New method using Wikis and forums to evaluate individual contributions in cooperative work while promoting experiential learning: results from preliminary experience

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ABSTRACT
This paper shows a new method for using Wikis and forums, among other web based productivity tools in blended learning strategies [33][39] to promote the acquisition of competences in Higher education [8][4] while enhancing experiential learning of students [28] in social collaborative knowledge building scenarios. Moreover, facilitating the process of grading student contributions in group work of not eyewitness activities was also pursued and achieved with this methodology. TikiWiki CMS/Groupware was the free software on-line platform which supported this experience, following previous successful experiences [9][10][16][17]. Here students had to think about "What's the 'type of contribution' that I'm going to make right now?", before submitting new posts in forums, comments, or document editions (either text or spreadsheet based). Students type and size (in bytes) of contributions were stored on a log at the web side, and it could be queried with filters or exported for further analyses on a local computer. The method was tested on a course of Environmental Sciences, showing some strengths and weaknesses which are discussed in the paper. The method description includes a process suggested to convert those student contributions (type and size) on numerical grades for individual students. Nevertheless, the main potential of this method is not just final evaluation for student accreditation, but serving data for tutorships with students along the process of the learning activities, in order to detect and revert whatever handicaps that prevented some students improving their contributions to the group work or cooperative learning "in time" (much prior to assignment submission to teacher). An three fold increase in time invested by teachers due to the evaluation methodology has been observed in this preliminary study case, and further data needs to be collected to better estimate the costs of this new information gathered by teachers about students learning evolution in time.

Categories and Subject Descriptors
D.2.2 [**Design Tools and Techniques**]: User interfaces.

*H.3.1 [***Content Analysis and Indexing***]: Indexing methods.*

*H.4.1 [***Office Automation***]: Groupware, Spreadsheets, Word processing*

*I.7.1 [***Document and Text Editing***]: Document management.*

K.3.1 [**Computer Uses in Education**]: Collaborative learning.

General Terms
Measurement, Human Factors, Design, Experimentation.

Keywords
Experiential-reflective learning, Knowledge building, Assessment, Individual Contributions, Cooperative work, Computer Supported Cooperative Learning (CSCL), Action log, Tikiwiki CMS/Groupware.

1. INTRODUCTION
This paper shows a new approach of using Wikis and forums, among other computer tools, to help teachers evaluate individual student contributions in group work or cooperative learning. This is performed enhancing the acquisition of "competences" in Higher education [8][4] while promoting students reflect on what type of contributions they were going to make (or were making) in activities of not eyewitness learning in "blended learning" scenarios [33][39].

1.1 Conceptual framework
The pedagogical model that underlies in this project is the called "experiential-reflective learning" [28]. This model initially designed in the University of Harvard is little known in higher education despite its enormous potential for a teaching with student-centered approach, while promoting their capacity to learn to learn, as well as enhancing the development of their creative and critical thought abilities.

The experiential-reflective learning takes place when the student observes and reflects on a prior experience and carries out some type of abstraction, integrating those reflections in its prior knowledge, utilized as guides for subsequent actions.

Thus, the experiential-reflective learning describes the acquisition of knowledge in a cycle of learning of four successive phases [28]:

(1) "Concrete Experience",

(2) "Reflective Observation",

(3) "Abstract Conceptualization", and

(4) "Feedback or Active Experimentation",

The nucleus in Kolb's model of four phases is a simple description of the learning cycle that shows how the experience (1) is translated through the reflection (2) in concepts (3), that in turn they are used like guides for the feedback or active experimentation, and the planning of new experiences or creation of alternative action methods (4). This way, process of concepts, competences and attitudes acquisition is understood from the point of view of the students.

