

# Fostering Collaborative Learning with Wikis: Extending MediaWiki with Educational Features

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**Abstract.** Wikis are increasingly popular Web 2.0 tools in educational settings, being used successfully for collaborative learning. However, since they were not originally conceived as educational tools, they lack some of the functionalities useful in the instructional process (such as learner monitoring, evaluation support, student group management etc.). Therefore in this paper we propose a solution to add these educational support features, as an extension to the popular MediaWiki platform. CoLearn, as it is called, is aimed at increasing the collaboration level between students, investigating also the collaborative versus cooperative learner actions. Its functionalities and pedagogical rationale are presented, together with some technical details. A set of practical guidelines for promoting collaborative learning with wikis is also included.

**Keywords:** educational wiki, collaborative learning, co-writing, MediaWiki extension, learner tracking.

## 1 Introduction

Collaborative learning is a widely used approach in education, in which "students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product" [17]; the interactions between peers play a highly important role in the process [2]. Co-writing is an effective strategy of collaborative learning, consisting in a joint production of a piece of text by students who clarify, edit and revise each others' contributions [3]; co-writing processes stimulate reflection, knowledge sharing and critical thinking, in a strong social context [19].

During the past several years, wikis have started to be used for such collaborative learning activities, facilitating group work and discussion. Paper [11] offers a comprehensive review on wiki as teaching tool, exploring its contribution to various learning paradigms, as well as actual use cases, as reported in the literature. A more recent review is provided in [9], with the goal to identify factors that influence collaboration in wikis and actions that need to be taken to increase this collaboration.

However, since wikis were not originally conceived as educational tools, many functionalities that could be helpful in the instructional process are not included. More specifically, the need arises for some features to provide support to the instructor in the learner tracking and evaluation process, but also to the student for managing their projects and monitoring their progress. Based on these needs, researchers started to

devise dedicated educational wiki platforms, either by extending general-purpose wikis or by building dedicated stand-alone wikis from scratch.

A summary of existing systems is included in the next section. While most of these tools aim for learner assessment support, we decided to propose our own wiki extension solution (starting from the popular MediaWiki platform), called CoLearn, which focuses more on increasing the collaboration level between students and on investigating the collaborative versus cooperative learner actions. An overview of CoLearn, including some technical details, functionalities and pedagogical rationale are presented in section 3. In addition to a good wiki platform, a sound pedagogy is needed to promote collaborative learning; hence some practical guidelines drawn from the literature are included in section 4. The paper ends with some future work directions and conclusions in section 5.

## 2 Transferring Wikis to Education: Related Work

Based on the growing popularity of wikis in education and the need for specific learner and instructor support, various educational wiki extensions have been proposed, as described next.

**Co-Writing Wiki** [1] is based on the open source ScrewTurn Wiki<sup>1</sup> and adds several functionalities for the students: i) view group members' actions feed; ii) visualize own contribution charts and compare progress with other peers; iv) view group members currently online; iv) visualize the differences between revisions (color-coded), comment and rate revisions. Similarly, several enhanced features are provided for the teacher: i) the contributions of each group member are marked with a unique color, so that the activity of each student can be easily explored; ii) a revision player is provided, which displays the color-enhanced revisions of a wiki page as a slide show; iii) useful statistical information is shown, both in textual form and as a chart panel; iv) the teacher has the possibility to send feedback to the students and evaluate their contribution.

**EdDokuWiki** [14] is based on the open source DokuWiki<sup>2</sup> and supports the following set of functionalities: i) peer evaluation support (add comments to wiki pages, rate pages, assess the utility of the comments received); ii) monitor and record all student actions; iii) automatic (quantitative) evaluation of student contributions (number of pages, number of characters on each page, number of internal/external links, amount of time spent on the wiki); iv) instructor evaluation support (visualize a summary of each student contributions, grade student, provide individual feedback).

**Tracking Bundle** [8] is available as a MediaWiki<sup>3</sup> extension and provides several additional functionalities for the teacher: i) create student groups; ii) configure review criteria and the formula used for computing the students' final score; iii) view all page

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<sup>1</sup> <http://stw.codeplex.com>

<sup>2</sup> <http://www.dokuwiki.org>

<sup>3</sup> <http://www.mediawiki.org>

revisions filtered according to various options and add a score and comment for each of the configured criteria; iv) visualize the students' activity and scores in graphical formats.

