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Semantic Wiki: A Tool for Collaborative Learning Environment in Computer Engineering Education

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Abstract

Computer engineering education encourages students to enhance their communication skills, critical thinking, analysis capabilities and abilities with group working. A successful way of improving student abilities is to organize them in work teams for specific tasks. These specific tasks play an important role for computer engineering students to gain habit of working together during all stages of a project development. Active learning methods can be used in the development of fundamental student qualifications. Collaborative learning methods such as project oriented learning and problem based learning are beneficial techniques to accomplish powerful active learning to promote engineering student's creative and critical thinking. In recent years, web-based collaborative learning strategies have emerged with the growing usage of Web 2.0 based internet technologies which allow web users to create and exchange information actively. One of the most popular tools is the Media Wiki platform used for collaboration among students in web-based education. This Wiki tool creates new opportunities for students to edit learning resources and to share, create, discuss or to modify their projects together. Wikis are mature technology constructed with new trends in e-learning education such as discussion pages and history pages. On the other hand, Semantic Wiki that is a combination of Wiki and Semantic Web (Web 3.0) technology has not completely explored yet. Semantic Wiki enables users more advanced searching and navigation facilities by using annotations of course materials. In this paper, we introduce the opportunities of Media Wiki and Semantic Wiki platforms for collaborative computer engineering education.

Keywords: Semantic web, Media Wiki, computer engineering, collaborative education environment.

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INTRODUCTION

Learning is a dynamic and interactive process where students perform the fundamental tasks that contain processing, discovery and application of new information. In the learning process, students' interest must be maintained to ensure the success. Therefore, students are encouraged to contribute in constructing their own knowledge by using of instructive techniques and thought inciting activities during the active learning. Active learning utilizes the methods in which students have to competing each other through competitive education or interact with others through collaborative learning. In the collaborative learning, students work together to achieve a specific task. Furthermore, students exchange their knowledge and share their experiences through collaboration. One of the main points of the collaborative learning is that each student in the workgroup is responsible for teach himself (Alanis-Funes, Neri & Nogues, 2011). According to Virvou & Sidiropoulos (2012) collaborative learning has a noticeable potential to enhance inventive thinking, critical thinking, elaborative thinking, social communication, and social abilities such as decision-making, leadership, trust-building and conflict-management.

Collaborative learning is also very important in engineering education. Reguer`r+Udqt´+Udqt´ & de Castro (2011) reported that there are many studies of collaborative learning experiences in engineering education. In these studies, the students were delighted to get comprehensive knowledge with a high level motivation. On the other hand, employers in industry want to employ new computer engineering graduates that are equipped with capabilities of communication and teamwork beside on knowledge. Therefore, in computer engineering education, collaborative learning must be a continuous strategy to develop the spirit of teamwork (Requena-Carrion & Alonso-Atienza, 2010).

It is very important that students must be closely traced for effective collaborative learning. In this way, the strength and weakness of learning can be identified and new approaches can be applied on the course content (Jiake, Wei & Xuan, 2010). Moreover, carefully monitoring assures that interaction among the students is maintained in a well-balanced manner and workload is shared by every student. So, every student will enrich their knowledge even more. Web based collaborative learning tools are provides the higher achievement and more productivity than classic methods with the support of effective monitoring. This collaborative learning tools are software applications which are provides to create a virtual collaborative space for students through a network (Alanis-Funes et al, 2011). A web-based collaborative learning environment introduces the online communication and mutual interaction to achieve tasks. From the perspective of social constructivism, students can effectively build their knowledge by sharing experiences and discussing (Chen, 2007).

Wiki applications have increased as a knowledge sharing environment for collaborative learning with the popularity of the Web 2.0 applications recently. Wiki is constructed on the theory of constructivism and have many advantages such as easy to use, low-cost, open and social platform for everyone. Wiki is a kind of hypertext system that contains a collection of assistant tools to enables the working with together (Çetin & Karakış, 2012). A wiki provides to create and edit course

contents easily by using only a web browser (Elrufaie & Turner, 2005). The collaborative nature of wiki is founded by using an environment where all users has read and change the wiki pages without having to know any programming language. In the Wiki platform, every user can initiate a new page. Instructor and students can change the contents and save the new versions or upgrade this content after startup. The information about students' usage and learning achievements can be obtained and analysed (Çetin & Karakış, 2012) any time. The co-writing process using Wiki tools stimulate the critical thinking, knowledge sharing and the reflection of students (Popescu & Manafu, 2011).

