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Learning and documentation using Wikis:
Use cases from state-of-the-art Engineering courses

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The wiki has been used as an effective tool for collaboration and sharing information, and Wikipedia1 is perhaps the best example of the power of the wiki. There are several other open source and proprietary wiki software, and many organisations have deployed wikis for various purposes. Duffy and Bruns (2006) detail the possible advantages and applications of wikis in teaching and learning. Teaching state-of-the-art engineering courses poses new and unique challenges which may not be relevant in other disciplines. This paper examines various use cases of wikis in embedded systems courses, and presents the associated benefits and challenges of this approach.

Embedded systems refer to computer systems which are embedded as part of larger systems. The technology and tools (hardware and software) in this field undergo rapid changes. Hands-on knowledge is crucial, hence most embedded systems courses incorporate major laboratory and project components (Hsu & Liu, 2005). The rapidly-changing nature of the tools and technology make it challenging to ensure that the students are exposed to the state of the art. Some use cases and advantages of using a wiki in this context are detailed below.

1. **Easier updating of information.** The lab manuals require constant updates to keep pace with the changes in the tools. The bleeding edge nature of the tools mean that many students run into problems which the instructor might not have encountered and have a ready solution for. Also, for such courses, it may not always be possible for the instructor to come up with exhaustive problem statements or project specifications that cover every scenario. Use of a wiki (we used the NUS Wiki2, which is based on the Confluence Enterprise wiki) makes it possible to disseminate information through a medium which is easily editable and updatable. Hence, the wiki was used to create lab manuals for courses such as EE2024 "Programming for Computer Interfaces", EE3032 "Innovation and Enterprise II", CG3207 "Computer Architecture" and EE4218 "Embedded Hardware System Design" for the most part of the past 5 years. All the related files such as sample codes were also provided through the wiki in a form that was easy to access and navigate.

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1. https://wikipedia.org

2. https://wiki.nus.edu.sg/

2. **Encouraging sharing and collaboration.** Wiki allows students to share their solutions to the various issues encountered. For example, certain versions of software might need some configurations before students can get the provided template or example codes to work. To facilitate this, edit permissions were granted to students. Students could also correct any errors they might have come across in the manuals, without having to wait for the teaching staff to do it, and the edits are instantly visible to others. The wiki page for each lab also has the provision to create threaded discussions, allowing for related information and discussions to be on a single page. This also gives students a sense of ownership of their own learning. Students can also choose to subscribe and get alerted to any edits and changes to a page.

3. **Easier linking of learning materials to external resources.** Embedded systems courses rely heavily on data sheets and links to other state of the art publicly available material. The use of a wiki makes this easier. In certain courses such as CG3207 "Computer Architecture", a separate page was maintained for the instructor and students to post links to new articles detailing new innovations in the field. For the course EE2024 "Programming for Computer Interfaces", all lecture notes were also disseminated through the wiki, with all the external information sources linked to the main text appropriately.

4. **Wiki for project documentation.** The capstone project for the course EE3032 "Innovation and Enterprise II", has a strong emphasis on collaborative learning. Students work in a group; they search for and share information within their groups to conceive and implement a complete product. The wiki was used as the platform for project documentation and information sharing within a group. The power of wikis in such collaborative engineering projects was illustrated in Minocha and Thomas (2007). Students were given a set of template pages, and they were expected to document and collaborate with their teammates through those pages. Permissions were set such that only the team members and the instructor had access to the documentation pages of each team. This encouraged collaborative learning through the active sharing of information within a team. It also allowed the instructor to track the progress and contributions of each student (through the version history of each page) and team, to give them timely feedback, a feature which was highlighted by Trentin (2009). The same wiki was used by the instructor as the medium for information dissemination for the whole class, using pages accessible and editable by all students as mentioned in the first point above.

5.   **Wiki for student-generated learning materials.** Various aspects related to using wikis for student-generated content can be found in Wheeler and Yeomans (2008). In the graduate course EE5903 "Real-time Systems", the wiki was used a tool for creating student-generated learning materials. EE5903 being a graduate course, it was very important to expose students to the state of the art in real-time scheduling strategies for computers. In this course, students were randomly assigned to work on 1 of the 10 scenarios encountered in scheduling (such as heterogeneous multi-processor scheduling, power aware scheduling etc.). Individual pages were created for students where they wrote articles on the advances in the respective topic, which were made available for the entire class after a submission deadline. Later on, these articles were used in the presentations and discussions in the class so that the entire class benefited from the student-generated learning material.

6.   **Wiki for administrative matters.** Some administrative matters, such as signing up for lab evaluations, were done through the wiki itself. Students could sign up for a slot by editing the wiki directly, relieving the teaching staff of having to schedule and inform students about their evaluation slots. It also allowed for announcements on updates to be made in a well-structured and formatted manner.

The use of the wiki was well received by students. In almost all the semesters there were constructive edits to the wiki, as well as active discussions. In the course CG3207 "Computer Architecture", more than 350 comments were posted over the past 5 years. For the course EE4218 "Embedded Hardware System Design", about 75 comments and discussions materialised in the last semester. Meanwhile, students in the course EE2024 "Programming for Computer Interfaces" were very appreciative of the comprehensive lecture notes provided through the wiki, based on the qualitative comments gathered the student feedback.

However, use of a wiki brings in some challenges too. Some students would "experiment" with the wiki platform and include non-constructive edits. Constant monitoring from the teaching staff ensure that such edits can be easily removed. The permission settings that need to be set for a group-based activity for a large class could be challenging too, as these permissions have to be manually set for many wiki pages. Also, there are limitations on the nature of content that can be posted on a wiki—it is difficult to incorporate interactive content and animations.

Keywords

Wiki, collaborative learning, student-generated learning materials, embedded systems.

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