ASSESSING INDIVIDUAL LEARNING AND GROUP KNOWLEDGE IN A WIKI ENVIRONMENT: AN EMPIRICAL ANALYSIS

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ABSTRACT
The aim of this study was to investigate the collaborative learning in an online environment in order to assess the role of technology in determining individual learning of students. It describes the benefits of using a wiki in education and how it can allow students to work together to reach a common goal, giving them a sense of how writing can be effectively performed in collaboration. In collaborative learning with a wiki, students need to agree the structure, the contents, and the methods that are necessary to accomplish cooperative activities. The technology investigated is PBworks Education (PBwiki Edu), a collaborative tool that offers a variety of powerful information sharing and collaboration features in order to improve student’s learning activities. Respect than traditional in-class course, PBwiki Edu facilitates the communication and encourages collaborative finding, shaping and sharing of knowledge, all of which are essential properties for student’s learning process. A survey methodology was used in undergraduate students of “Management Information Systems’’ course who used PBwiki Edu for doing four reports concerning to case studies on specific lesson topics. With regard to these topics, we measured individual learning of students before (traditional learning) and after (online learning) any case study and compared these results through t-test method. Findings have shown significant differences between learning before and after case studies, pointing out the contribute of PBwiki Edu to student’s learning.

KEY WORDS
Wiki, online collaborative learning, individual learning, educational processes, knowledge sharing.

1. Introduction
The growing and fast development of web 2.0 applications is giving to several academic organizations the possibility to use into classrooms new tools and two-way services to meet the needs of the new students generation [1, 2]. Of these applications, wikis systems today are gaining popularity as tool for implementing collaborative learning environments. Wiki is a system that allows users to collaborate in forming the content of a web site, enabling users to easily create and edit web pages collaboratively [3]. The goal is to simplify the process of participation and cooperation in the development of content, supporting interaction process and collaborative learning. Wiki enables students to collaborate in a space that is immediately updated [4]. In classroom settings, wiki can be used to encourage collaboration among students by allowing them to read and edit each other’s work. Despite the growing number of research on the application of wiki in the teaching environment [5, 6, 2], the full potential of these web 2.0 tools for education is yet to be established and many questions still lie ahead [7]. Some researchers have highlighted that higher education has only recently begun to use wikis as a teaching and learning tool from both inside the classroom and out [3]. “Exploring wiki use can promote the diffusion of this new technology and help achieving its potentials in the teaching environment” [8]. Wiki eases the collaborative learning, providing a flexible and user-friendly interface for knowledge creation and archiving, and student interaction [9]. Collaborative learning increases student involvement with the subject matter and encourages student learning [10]. Understanding how collaborative learning supports individual learning and student involvement with the subject matter is essential to analyze wiki use, topic that continues to be a focal interest in educational research. This study investigated collaborative learning through wiki and how these collaborative dynamics improve student’s learning process. Through the introduction of wiki into an undergraduate “Management Information Systems” course, we investigated student’s learning process through wiki. The goal of this study is to explore online collaborative learning through wiki by integrating information systems (IS) and educational literature in order to offer important
contribute to debate on use of wikis application in general, in learning and web 2.0 settings. Specifically, this study aimed to address the following research question: RQ: Does collaborative learning through wiki increase individual learning?

In the next section, we begin by explaining the main characteristics of wiki and its use in educational settings. Then we deepen online collaborative learning framework. The following section describe the study context, the research method and the results. Finally, we discuss the findings and their implications for research and practice.