Apart from the extensions summarized above, another proposed approach was to build a dedicated educational wiki from scratch [6]. **ClassroomWiki**, as it is called, was conceived as a complex Web-based collaborative wiki writing tool, which provides enhanced functionalities both for the students and the teachers: color-coded visualization of revisions, activity tracking, building student model, automatic group formation. Beside the actual wiki module, the platform includes also: i) a communication module (a topic-based forum and an announcement system); ii) a tracking and modeling module (which tracks all students' interactions with the system and with group members and builds a detailed learner model); iii) a group formation module (an agent-based framework in which students' agents negotiate to form heterogeneous groups in terms of student performance) [6]. A comparison between the four wiki platforms presented above is included in [7].

There are also a few commercial hosted wikis designed for educational use, such as: i) **Wikispaces**<sup>4</sup> - **Classroom type** (which includes formative assessment features and tracking learner activity such as reading, writing or saving pages); ii) **PBworks**<sup>5</sup> - **Classroom and Campus editions** (which include some basic learner tracking and assignment management features).

To sum up, the wiki platforms presented above include support for: student group management, communication activities, learner tracking and monitoring, peer and teacher assessment. In this context, we propose an educational wiki extension focused mainly on fostering collaborative learning between students, rooted in pedagogical principles. The starting point is MediaWiki platform, a choice motivated by its popularity, available functionalities, ease of use, good development community support, as well as our own experience with it in educational settings [15].

## 3 Designing CoLearn

### 3.1 MediaWiki Extensions

MediaWiki is one of the most active and widely deployed wiki engines, being the platform used by the highly popular Wikipedia. MediaWiki is written in PHP and provides an extension mechanism for customizing its appearance and functionalities. Some of these extensions are maintained by MediaWiki developers, while others are implemented by third-party developers<sup>6</sup>. Extensions can be used for adding reporting and administrative capabilities, changing the look and feel, extending the wiki markup, adding custom authentication mechanisms etc. There are also a few publicly available MediaWiki extensions for educational use (the last two seemingly no longer maintained): i) The Education Program<sup>7</sup> - which provides various interfaces to man-

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<sup>4</sup> <http://www.wikispaces.com/>

<sup>5</sup> <http://www.pbworks.com/>

<sup>6</sup> <http://www.mediawiki.org/wiki/Manual:Extensions>

<sup>7</sup> [http://www.mediawiki.org/wiki/Extension:Education\\_Program](http://www.mediawiki.org/wiki/Extension:Education_Program)

age courses, students and institutions; ii) eduWIKI<sup>8</sup> – which consists in wiki patches designed for educational usage; iii) TrackingBundle<sup>9</sup> – which was presented in the previous section.

In this context, we designed and implemented an extension specifically aimed at supporting collaborative learning. This extension, called CoLearn, creates various MediaWiki *special pages*, for creating group projects, adding students to projects, visualizing projects and statistics, monitoring student activity etc. CoLearn is based on an MVC architecture and extends the MediaWiki database with information regarding student groups, project pages, revision types, collaborative actions, ratings, comments, grades etc. The new functionalities are added by using the *hooks*<sup>10</sup> provided by MediaWiki, which allow custom code (*event handlers*) to be executed when some defined event occurs (e.g., *onRevisionInsertComplete*, *onArticleInsertComplete*, *onOutputPageBeforeHTML*); the front-end uses various *jQuery*<sup>11</sup> plugins, such as *jqPlot*, *jQuery Raty*, *DataTables* etc.

### 3.2 CoLearn Features

CoLearn provides the possibility to set student and instructor roles, offering various functionalities for both of them. Thus, an instructor can:

- Create student accounts
- Manage courses
- Setup student groups (teams)
- Create and assign projects
- Visualize project pages
- Visualize student profiles
- View differences between page revisions by using a custom engine
- Monitor student activity
- View summary information about each project, page, group and student
- View graphical statistics regarding each project, page, group and student
- View student and project activity reports
- View project revision history
- Grade students
- Provide feedback to students.

Similarly, CoLearn offers students the possibility to:

- Create and manage projects for their own group
- Create and edit pages associated to a project
- Annotate each page revision with the type of editing performed and the current group activity
- View project revision history

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<sup>8</sup> <http://www.mediawiki.org/wiki/Extension:EduWIKI>

<sup>9</sup> <http://www.mediawiki.org/wiki/Extension:TrackingBundle>

<sup>10</sup> <http://www.mediawiki.org/wiki/Manual:Hooks>

<sup>11</sup> <http://jquery.com> (a fast, small, and feature-rich JavaScript library)

- Add comments and ratings to peers' pages
- View summary information about their project
- View graphical statistics regarding their own activity and comparisons with peers
- Visualize grades and feedback from the instructor.