A wiki environment is occurs sum of subjects, contents and hyperlinks. But, this massive knowledge collection is not accessible or understandable for machines. Further, finding and comparing information from different pages may consume time. There is also a drawback in wiki related to presentation of structured information. A wiki doesn't provide structured access for searching information. Semantic Wikis has appeared to overcome the shortcomings in the Wikis by combining features of Wikis with Semantic Web technologies. Semantic Wiki utilizes the definitions of contents by annotating the pages. The annotated content is the property and annotated object is a hyperlink to the page. The property metadata information enables to student hypertext relations between pages after annotating (Junjie, Qian, Dongxia & Su, 2010).

In this paper, we proposed a collaborative learning tool called Semantic Wiki in order to improve engineering students' ability to work together. Also, the opportunities and enhancement of Wikis and Semantic Wiki for collaborative education are introduced in the following sections.

Related Works

Wiki based collaborative training took place in computer engineering such as in training of students about programming and network applications. Elrufaie & Turner (2005) used a wiki based system to increase learning performance of their students on XHTML programming languages that is necessary for development of web based applications. They added authorization functionality to traditional wiki structure so that students have to use XHTML to insert their contents into the system. Content insertion in system was parsed according to XHTML structure and invalid inputs were not accepted. Hence, their students have gained experience about XML and HTML by using strict XHTML. Requena et al. (2010) used wiki technology to increase understanding of the importance of wireless technologies and the opportunities they offer. They set students as groups of either two or three and ask them to investigate an industrial wireless technology sector to develop a better understanding. Jiake and friends (2010) offered a wiki-based collaborative learning platform for Visual Basic Programming Design. According to their results, wiki based learning environment has positive effects on group working, follow learning progress and coordination of teaching activities.

Regueras et al. (2011) can be given as a good example of wiki based collaborative learning education studies in computer networks. They have used contents of Ethernet, inter-networking, addressing and IP routing subjects in

communication networks laboratory. Test results indicated that the majority of students found the learning system very effective. According to students, system has stimulated them to study regularly, increased their motivation and enabled them to check their level of understanding continuously. Some students also commented this kind of studies encourages them to help each other. Lately, Virvou & Sidiropoulos (2012) used collaborative learning techniques to increase success rate of the students in Python programming language. In study, instructor has authorization to manage theoretical contents, exercises and initial system parameters. System has three different (theoretical, algorithmic and coding) sections. Algorithm based programming contents were offered in theoretical section. In algorithm section, simple pseudo-codes for solution of algorithm problems were presented. In coding section, students are required to write their codes according to given instructions. During code development phase students are able to see codes developed by their friends and they are able make corrections them.

Mediawiki

MediaWiki is free server-based software that is extremely powerful and scalable. Media wiki is built on wiki structure and it uses PHP language to process and presentation data that are stored in the MySQL database (Manual: What is MediaWiki, 2013). A MediaWiki environment can be illustrated as shown in figure 1. In a MediaWiki system, students can be divided into work-teams or individual students also participate in projects. Students can edit, review, rate or delete course contents and create new topics or projects for the purpose of education in MediaWiki platform. Although main purpose of instructors is to monitor the learning process and students contributions, they can be responsible for creation of projects, task or course content as well as students.