2. Wiki in Education: Teaching to Manage Learning and Share Knowledge

Wikis provide teachers with potentially significant opportunities for creating socially engaged tasks that require active student participation and collaboration. Besides they allow students to work together to study and develop contents, giving them a sense of how writing can be carried out collaboratively. Collaborative writing offer opportunities not only to practice literature review, academic reading and writing, but also to stimulate reflection, knowledge sharing and critical thinking. Teaching and learning have always had a collaborative element, but wiki technology has in recent years made collaboration central to the method of many educators. Since they can be edited by anyone with access to them, education wikis are ever-changing and evolving documents that ideally represent the wisdom of the student crowd. Teachers are constantly finding new and creative ways to use wikis, some classes are using wikis to develop research proposals and others use them to complete collaborative writing projects. The possibilities for wikis in the classroom, in other words, are as limitless and never-ending as wikis themselves. Teaching and learning have always had a collaborative element, and wiki technologies are having in recent years a central role for the method of many educators. Although the wiki was introduced more than ten years ago, its use is relatively new in academia environment. Higher education has only recently begun to explore the potential educational value of wikis as a means to promote deeper learning and integration of classroom learning experiences [11]. However, the popularity of wikis finally is attracting the attention of educators, who expect that wikis will facilitate not only communication but also collaborative finding, shaping and sharing of knowledge, all of which are essential properties in an educational context [12]. As a consequence, many researchers are studying in recent years wikis’ use in education, focusing only on uses such as simple webpage creation, peer review authoring, groups’ task tracking and data collection. Some researchers [13] describe several possible educational uses of wikis:

• students can add summaries of their thoughts from the suggested readings, building a collaborative annotated bibliography;
• a wiki can be used for sharing course resources like case studies and handouts, and students can edit and comment directly;
• lecturers can use wikis as a knowledge base, enabling them to share considerations regarding teaching practices and allowing documentation’s versioning;
• wikis can be used to map concepts. They are useful for brainstorming and to produce a list of resources;
• a wiki can be used as a presentation tool and students are able to comment on and revise the content;
• they are tools for group authoring. A team leader using a wiki can coordinate a group and enables members to build and edit a document.

Tonkin [14] classifies four different systems of educational wikis:

• single-user wikis allow an individual to collect and manage considerations using a simple online environment;
• lab-book wikis allow students to add online notes and to see the changes made by other students;
• collaborative writing wikis can be used by a team for a documents’ joint production;
• knowledge base wikis provide a knowledge repository for a group.

Lamb [15] points out that some faculties utilize wikis so that design teams can quickly and collaboratively build reference lists and outlines, brainstorm instructional strategies, and capture suggestions. Bergin [16] suggests a variety of uses for wikis including students’ personal pages, anonymous feedback, FAQ, new ideas, discussions and suggestions related to a course. Schwartz and colleagues [9] survey many universities and report how wikis are being used. They report that most dealt with activities and events, rather than with curricular issues. The common idea that transpire is that collaboration is less likely to be a success without proper guidance. It is important for instructors and tutors to organize a well-focused pedagogical scenario with several distinct phases for each learning activity [17]. It requires some basic information such as: the tasks that students have to perform, the composition of their groups, the tasks’ distribution approach within and among groups, the mode of interaction and an accurate scheduling of the working phases.

With all of the positive features and possibilities of wikis in education, there are some drawbacks. Most teachers, for instance, discourage students from using wikis as a sole source of information in research projects. It might be a place to begin researching a topic, but anything found in a wiki usually needs to be verified via other sources. Another problem is that with some programs, only one user can edit a page at a time. In these cases it is recommendable that teachers divide their classes up into small groups, with each group getting their own wiki page.
3. Online Collaborative Learning through Wiki and Individual Learning

Within collaborative learning “learners work together on a topic, exchange their opinions about a subject matter, clarify the meaning of knowledge concepts or aim at a joint problem solution” [18:10]. Online collaborative learning, more specifically collaborative learning supported by technology, was traditionally defined as Computer Supported Collaborative Learning (CSCL) and recognized as an emerging paradigm of educational technology [19]. The starting point of online collaborative learning is the construct of “collaborative learning”, that as suggested by Curnow and colleagues [18:10], “involves the joint construction of meaning through interaction with others and can be characterized by a joint commitment to a shared goal”. In this regard, learners work together on a topic, exchange their opinions about a subject matter, clarify the meaning of knowledge concepts or aim at a joint problem solution [18:10]. In 1990 it took place the first CSCL workshop [20], and the first international CSCL conference was held 1995 in Bloomington, Indiana. However, O’Malley and Scanlon [21] in 1989 used for the first time the term computer-supported collaborative learning. CSCL, or online collaborative learning, is focused on how collaboration and technology enhance peer interaction and work in groups, and facilitate sharing and distributing of knowledge and expertise.