### 3.3 Illustrating CoLearn: Some Collaborative Learning Underpinnings

Every time students revise a project page, they are asked to specify the type of revision performed, according to the taxonomy proposed in [12] (see Fig. 1): *Add information*, *Add link*, *Clarify information* (i.e., reword existing information in order to clarify the content), *Delete information*, *Delete link*, *Fix link*, *Structure* (originally called *Format* – i.e., change the page structure by moving paragraphs or adding sub-titles), *Grammar* (i.e., correct grammatical errors or punctuation), *Mark-up language* (i.e., switch between wiki mark-up language and HTML, but without affecting the appearance of the page or the text), *Reversion* (i.e., restore a previous page version), *Spelling* (i.e., correct spelling mistakes), *Style* (i.e., change the presentation or appearance of the text). The original taxonomy, which referred to public open wikis such as Wikipedia, contained also *Vandalism* actions, but this is not applicable in educational settings, in which only logged-in students are allowed to contribute to the wiki.

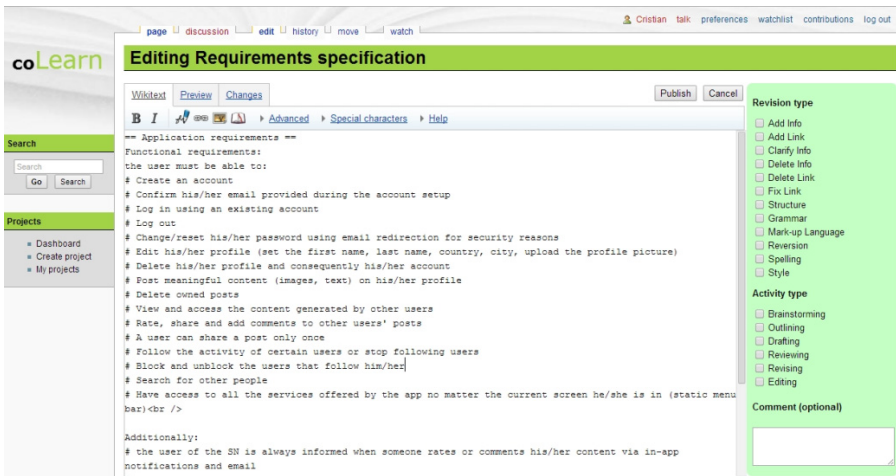


Fig. 1. CoLearn – Revising project page

These revision types describe various levels of collaborative writing between students, as suggested in [3]. Thus, revisions of type *Style*, *Structure* and *Mark-up language* refer mainly to technical issues (presentation and appearance) which indicate a lower level of collaboration. Revisions which directly affect content but without generally changing the meaning of sentences (e.g., *Add information*, *Add link*, *Delete information*, *Delete link*) can also be considered more as cooperative than collaborative activities. The highest level of collaboration occurs when students revise and alter their peers' contributions and change the meaning of sentences (e.g., through actions of type *Clarify information*, *Fix link*, *Grammar*, *Spelling*).

Furthermore, CoLearn provides students with an interface to specify the activity stage of their collaborative writing, according to the taxonomy in [10]: *Brainstorming, Outlining, Drafting, Reviewing, Revising, Editing* (see Fig. 1).

On one hand, this revision annotation task in CoLearn raises students' awareness regarding their cooperative and collaborative actions, the way they interact with their peers and their contribution toward the group project. On the other hand, the aggregated data obtained from all students provide the teacher with a perspective on the collaboration level inside each group (see Fig. 2). These graphical visualizations provided by CoLearn also help teachers to clearly and easily identify each student contribution, spot free riders and support the grading and evaluation process, replacing the time-consuming manual methods used in [3].



Fig. 2. CoLearn – Project dashboard (graphical statistics of page revisions)

Furthermore, by visualizing the timing of the students' contributions (bottom chart in Fig. 2), the instructor can get a good indicator on the type of work partitioning inside a group: *sequential* (students contribute in successive stages), *parallel* (students work simultaneously on independent subtasks) or *reciprocal* (students work together, mutually adjusting their activities based on peers' contributions) [16].

Another functionality provided by CoLearn is students' access to detailed profile pages, where they can visualize their overall progress, as well as comparative statistics with the group and class average (see Fig. 3); this is a feature which seems to be missing from the other educational wikis [7]. This provides an important self-monitoring and self-evaluation support for students, helping them to take initiative and responsibility for their own learning [4]. Furthermore, the continuous activity monitoring and the comparative evaluations can enhance student competitiveness and involvement.



**Fig. 3.** CoLearn – Student profile page excerpt (distribution of page revision types and activity types, comparative statistics with the group average)

Additionally, students' participation is increased by the possibility to rate and comment on peers' pages, offering help, feedback and constructive criticism (Fig. 4). This peer evaluation enhances students' social motivation for learning, encouraging

critical thinking and contributions. Furthermore, peer assessment can be very valuable for the students assessed, as an appropriate substitute for teachers' feedback (since its reliability and validity can be comparable to that of the teacher, given the instructor's time constraints) [18]. Finally, teachers also have the opportunity to provide both private and public feedback to students through CoLearn, which is an essential aspect in order to align collaboration [9].