In the experiential-reflective cycle of students, they are asked that, upon interacting with their companions (either discussing or editing documents), they define what type of contribution are they carrying out or have carried out. From one point, students use to agree that the community does help them learn more and faster [6]. From another point, students were expected to be more conscious about what contributions they had carried out (and of what type) in the not eyewitness learning activities from that course, by which they were going to be evaluated. And they were promoted to self-regulate and self-stimulate, at the same time, in order to contribute more significantly in electronic discussions that were being carried out, or in a group common document that was being edited. Our premise was that, helping students be more conscious of its own learning process, can help them to obtain more satisfactory learning results [31].

Therefore, our objectives were two:

- Stimulating the experiential-reflective learning of students, since they had to answer the question "*What type of contribution is the one that am going to do – or I am doing – myself right?*". They had their prior experience present, at the same time that they knew beforehand the objectives and competences acquisition pursued with the course. And these competences carry associated some specific types of contributions in the planned or suggested activities by teachers for the student learning.
- Facilitating the assessment that teachers make upon individual contributions of students in the not eyewitness activities, to be completed either individually, and specially, those of collaborative character.

1.2 Computer tools to support the project

In recent years we have attended a significant increase in the use of computer tools of collaborative work in university educational environments [23][10][37][21][25][2][34]. In this process, the problem is used to be located at the learning of the tool, in a first instance. This comprises from forums usage to spaces like "Wikis" [7][14][15], including more complete environments as the corresponding to the e-portfolios [22][17]. And most students are not used to them at all yet.

Once the students have been introduced and know the more technical aspects of these computer tools, some difficulty resides in making that the students contributions are not a simple action of copying and pasting information from other sources, or mere exposition of their opinions without contrasting them. That is to say, the simple participation in virtual platforms of teaching/learning with contributions of so low level does not guarantee the learning and the collaborative construction of knowledge [40], although the computer tools can facilitate that students take a more active role in that collaborative construction [19]. Teachers tend to miss more elaborated contributions, that involve interactions where doubts are expressed, problems & suggestions are enunciated, and utilizing prior information to devise new hypothesis, alternatives ..., in a argued and documented basis.

Once this difficulty is surpassed, a third problem of more difficult resolution rises: monitoring and evaluation of these activities [26][36][5], beyond a simple log of students connections and which pages they have seen or documents downloaded [30]. Indeed, the teacher that develops an activity of social knowledge building with these tools [38][16], can be found in a complex situation by the own nature of these tools, since:

- They are tools thought to facilitate the creation of content, in an expansive way and freely enough. But they are not designed as a system to facilitate the monitoring and easy appraisal of students work in the tutorial activity of teachers. And even less designed to promote experiential-reflective learning.
- They require a system of continuous appraisal, based on multiple activities of discussion and contribution along the course [35][29].

That can carry to situations of:

- Confusion on teachers side that see how as their experience of "traditional" assessment and appraisal serves them of little use in such open frameworks as within forums and Wikis.
- Increase of the work load for students and teachers, upon trying to supply the lack of references and aids in the assessment of this type of activities with a re-elaboration and own systematization within a process of continuous evaluation.
- Resistance to the adoption of these tools and dynamics without aid for the evaluation, due to work load previously cited.

By this reason, emphasis is placed in this paper in difficulties of evaluating the activities of experiential-reflective learning in collaborative contexts of social construction of knowledge, as some other authors in similar contexts have already described [34][5].

2. METHODS

2.1 Teaching scenario

The subject where this work was developed was "Evaluation of Environmental Impact", 2005/06 course ("Avaluació d' Impacte Ambiental" – "AIA06"), from the 6th semester of Environmental Sciences degree at University of Barcelona, Spain. There were 52

registered students, and they were divided into groups of 20, 19 and 13 students, approximately, each one (groups T1, T3 and T4). Groups T3 and T4 had the author of this paper as its teacher, and for simplicity sake, only results for group T3 are shown and discussed in this paper, since there seemed to be no relevant differences between the two groups.