Online collaborative learning has great potential for knowledge and skills acquisition and sharing, even if there are different characteristics from conventional learning scenarios. Differences are confirmed in Hron and Friedrich’s research [22] with respect to social communication (synchronous and asynchronous communications, eye contact, non-verbal and tone hints), message exchange (text chat and real-time chat), cognitive load (necessary computer literacy) and participation of the learners (discussion, reading and asking questions). Online collaborative learning has attracted the attention of many researchers who decided to investigate phenomenon through different perspectives of analysis. To date, it is considered a heterogenic and multidisciplinary field of inquiry including “cognitive science, learning sciences (psychology, computer science, education), educational psychology, educational technology, communication, epistemology, social psychology (small group research), artificial intelligence, and informatics (group support systems)” [23:67].

Within online collaborative learning, individual learning processes “are no longer seen as isolated one-way processes, but rather as interlinked with others and loosely coordinated by organizational goals” [24:321]. Individuals learn a great deal through interactions with others and individual learning is the result of the collaboration. There are many technologies that can support online collaborative learning, such as social software tools, like wiki systems. “Wikis enhance asynchronous communication and cooperative learning among students, and promote cooperation rather than competition” [25, 26:10]. Minocha and Thomas [27] conducted a research on how wiki encourages collaborative activities among groups of distance students, stating that “wiki activities facilitated collaborative learning and that a wiki is a good medium for collaborative work in a distance education course” (p. 198). Judd and colleagues [28] assessed students collaborative behavior based on their contributions to a wiki-based shared writing task. Wiki can have positive effects on learning process, like the development of new ways of learning, the improvement of the collaboration and learning results, the increase of self-directed learning activities/skills [29]. However, there are still few studies on how wikis can improve and support individual learning process [28]. Wikis can stimulate and promote online collaborative learning, but this is possible because each individual involved in the process improves his/her knowledge, information, skills and competences, activating a personal learning process supported from wiki tools. The model of the collaborative writing approach is concerned with the features of the final products that define the properties of the wikis in terms of coherence with the assigned topics, wiki architecture, conceptual structure, user requirements, information accuracy and completeness, sources of references, and writing style.

4. Methodology Adopted

4.1 Case Study Framework

This study was conducted in undergraduate “Management Information Systems” (MIS) course taken by “Management and Control Systems” students during the Second Semester of the Academic Year 2011-2012. The MIS course was taught by one author, within the Business Faculty at the Università degli Studi di Napoli “Parthenope”. The period of course was nine weeks and the students were approximately 120. Of these, 98 students have decided to join to group work sending an e-mail to teacher.

Despite the course is compulsory for students pursuing the business degree, group work activities are voluntary. The PBworks Education (PBwiki Edu) system was used for the group work. PBwiki Edu is freely available (http://pbworks.com/) and it is one of the largest and most powerful systems among the approximately 200 wiki species. To date, over 4 million people each month use PBworks solutions. PBworks lets people capture knowledge, share files, and manage projects from any computer or mobile device. It tracks every change, and automatically notifies team members to involve everyone in the learning activities. PBworks built specific products to solve specific needs such as PBworks Education Edition (http://pbworks.com/education). It is an ad-hoc solution developed for academic environments. PBworks Education hosts over 300,000 educational workspaces, supporting teaching and learning activities of millions of
students and teachers. Figure 1 shows the groups in PBwork Edu.