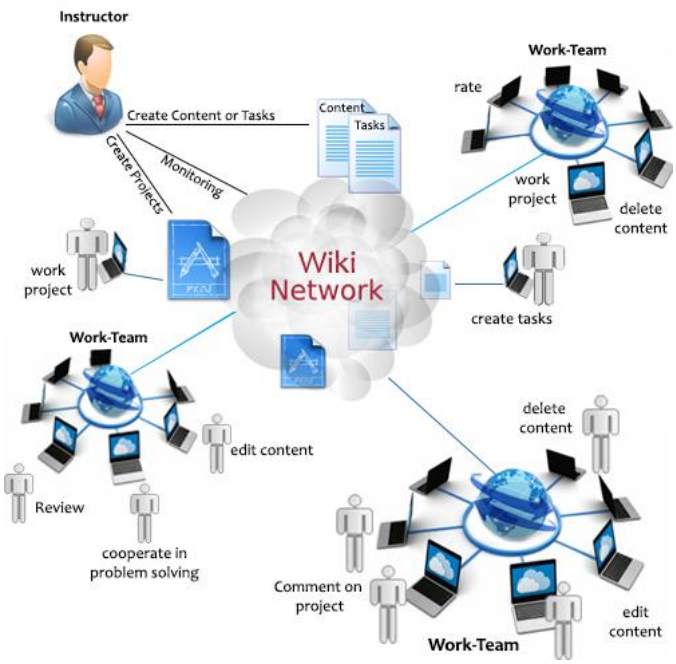

Figure 1. A Wiki-based collaborating environment

In a MediaWiki platform, it is easy to create, operate, change and save the wiki pages rapidly. The structure of the MediaWiki platform is growth-oriented, self-organized and data collection. MediaWiki is more than just a gathering of web site, it can be used to install and share course materials such as interactive objects, flash animations, videos and 3D contents (Çetin & Karakış, 2012). A MediaWiki platform that provides a collaborative learning environment should possess pages is listed below

Content Page: MediaWiki provides a web environment to creating, editing, browsing and storing knowledge for students. All students can compose contents of a course for other students to read or edit. A MediaWiki content page that was created by students at the artificial neural network course is shown in figure 2. This page consists of flash animations and images on the subject of perception. Other students can edit, share or add new information for this page at training progresses.

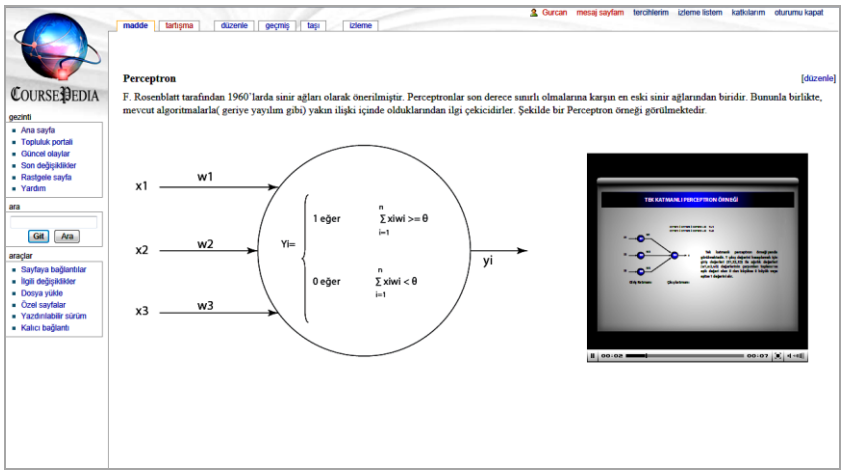

Figure 2. A MediaWiki content page (Çetin & Karakış, 2012)

Revision History Page: Revision histories particularly useful to record every change are performed by students on the content. Every change can be traced by the all students or instructors and older versions of contents are available in a revision history page. Group members and instructors could monitor what improvements were made during the time period (Jiake et al, 2010). A Revision History page is shown in Figure 2. The revision table retain metadata for every change done to a page in the Wiki. Every edit of a page generates a revision row which holds information such as the user who made the edit, the time at which the edit was made and a reference to the new wikitext in the text table. This prevents the unintended removal of the content. But more importantly, revision table displays how the content was established during a project (Çetin & Karakış, 2012).

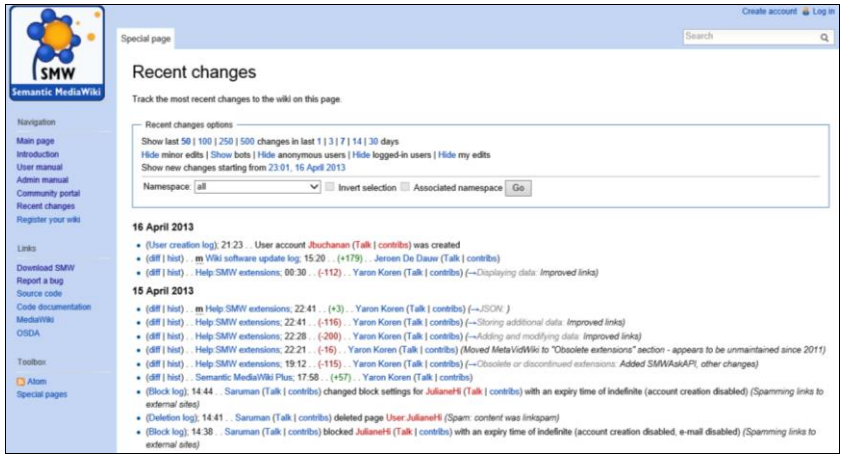

Figure 3. Wiki revision history page

Discussion Page: Wikis don't have a chat room in their structure. But there is an extension tool that is used for leave notes by students can be inserted in wiki. By using a discussion tool as shown in figure 4, students can discuss and communicate with other students (Çetin & Karakış, 2012).