The project developed in the practical classes of this subject (3 credits out of 9 when including theory). Students had to integrate a lot of knowledge from prior subjects from the university degree or from their own, and they had to put many abilities in practice that will be required to them in their close future [1]. The assignment in this practical classes is used to consist of the collaborative elaboration of a document, one per group of students, relating to a system of environmental management (an environmental audit or a plan of environmental improvement of its Faculty, for example, as the previous and this last course occurred, respectively).

The evaluation of this work corresponded to a 30% of the final grade for that subject. The work shown here lasted from January until July 2006, and included some meetings in person with students (1 meeting in weeks 2, 5, 8 and 12) as well as days of autonomous work, which were the rest of the days of that time from weeks 2 to 11 (Figure 1).

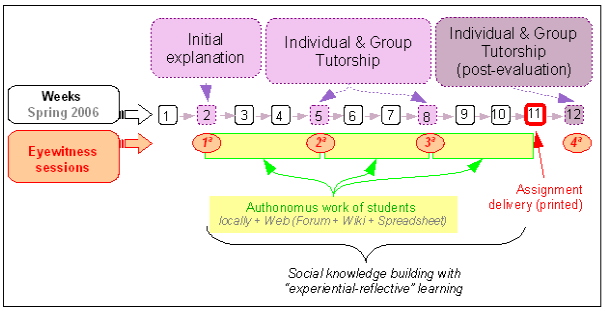

Figure 1: Action plan of the eyewitness sessions with students and faculty. First week of work referring to the project (1a eyewitness session of practices) was initiated March 13, 2006, that corresponded with the second week of class of the subject. For more information, see text.

Students were requested to choose one or more from a semi-closed list of contribution types (Table 1). They could suggest new contribution types, that could be added during the first weeks to the list, if teachers agreed.

2.2 Technology deployed

Tikiwiki CMS/Groupware v1.10 (http://tikiwiki.org, from now onwards, "Tiki") was used as the Web platform to support not eyewitness individual group activity from students, following other previous successful experiences [9][10][11][14][15][16][17]. Main used features were Wikis [7] with their Plugins, Forums, Comments and Spreadsheets with Contribution feature activated on all of them, on the student side, and Action log, in addition, on the teacher side. Other authors have explored other ways of using Wikis in education [10][3][32] and in other fields [18][20][24], but the methodology used in this experience is a novel approach that had never been applied and reported up to date.

Table 1: List of "Contribution types" used in the project. ("I" stands for Contribution importance or impact in evaluation; the more asterisks, the greater relative importance)

I	Contribution type	Description
	Others (report)	Other contribution type not listed in the menu at present (report which one to teachers)
*	Organizational aspects	Proposals and other questions related to the organization of the work team, scheduling,....
*	Improvements in markup	Improvements in markup, spelling, etc. (bear in mind that final document quality for printing (nicer tables, paginated table of contents, page markup...) will be performed at the end
*	Support requests	Simple questions, help requests, etc. without too much making of previous information
**	Help partners	Help group or course mates who asked questions, requested support, formulated doubts, etc. (group or course forum)
**	New information	New information has been added to text or discussion
***	New hypotheses	New hypothesis has been prepared from preexisting information, and possibly, some new information (if so, mark option 'New information' also)
***	Elaborated questions and new routes to advance	Elaborated questions and new ways to move forward in the work which they were not taken into account previously (not just simple questions or elementary requests of support)
***	Synthesis / making of information	Synthesize or refine speech with preexisting information

Students were encouraged to use the web platform to edit the document they had to write and to keep asynchronous discussions through its forums or comments on Wiki pages, since it was going to be very difficult for such a big group like theirs that they could meet in person frequently enough to discuss every single issue that could arise during the 10 week period among all of them (Figure 1).

Thus, when they attempted to post a new message or reply in a forum, they were faced with a form below requesting them to select one or more contribution types (Table 1), which matched the best the kind of message they were submitting (Figure 2).