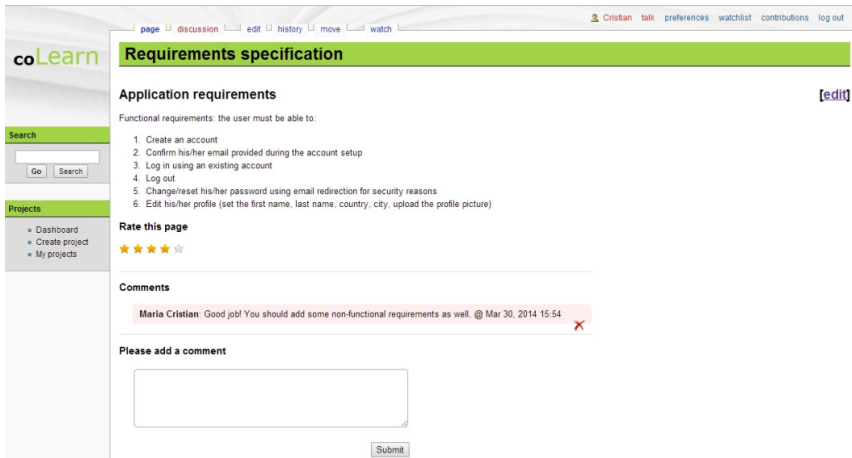


Fig. 4. CoLearn – Peer review functionality

## 4 Practical Guidelines for Promoting Collaboration in Wikis

In the previous section we focused on the technology-side of the collaborative learning process, providing a short overview of the CoLearn wiki extension. However, a sound pedagogical scenario is needed as well in order to foster collaborative learning in wikis [3], since by itself "a collaborative tool does not necessarily lead to collaborative behavior" [9].

Therefore, in what follows we outline several recommendations for successfully integrating wikis in educational activity and promoting student collaboration; these are drawn from various reports from the literature [3], [5], [9], as well as from our own 5-year experience with using wikis in the instructional process [13], [15].

1. Carefully design the instructional activity, based on a sound pedagogy; the wiki should be integrated with the curriculum, the learning objectives and the assessment.
2. Choose an assignment that inherently requires collaboration.
3. Provide an introductory lecture about collaboration as well as continuous scaffolding, since students may lack collaborative skills, due to the traditional, dominantly individual learning approach.
4. Offer technical training for using wikis in the beginning and continuous technical support.



5. Provide clear guidelines for interaction and educate students to edit peers' contributions (since they are generally uncomfortable to both accept modifications of their own work and alter others' work); creating an atmosphere of trust and confidence encourages students to change peers' contributions and modify content created by others for the benefit of the group.
6. Encourage students to contribute regularly to the wiki, well before the deadline (students' natural tendency to last minute activity hampers interaction, discussions and iterative page edits).
7. Alleviate students' fear of exposure, since they may feel uncomfortable to share their incomplete ideas or drafts and only upload final versions of their work, negating the idea of collaboration.
8. Support discussion and socialization of participants, generally by using wiki discussion pages together with other social media tools (e.g., blog, Twitter etc.).
9. When possible and appropriate, make the wiki open to the public, so that students can be motivated by an authentic audience.
10. Make the wiki task mandatory and explicitly graded, since assessment plays an important part in students' engagement with learning; a combination of group and individual assessment should be used, based on the quality of each student contribution.
11. Ensure also intrinsic motivation, by allowing students to take control over their own learning and by providing a meaningful and authentic task, highly relevant to the student.
12. Ensure positive group climate, team cohesion, discourage individualistic strategies; play the role of facilitator, moderate in case of difficulties, offer support but do not dominate group work.

## 5 Conclusion

We started this paper with a short overview of adapting wikis for use in the instructional process. The main contribution was our proposal for an educational MediaWiki extension called CoLearn, followed by some practical guidelines for successfully using wikis in collaborative learning.

As future work, we plan to experimentally validate CoLearn. The experimental setup that we envision is a collaborative Project-Based Learning scenario which we have been applying for the past five years in our teaching [13], [15]. The context is an undergraduate course on Web Applications Design, in which MediaWiki is used by the students for collaborative writing of project deliverables (among the members of each team), for gathering and organizing knowledge and resources regarding the project, for clearly documenting each stage of the project as well as the final product. By including the CoLearn extension we hope to increase collaboration between students as well as allow for a more comprehensive investigation of learners' activity.

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