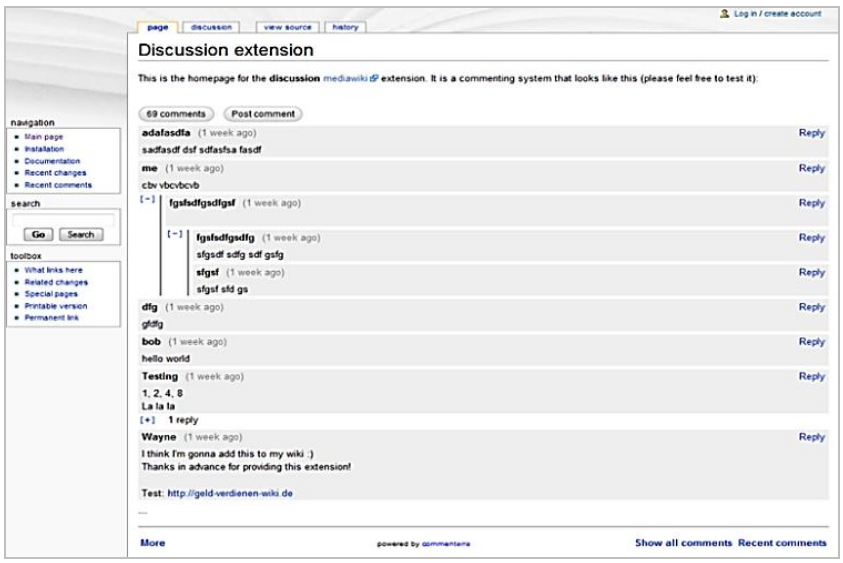

Figure 4. Wiki discussion page

File Page: Documents can be organized or classified into more detailed themes or topics by using collaborative document editors. When a file is uploaded, a file page will be created with a page name consisting of the file name (Çetin & Karakış, 2012).

Semantic Wiki

Semantic Wiki is an additional Wiki extension and can be used with wiki-based applications such as Media Wiki. Semantic wiki platform is a combination of traditional wiki and semantic web technologies. The aim of semantic wiki is to allow users to organize and improve the structured information in wiki pages that can be processed by machines with use of current knowledge in a simple and easy way since the knowledge model is generally in a formal language format and uses relational database. This information which includes semantic data processed by machines improves user's perception and let them to share, search and browse the knowledge (Help:Introduction to Semantic MediaWiki, 2013).

The use of semantic annotations simplifies the structure of Wiki and reduce the time is needed to access knowledge by students. In semantic wiki, it is easy to add dynamic lists or tables to a page with inline query. Inline queries are more accurate and easier to create and update compared to manual lists and tables (Li, Dong & Huang, 2010). Some benefits of the use of the Semantic Web are given below.

Automatically-generated lists: The lists can be found highly in Wikis environments tend to errors, because they have to be updated manually. However, Semantic Wiki enables to create lists automatically. These lists always up-to-date and can easily be updated with new information.

Visual display of information: Semantic Wiki contains a lot of display formats (Semantic Result Formats, Semantic Maps) in order to show information in calendars, timelines, graphs and maps. These display formats is enabled by additional extensions to wiki structure and provide a much richer view of data than simple list would.

Searching information: Individual users can search for specific information by creating their own queries.

External reuse: If knowledge is created by means of Semantic Wiki, it doesn't have to keep within the wiki. This knowledge can be exported with JSON, CSV or RDF format easily in order to serve a data source for other applications.

Although computers can overcome with a lot of information easily, they cannot help us enough about to research from a wiki. On the other hand, the advantages of Semantic Wiki enable to understand wiki texts by machines. So, a student can query the annotations directly in the field of computer networks such as ("show me all TCP protocols") or generate views from such queries in order to list all TCP protocols in the course content page. Also, students can navigate the wiki using the annotated relations such as ("go to Object Oriented Languages") in the programming lessons. Figure 5 shows an example that lists TCP protocols by Semantic annotations. By using the annotation as given in figure 5, the list is created dynamically. Moreover, this annotation is not displayed at the wiki page. Only list of TCP protocols is displayed at the wiki page and always updated depending on the information about TCP protocols.