![Figure 1. The groups in PBworks Edu](image)

It encourages student-centered learning and provides access to information sources making distance learning more interactive. Several universities use PBworks Education as their collaborative learning environment. In our empirical analysis students were randomly selected and distributed in 20 groups. All groups were closed and composed of 5 students, excepted 2 of just 4 people. Figure 2 shows group users in PBworks Edu.

![Figure 2. Group users in PBworks Edu](image)

Students has been invited to join wiki by an outside observer who has not participated to group activities, but he monitored the progress of members’ work activities by PBwiki Edu. At the beginning of course, the teacher held an introduction to PBwiki Edu for approximately 90 min., explaining its intentions and functions. An PBwiki Edu user guide has been written and uploaded on teacher website due to support PBworks Edu usage. Furthermore, online help-desk service has been provided in order to help students to solve practical problems. Teacher selected four IS case studies concerning some issues of program course and uploaded them on its website following time periods previously defined. These cases are particularly useful for teaching and have been already used in the course held in the past year. Group work activities have concerned to examine the IS case studies and to write a report for each. Before each case study, teacher introduces the topic into classroom and gives students two days to study it. After this period, students can download the case study related to lesson’s topic from teacher website and use it for doing work activities. PBworks Edu was mandatory for group activities. Thus, group members have interacted, exchanged data, and written reports only by wikis platform. Figure 3 captures the activities of a group in PBworks Edu.

![Figure 3. The activities of a group in PBwork Edu](image)

Overall, students spent six weeks to deliver all the reports, about one week and half for each case. All groups were assessed using a score ranging from -1 to +3. In particular, the teacher’s assessment was based on two criteria such as: a) the report quality and b) student participation in working activities expressed by qualitative (individual contribution to the report) and quantitative (total comments) information displayed on PBwiki Edu. Outside observer has supported teacher in this phase. This score will be added to the final mark obtained by the students in the “Management Information Systems” course. Furthermore, in order to improve the engage of students, the best two groups will be rewarded with one more point.

4.2 Survey Design and Data Collection

A survey methodology was used to gather data during the period from February 2012 to April 2012. In particular, we assessed individual learning before and after any case study by administering to group members a questionnaire through an online platform named Survey Monkey. In this regard, the learning before case study is related to face-to-face lesson, while leaning after case study is related to usage of PBwiki Edu. Overall, eight questionnaires were
developed and administered in order to evaluate learning of students before and after any case. Each questionnaire was composed of 5 sets of multiple-choice questions. Each set of questions was composed of four items, of which just one answer was true and the others three were false. Respondents could select only one answer. Two academic researchers developed multiple-choice questions, of which one is the author of case studies’ book and the other is the teacher of MIS course. These questions were tested during the previous academic year on 100 students of MIS course. Despite students have composed work groups and have worked together to perform reports, learning was measured at individual level of analysis. In particular, for each set of multiple-choice question, respondent’s answers were decoded as a dichotomous variable having the values 0 for non-right answers and 1 for right answers. In this regards, we had 5 dichotomous values (0 and 1) for any respondents. Summing these values we assessed learning through a scale from 0 (all answers are not right) to 5 (all answers are right). Of the 98 users surveyed, a total of 76 questionnaires average collected for any survey were returned (response rate 76.53%).

4.3 Analysis and Results

This section sets out the results of the data analysis. Firstly, we calculated the student’s learning at individual level of analysis before and after any case study following the criterion explained above. Then, we conducted a comparative analysis between learning before case study and learning after case study. Data analysis was performed by the t-test statistical method. The t-test is a statistical test common used to assess whether the means of two groups are statistically different from each other. In this regard, the t-test is very useful for our study because it allows to compare learning before and after case study showing the significant differences at *-*p≤0.001 and **p≤0.05 values. The results of comparative analysis are represented in Table 1.