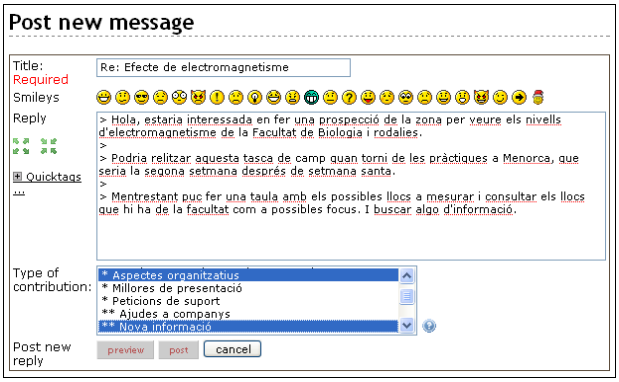

Figure 2: Posting messages in forums, or comments to Wiki pages or any other object in the web platform (Tiki).

On the other side, when they attempted to edit a Wiki page, they were shown a similar form to select contribution type (Figure 3). If comments were added to a Wiki page or to any other object in the web platform (file galleries, image galleries, etc.), they were shown a similar html form as shown for forums (Figure 2).

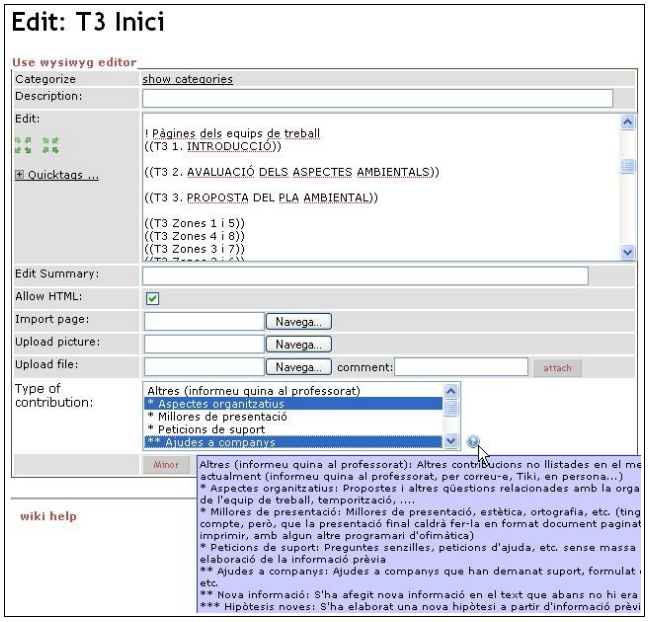

Figure 3: Example of Wiki page at edition time, where a box with multiple selection of "Type of contribution" is observed in the lower part, and a help icon on its right ( ): an emerging explanatory pop up blue box was shown, describing each of the options, upon passing the mouse arrow above it.

Since they needed to compose big tables that had to be recurrently edited by the whole group, the Spreadsheet feature in Tiki was used to support WYSIWYG tables (”what you see is what you get”). Then, content from the spreadsheets could be dynamically inserted as table within wiki texts, through using the correspondent Wiki plugins which Tiki includes by default. WYSIWYG tables also obliged students to select one or many options in the list (Figure 4).

All those user selections and some other information from their contributions were recorded in the Action log feature in Tiki (Figure 5). Some reports could be performed at any stage, showing author of the action or contribution, date and time, type of action carried out and on what Tiki object or feature. Moreover, number of bytes was registered (bytes) regarding additions and/or deletions of information by each contribution, and the contribution types with which the author/to had associated his or her contribution. Finally (not show in the figure), there was a link to be able re-associate student contribution when it was necessary from the teacher point of view.

