledge between each other.

Although several support tools for collaborative work have already been tested, wikis are one of the most promising technologies that allow implementing collaborative techniques on the work group in virtual environments. A wiki is a website produced by several authors through a collective work.

It allows the creation of new web pages only by clicking on certain buttons and by writing a text, as if it was a word processor. Wikis allow to publish and share content on the web in a very easy way [2];[4].

According to [7] wikis can be used in two different writing modes or styles of usage: the document mode and the thread mode. In document mode contributors create collaborative documents and in the thread mode contributors carry out discussions in the wiki environment by posting signed messages. Although there is still few research regarding educational uses of wikis, findings support the use of this tool for collaborative learning [8]; [9]; [10]; [11]; [12]; [13].

The most spread use of wikis is known in literature as wikis interclass [11] and consists in the creation of a repository or a collaborative database by a group of students that attend the same subject or course. The wiki can be used so students can develop a project in small groups, can work a part of a collaborative class project or so

they can create and maintain the website of the subject or course. [11] give this tool the following educational potentialities:

- To dynamically interact and cooperate with students;
- To exchange ideas, create applications, purpose work guidelines for certain goals;
- To recreate or make glossaries, dictionaries, textbooks, manuals, repositories of classes, topics, meetings etc;
- To make structures of shared, collaborative knowledge that can create learning communities;
- Inclusion in edublogs, because they complement each other despite being different in their creation;
- To check all modifications, allowing the professor to evaluate the improvement;
- Students can create, edit or delete a posted text, being responsible since they are logged on;
- Wikis can be used to create a work schedule or to develop projects;
- The use of wikis leads to a decrease in the use of media such as the telephone and e-mail, because a colleague can search for information on the wiki before asking about it.

Wikis have quickly increased and they were used in areas such education, namely in teaching and distance learning; in business, as co-workers share knowledge and in engineering and management as a tool for projects management, etc.

3. Some Contexts of Use

[11] Define some contexts of use for wikis: the first is the willingness to **write**. In our society, this skill is very important, as it represents not only the ability to write but also the ability to understand or recognize when a mistake is done. Wikis allow people to write for their profit as well as for their team-mates.

Portfolios have also been improved through media. Wikis help people to organize digital material and to connect them in hypertext networks.

As far as **collaborative knowledge** is concerned, groups can use wikis to create a database of shared knowledge. Therefore, they can develop a project as a group, can work a small part of a class project and can maintain the website of the course.

In **research coordination and cooperation**, wikis allow people to be in different places when building a collective digital space of ideas, articles, data, documents and research results. Researchers can also use wikis as a notepad of their main ideas.

As a way to perform a **curricular and interdisciplinary coordination**, wikis allow the persons involved (professors, directors, co-workers, etc) to organize together classes, schedules, evaluation and distance coordination without the need of using books or registers.

Events coordination through web: many universities organize symposiums and congresses, scientifically and professional meetings through wikis. One advantage of using them is the ability to edit the content and layout without having much knowledge of it.

Time and project management is also important. Wikis are one of the best tools to manage a project in several fields. We will approach this subject on the next topic.

Some contexts of use will be thoroughly presented. In a recent study done by [12], a wiki was used for the work of a master degree subject in Educational Technology at the University of Minho, in Portugal. The wiki was the repository of the class and it was built by all students that worked together on a specific topic of the subject. The final evaluation of this experiment showed how important the collaborative work was (the students had the chance to learn from their partners and consult their material) and the final product was a data repository, which can be consulted and used online by those interested in different areas.

This repository [<http://claracoutinho.wikispaces.com>] was also a communication method between students and professor, as comments and evaluations could be seen by all class, allowing the students to correct their mistakes and improve their contribution to collaborative knowledge.

Another context used for wikis is personal sites or class/group sites. Paulo Marques, professor of the Department of Informatics Engineering in the University of Coimbra (Portugal), uses the wiki [http://pmarques.dei.uc.pt/wiki/Paulo_Marques] as a personal site. In this wiki we are able to check personal information, his education, professional experience, publications, projects and information about the subjects he teach. The advantage of having a wiki is that the keywords are always hyperlinked and users can always see the updates by clicking on the bottom *related changes* or through a RSS.

Other advantage is presented on the wiki of the course “*Cadastro Técnico Multifinalitário e Gestão Territorial*” [http://geodesia.ufsc.br/wiki-ctm/index.php/P%C3%A1gina_principal] of the Federal University of Santa Catarina. This wiki is a repository for all contents of the different course subjects. Both students and professors who belong to the group can consult and add interesting issues to the database, where are also available news of that area, professor’s contacts and useful themes for future researches.