<table>
<thead>
<tr>
<th>Case</th>
<th>Period</th>
<th>Mean</th>
<th>S.D.</th>
<th>Diff.</th>
<th>t</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>Before</td>
<td>3.154</td>
<td>0.905</td>
<td>0.815</td>
<td>5.162</td>
<td>64</td>
<td>**</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>3.969</td>
<td>0.847</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 2</td>
<td>Before</td>
<td>3.623</td>
<td>1.139</td>
<td>0.319</td>
<td>2.241</td>
<td>68</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>3.942</td>
<td>1.110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 3</td>
<td>Before</td>
<td>3.032</td>
<td>1.493</td>
<td>0.339</td>
<td>2.005</td>
<td>61</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>3.371</td>
<td>1.462</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 4</td>
<td>Before</td>
<td>2.889</td>
<td>1.427</td>
<td>0.286</td>
<td>1.382</td>
<td>62</td>
<td>p≤0.05</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>3.175</td>
<td>1.602</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>Before</td>
<td>3.158</td>
<td>0.960</td>
<td>0.339</td>
<td>3.441</td>
<td>78</td>
<td>**</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>3.497</td>
<td>0.992</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Comparative analysis

With regard to case 1, the results of comparative analysis have shown that learning after case (mean=3.969) is greater than learning before case (mean=3.154), showing a significant difference among them (diff.=0.815; t=5.162; p≤0.001). With regard to case 2, findings have highlighted that learning after case (mean=3.942) is greater than learning before case (mean=3.623), showing a significant difference among them (diff.=0.319; t=2.241; p≤0.05). Likewise, with reference to case 3 the Table 1 results have shown that learning after case (mean=3.371) is greater than learning before case (mean=3.032), showing a significant difference among them (diff.=0.339; t=2.005; p≤0.05). On the contrary to previous results, for case 4 learning after case (mean=3.175) is greater than learning before case (mean=2.889), but the difference among them is not significant (diff.=0.286; t=1.382; p≥0.05). Finally, with regard to overall cases, findings have shown that learning after case (mean=3.497) is greater than learning before case (mean=3.158), pointing out a significant difference among them (diff.=0.339; t=3.441; p≤0.001).

5. Discussion and Implications

This research contributes to understanding the role of collaborative learning in an online environment in fostering individual learning and group’s knowledge. Previous research has focused on online collaborative learning mainly focused on understanding of phenomenon, on the kinds of technology used, such as synchronous versus a synchronous tools, and on the quality and quantity of interactions among learners [e.g., 30; 6; 31]. Other few research, instead, focused on online collaborative learning assessment, showing the role of technology in improving learning of group members [32, 33, 26]. Among them, some studies have investigated how wiki platform supports collaborative learning [33, 26]. However, despite these studies, little is still known about how technology for collaborative learning, and wiki in particular, can improve and support individual learning process.

Our research was aimed to assess individual learning process of undergraduate students of MIS course who use online collaborative technology for learning. PBwiki Edu, for doing their tasks. A comparative analysis was conducted in order to assess individual learning of students before (traditional learning) and after (online learning) PBwiki Edu usage. Findings of comparative analysis have shown that individual learning after case studies is greater than individual learning before case studies, deepening the usefulness of PBwiki Edu in fostering and supporting individual learning of students. Contrary to traditional learning, CSCL, like wiki, is more adequate in effectively fostering interest and providing stimulates to learning of students. CSCL serve to expose students to increase idea generation and exchange, as well as to increased feedback on their own ideas, enhancing the potential of the student groups [34].