2.3. Numerical measurement of individual contributions in cooperative group work

Type of contribution, as well as size in bytes of new information added or deleted per contribution were recorded by the action log in Tiki. This way, knowing both type and size of contributions, a first approach to value in a more detailed way the contribution of

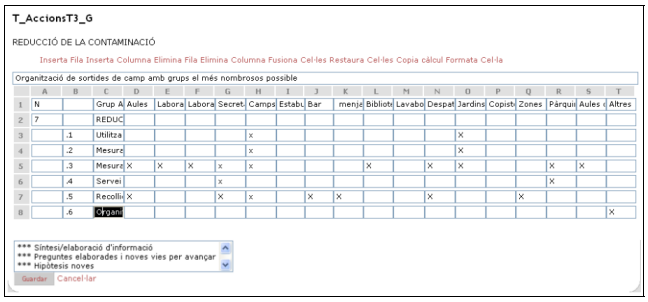

Figure 4: Example of WYSIWYG table (Spreadsheet) at edition time, with the box for type of contributions selection underneath.

each student/to in the group work could be performed, respect to him or herself in previous weeks, or respect to its group, or subject-course mates.

The quantitative estimation of students contributions using their size in bytes by itself, has the limitation of not appreciating the intrinsic quality of the editions carried out by the student. That is to say, there can be two different students that include 5 kilobytes of "synthesis of the information", (recorded as the same quantity and quality of contribution for both of them), but, nevertheless, one contribution could be more elaborated than the other.

Therefore, as in the use of any technology, this computer-mediated methodology should not substitute evaluation work by teachers, but the goal is that it can assist teachers work in their evaluation and grading of students. And if reflection of students is stimulated concerning their individual contribution types (and which ones are the most valued, according to the objectives of the course), as in this case, therefore it is more probable that students learn more and better, through their experiential-reflective learning cycle. They are more conscious about what they do know, or the abilities they already execute without difficulties, and about what they do not know or have not acquired yet.

The final grade for each student comes from a grade for the group, multiplied by an individual weighting factor for each evaluation criterion (Table 2). This procedure allows teachers to have an extensive range of learning evidences, that include as much the process as the final product, with variety of focus, contents, methods and instruments, just as it is recommended in the European Space of Higher Education [29].

A grade for the group in each evaluation criterion was set according to the quality from the final product delivered to the teacher (document with the printed version of the environmental plan), as well as of a general impression of all the process carried out within the group.

The weighting factor took into account the order of magnitude of the total bytes added and deleted by each student (according to the criteria and methods established in Table 2), respect the average on order of magnitude for the same criterion considering all the working group, so that it ranged from zero to 1. The order of magnitude was calculated from decimal logarithms, since the result indicates if contribution size was in terms of bytes, tenths of bytes, hundreds of bytes, kilobytes, ...