Events and congresses management, as it was already mentioned, is also a context for wikis. The 5th Working IEEE/IFIP Conference on Software Architecture site [http://www.dnsalias.org/wiki/5th_WICSA_2005] was built within a wiki. Through this website it was possible to search all information of the congress, such as deadlines, the programme, organization and scientific committee, sponsors and more information regarding the event.

This tool is not only a new way to do things, but it helps to organize many ideas of different groups from a company, regardless its size and number of employees. The wiki managed to have many users in many companies in such a short time, because the productivity of a department increases a lot.

4. Projects Management with Wikis

Engineering uses projects methodology in most of its services, as tasks are performed by a multidisciplinary group that shares its knowledge to build a goal or product. Nowadays, there are several projects within engineering, some are: a) civil engineering; b) research; c) products and systems development; d) commerce; e) environmental impact, etc. They can also change as far as size, complexity, subject, and types of activity are concerned. They involve different groups of persons and they have a clear beginning and end.

To [14] a project is a non-repetitive, planned job performed according to specific techniques and with pre-defined costs, investments and deadlines. A project can be also defined as a complex, extensive work, which is performed with the cooperation of several departments of a company and eventually of other persons.

Team members do the project management, including power and tasks division and this should be a clear process in evaluation and observation. To accomplish it, they should use management systems for project development to record tasks division and distribution, deadlines, information register, lists from the team members, representatives and partners e-mails. Wikis are software capable of store all this data fast and in a practical way, as they offer a rich and simple environment for information management. The best thing about them is the fact that they are free (open source) and allow all users to have login and passwords, making possible to secure and recover all posted contents.

A wiki system creates an interactive space, where information of engineers or students teams can be managed. It can also lead to a collaborative learning as well as to a connection between the different project levels. It promotes the collective grow of a certain matter, giving simple solutions to complex problems through a collaborative hypertext construction. Learning or collaborative work occurs when two or more persons perform together an activity that aims to define a goal, search a theme or improve skills. For [15];[16] the elements that define a collaborative activity are:

- a) Individual Responsibility: each person is responsible for the group work;
- b) Positive Interdependence: each person of the group depends on the other to perform the job;
- c) Cooperation Skills: the persons involved should learn about team work;
- d) Promoting Interaction: interaction between the persons of the group can develop richer relationships and effective learning processes;
- e) Group Process: periodically, it is realized the reflection and evaluation of the process to proceed the necessary changes;

The use of wikis leads to the idea of connection, as [17] believes “connection is guided by the idea that decisions are based on principles that quickly change”. Therefore, we can change already posted information, creating a new space of continuous learning through exchange of knowledge. Siemens [17] describes some principles of connection that are similar to wikis functionality:

- a) Learning and knowledge are based on several opinions.
- b) Learning is the process of connecting specialized persons or information sources.
- c) Learning can also be done through non-humans methods.
- d) The ability to learn more is more critical than what is actually known.
- e) It is necessary to create and maintain connections in order to make easier continuous learning.
- f) It is important to have the skill of noting connections between different areas, ideas and concepts.
- g) Update (“currency” – an accurate and updated knowledge) is the goal of all learning connection activities.
- h) To make a decision is a learning process. To choose what to learn and to understand the meaning of information is to be able to note through a changing reality. Although there is a correct answer now, this can be wrong tomorrow due to changes of the conditions that affect information and decision.

The advantages of using wikis when managing projects are the possibility to define objectives for the project and their accomplishment, allowing all participants to understand, share and approve the responsibilities along the different stages. This leads to a logical approach to planning and encourages more strict calculations, it gives all necessary means for supervision and control, and it gives security to management by showing the control of all accomplished stages and the remaining ones.

5. Conclusions

Information and communication technologies along with new computer technologies have influence upon society and the education of the engineer is directly influenced by it. The inclusion of wikis in learning processes is a natural path that an engineer can take to learn in a society of knowledge.

The student, future engineer, will work in a market of social and technological change and he creates his concepts and knowledge through situations that represent his expectations and allow him to contact a technological world.

Wikis are very successful because they are simple, efficient and easy to use, learn and implement. They make the content available to the persons all the time without costs.

Although there are several software's for project management, wikis can be the first choice as they are simple, with open code, which means that besides not demanding a licence payment, managers can change their layout and structure. Wikis are a cheap solution to project management, cooperation and they solve communication problems or obstacles.

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