Moreover, wiki technology allows students to show their contribution more transparent, making easy both group and individual assessment. In this regard, the characteristics of wiki lead towards a greater participation.
and collaboration of group member to group activities, making a significant contribution to learning process. According to Gokhale [35], CSCL provides students opportunities to analyze, synthesize, and evaluate ideas in cooperatively way. Using collaborative technologies for learning students can interact and communicate, learning from each other’s scholarship, skills, and experiences. The informal setting of these technologies encourages discussion and interaction among students, fostering and supporting learning at both individual and group levels. However, as Leidner and Fuller [34:151] suggested, “the value of collaborative learning should not be that a group of students outperforms a single student on a given learning task such as a case analysis, but that each student learns more and performs better after having interacted with a group than if they had worked entirely alone”. Using CSCL, and PBwiki Edu in particular, students can enhance the development of critical thinking through discussion, clarification of ideas, and evaluation of others’ group members ideas. As individual epistemology suggested, the individual is the learning agent, who may benefit from the collaborative situation. In this regard, wiki technology enhances collaboration among group members and contributes to knowledge construction, encouraging the individual creation meaning for himself rather than just receiving it preformed from others. To prevent students from concentrating solely on their own part of the wiki, it is required that they examine the whole wiki collaboratively, and search for pages that are developed by other members, which may be conceptually be linked to their own pages. This activity fosters a better understanding of the wiki and provides a more complete and overall representation of the wiki as a whole. The activity is an iterative process that should begin as early as possible and not end when the contents are completed. Students are encouraged to perform the activity while they actually develop their own pages and not leave it as a final refinement. The reading and commenting of pages, that other members have developed, not only foster new ideas and improvements of the student’s own pages, but also helps to avoid overlaps, repetition, and duplication, especially when two or more students work on subjects that are closely related to each other [36]. This activity leads to a gradual change and transformation in the wiki from a hierarchical organization to a network structure. Student collaboration needs to be supported by a significant discussion activity between group members and with regard to each wiki page.

6. Limitations

This paper has a major limitation. In particular, our findings have shown that t-test after case study (online learning) is better than the t-test results before case study (traditional learning). Thus, we deduced that these “better” results are caused by collaborative learning using PBwiki Edu, without considering the contribution of the case study material itself. In this regard, the improved individual learning from face-to-face interaction to online learning using PBwiki Edu could be caused by both wiki platform and case study material used to perform group work. However, we have not measured the effect of case study material to individual learning using PBwiki Edu and, thus, we just considered the overall effect.

7. Conclusion

The benefits of a wiki as a collaborative tool for learning are several. It can be a considerable support for the collaborative production of ideas, documents, projects, and shared knowledge, by means of reading, writing, group reflection and interaction. The characteristic collaborative learning approach is applicable to a wide range of situations, where academic institutions are expecting to gain learning benefits in investing in wiki applications associated with collaborative writing. It can be flexible enough to be adapted to the specialized conditions of academic institutions. More specifically, its application domain includes different levels of higher education, ranging from graduate to postgraduate education. Apart from collaborative writing associated with academic subjects, a variety of wikis may be developed for a number of applications, such as generation of updated teaching materials, online peer assessments, and collection of data for a class project. Collaborative writing requires however little technical skills associated with formatting, editing, input of multimedia elements (text, graphics, images, audio and video) onto wiki pages, hyper linking, etc. Besides sometimes it is difficult to measure the degree of collaboration as it probably has been much face-to-face discussions directly between the students. Such dialogues are not easy to transmit by means of the discussion forum. However collaborative writing involves, usually with some difficulties, active participation of the members through shared editing, reading and group writing strategies, revisions, peer-review, and group evaluations of contributions. Previous research has mainly emphasized how wiki technologies support collaborative learning. This study, instead, was aimed to understanding how online collaborative learning, through wiki technology, favors individual learning. From the pedagogical perspective, our findings have shown that students’ engagement with wiki-based learning activities is greater respect than students’ engagement with traditional in-class course. Using a wiki as an individual writing tool can maximize the advantages of reflection, reviewing, publication, and of observing cumulative written results as they unfold. Furthermore, these tools stimulate collaborative writing, provide a low-cost but effective communication way for a wider audience; promote the revision and tracking of preliminary work; discourage product oriented writing while facilitating writing as a process [15].
References