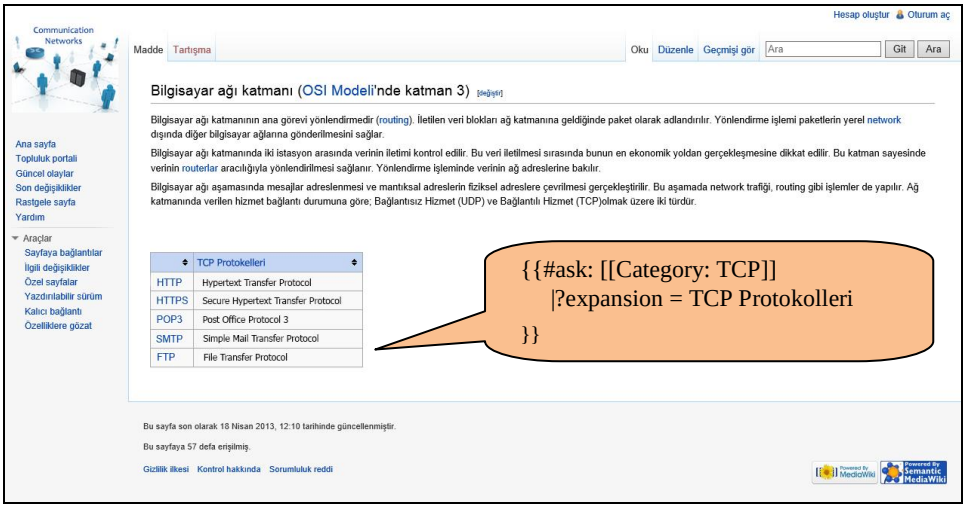

Figure 5. A semantic annotation example in order to list TCP protocols

CONCLUSION

In this paper, a wiki-based collaborative learning environment that use Semantic Wiki and Media Wiki tools to improve computer engineering students' communication and collective study skills was presented. Besides offering course contents, as being a social platform Media Wiki further presents an opportunity for students to discuss their intellectual thoughts and projects. The structure of MediaWiki supports new and innovative learning methods, improves collaborative studies, increases the effectiveness of learning outcomes and motivates students for self-directed learning. In point of instructors, MediaWiki facilitates monitoring of students' learning activities and their relevance to course aims and objectives and they may intervene to learning process by making active contributions when necessary. MediaWiki is a successful tool for collecting data. However, it does not fully meet the requirements of knowledge management. To solve the knowledge management structural weakness of MediaWiki, semantic web technology based Semantic Wiki tool was investigated in terms of its potential use as an educational tool. It has been experienced that semantic wiki can be organized and used as a content management tool with little programming effort. It was also observed that computer engineering students can reach the information fast and easily. They can create interrelationship among new pieces of information and their level of perceived knowledge can be improved.

REFERENCES

Alanis-Funes, Neri, G. J., & Nogues, J. (2011). Virtual Collaborative Space to Support Active Learning. *41st ASEE/IEEE Frontiers in Education Conference*, (pp. F3C-1 - F3C-6).

Chen, Y. (2007). Wiki Technology as a Scaffolding Tool in Education. *9th IEEE International Symposium on Multimedia Workshops, ISMW '07*, (pp. 459 - 463).

Çetin, G., & Karakış, R. (2012). A Wiki Application for Artificial Neural Network Course in Engineering Education. *15th International Conference on Interactive Collaborative Learning (ICL)*, (pp. 1-4).

Elrufaie, E., & Turner, D. (2005). A Wiki Paradigm for use in IT courses. *International Conference on Information Technology: Coding and Computing, ITCC.*, (pp. 770 - 771).

Help:Introduction to Semantic MediaWiki. Semantic Wiki: Retrieved April 16, 2013 from http://semantic-mediawiki.org/wiki/Help:Introduction_to_Semantic_MediaWiki.

Jiake, L., Wei, Z., & Xuan, W. (2010). Design and Evaluation of a Wiki-based Collaborative Learning Environment for Colleges Computers Compulsory Education. *5th International Conference on Computer Science and Education (ICCSE)*, (pp. 695 - 699).