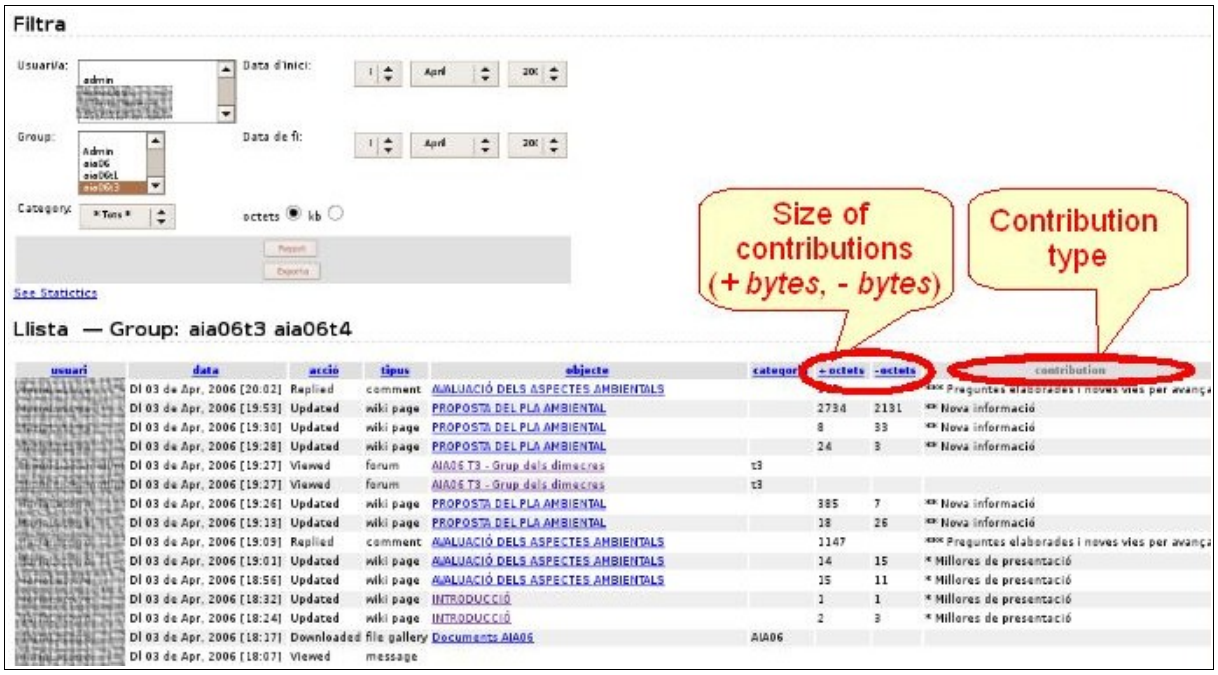

Figure 5: Action log feature on the web platform (Tikiwiki CMS/Groupware). Reports could be created for users, groups of users and content categories, for any time interval. Two superimposed globes in red stand out the columns referring to "size" in bytes of information added or deleted per contribution and contribution types. Data could be exported to a spreadsheet or external database for further analysis.

3. RESULTS AND DISCUSSION

3.1 Contributions in groups

In all the figures shown from now onwards, the period of 10 weeks of work from students prior to submitting their document in paper correspond to the rank between the second and the eleventh week (Figure 1). And except where otherwise noted, figures from contribution in groups are shown with the same scale as in figures from individual contributions.

Students of group T3 carried out contributions, in general for all the whole period of 10 weeks, in order to add new information, synthesize it and discuss organizing aspects, including some modifications to improve the presentation of the content along the process, by order of greater to smaller quantity of information contributed (Figure 7) or suppressed (Figure 6).

The average (± standard error) of contributions size by student in the 10 weeks in total was 15.8 ± 3.0 kb for group T3, and 13.1 ± 3.9 kb for group T4, respectively. As for the suppressions of content, the averages were 4.8 ± 1.2 kb and 3.4 ± 1.2 kb, for groups T3 and T4, respectively.

It has to be kept in mind that these graphics don't include information from the last edition work by the person with the editor-in-chief role. This person exported the final content from the Wiki and pasted it to a word processing local computer program, in order to paginate it and perform the last editions: header and footer, paginated table of contents, last spell and grammar checking where applicable, etc. This was taken into account manually at the end by teacher, since it was not logged in action log database (Table 2).

Table 2. Evaluation criteria, estimation methods and grading percentage. "(*P*)" *(Process):* information was obtained from discussion and document edition time, and "(*FP*)" *(Final Product):* obtained from printed final document, since students wrote their names next to sections where they contributed.

Criteria	Estimation method	%
Teamwork	*(P)*: Sum of sizes of all contribution types	15
Synthesis & clarity of information	*(P)*: Statement (corrected) of students, and sum of sizes of specific contribution type ("*** *Synthesis / making of information*")	30
Quantity & quality of contributed information	(a) *(P)*: Statement (corrected) of students and sum of sizes of related contributions types ("** *New Information*", "*** *New hypothesis*", "*** *Synthesis / making of information*"), and (b) *(FP)*: Revision by teachers of individual attribution statements of each section at final printed document	40
Formal quality of work	(a) *(P)*: Statement of the students and specific contribution size and type ("* *Improvements of presentation*"), and (b) *(FP)*: Arbitrary scoring by teachers to last work by editors-in-chief to final document prior to printing	15