Junjie, W., Qian, M., Dongxia, M., & Su, L. (2010). Research for Collaborative Knowledge Management Based on Semantic Wiki Technology. *2th International Workshop on Education Technology and Computer Science (ETCS)*, (pp. 464 - 467).

Li, Y., Dong, M., & Huang, R. (2010). Developing a Collaborative E-Learning Environment based upon Semantic Wiki: From Design Models to Application Scenarios. *IEEE 10th International Conference on Advanced Learning Technologies (ICALT)*, (pp. 222 - 226).

Manual: What is MediaWiki. MediaWiki. Retrieved April 12, 2013 from http://www.mediawiki.org/wiki/Manual:_What_is_MediaWiki.

Popescu, E., & Manafu, L. (2011). Repurposing a Wiki for Collaborative Learning - Pedagogical and Technical View. *15th International Conference on System Theory, Control, and Computing (ICSTCC)*, (pp. 1-6).

Qdf t dq` r+K-+Udqc t´+D-+Udqc t´, M., & de Castro, J. (2011). Design of a Competitive and Collaborative Learning Strategy in a Communication Networks Course. *IEEE Transactions on Education*, 302 - 307.

Requena-Carrion, J., & Alonso-Atienza, F. (2010). A Student-Centered Collaborative Learning Environment for Developing Communication Skills in Engineering Education. *Education Engineering (EDUCON)*, (pp. 783-786).

Virvou, M., & Sidiropoulos, S. (2012). Collaborative tools in learning a programming language. *International Conference on e-Learning and e-Technologies in Education (ICEEE)*, (pp. 162-165).

Anlamsal Wiki: Bilgisayar Mühendisliği Eğitiminde İşbirlikçi Öğrenme Ortamı İçin Bir Araç

Özet

Bilgisayar mühendisliği eğitimi, öğrencilerin iletişim becerilerini, kritik düşünme ve analiz etme yeteneklerini arttırmak için onları grup çalışmaları yoluyla teşvik eder. Öğrencilerin yeteneklerini geliştirmek için kullanılan başarılı yöntemlerden birisi onları belirli görevler için çalışma gruplarına ayırmaktır. Bilgisayar mühendisliği öğrencileri için bu görevler bir proje geliştirilme sürecinin tüm aşamalarında birlikte çalışma davranışını kazandırmada önemli bir rol oynar. Temel öğrenci yeterliklerinin geliştirilmesinde aktif öğrenme yöntemleri kullanılabilir. Etkili bir aktif öğrenme sürecini başarabilmek için problem tabanlı öğrenme ve proje odaklı öğrenme gibi işbirlikçi öğrenme teknikleri mühendislik öğrencilerinin yaratıcı ve eleştirel düşünmelerini geliştirmek için kullanışlı yöntemlerdir. Son yıllarda web kullanıcılarının bilgiyi aktif bir şekilde oluşturabildikleri ve değiştirebildikleri Web 2.0 tabanlı internet teknolojilerinin artmasıyla birlikte web tabanlı işbirlikçi öğrenme stratejileri ortaya çıkmıştır. Web tabanlı eğitimde öğrenciler arasında işbirliği için kullanılan en popüler araçlardan birisi MediaWiki ortamıdır. Bu Wiki aracı eğitim kaynaklarının düzenlenmesi ve projelerin birlikte oluşturulması, tartışılması, paylaşması ya da düzenlemesi açısından öğrenciler için yeni fırsatlar yaratır. Wiki, tartışma sayfaları ve geçmiş sayfaları gibi e-öğrenme eğitimdeki yeni yönelimler ile yapılandırılmış olgun bir teknolojidir. Diğer taraftan, Wiki ve Anlamsal Web (Web 3.0) teknolojilerinin bir birleşimi olan Anlamsal Wiki henüz tam anlamıyla keşfedilmemiştir. Anlamsal Wiki, ders içeriklerinin çıkarımları yoluyla kullanıcılara daha gelişmiş arama ve dolaşım kolaylıkları sağlar. Bu makalede, işbirlikçi bilgisayar mühendisliği eğitimi için Anlamsal Wiki ve MediaWiki ortamlarının fırsatları sunulmuştur.

Anahtar Sözcükler: Anlamsal Web, Media Wiki, bilgisayar mühendisliği, işbirlikçi eğitim ortamı.