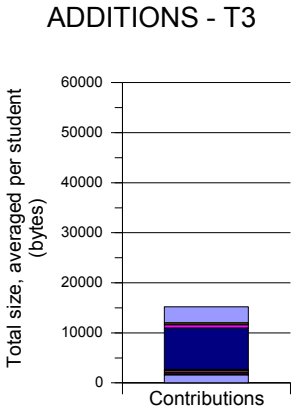

Figure 7: Average of text additions per student for the 10 weeks of work, group T3. (same scale as Figure 9)

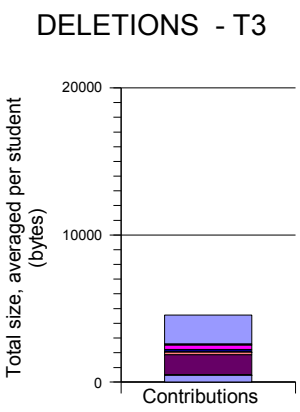

Figure 6: Average of text deletions per student for the 10 weeks of work, group T3. (same scale as Figure 10)

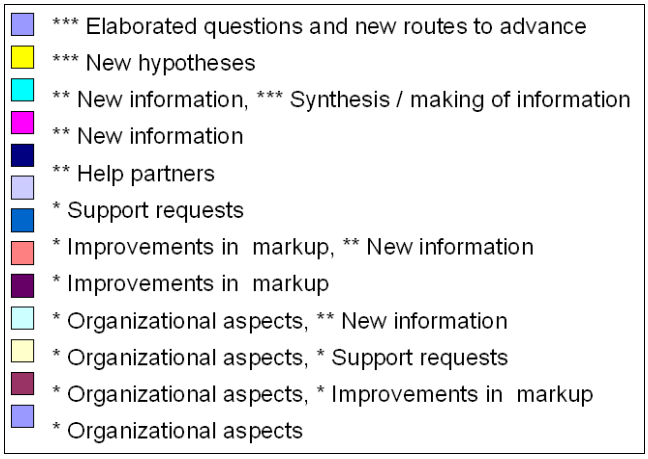

Figure 8: Legend for Figures 6, 7, 9 and 10.

3.2 Individual contributions

In general, degree of individual contribution from each student was very diverse, as it is supposed to be common in group works, oscillating from people that contributed with modifications from the order of magnitude of 50 kb of text (Figure 9 and Figure 10, for group T3, which corresponds to more than 3 times the average of all the students), to others that were below 5 kb of content (a third of the average).

It can also be observed at the results that barely all students contributed (either through discussions in forums or through document editions), but only between a third and the half of them (for the groups T3 and T4, respectively) contributed notably to the synthesis of prior information added by themselves or their mates. This result is low, yet, but very satisfactory if we know the the earlier year, the same students had even lass contributions of making synthesis of previous information, according to their teacher [Pilar López, personal communication].

On the other hand, few people formulated new hypothesis of aspects to keep in mind, or elaborated questions or comments which supposed new ways to move forward, or that supposed solutions to new situations that they did not know how to initially confront.

3.3 Temporal evolution of individual contributions

Students invested most of their effort in document content and discussion during the prior weeks to the eyewitness sessions with teachers (individual and group tutorship, Figure 1), or prior to the dead line for printed document submission (Figure 11 and Figure 12, additions and suppressions, respectively for T3).

It is remarkable that most of the bibliographical content was contributed in the 3rd week, with lower contributions in successive weeks, along which synthesis and elaboration of the information work was increasing. This pattern in content contribution was totally normal in such kind of assignment where bibliographical work was important, since students had to take information from documents made by students from previous year ("Environmental Audit" in 2005, versus "Environmental Improvement Plan", in 2006). The nourishment of information from 2005 to 2006 was carried out around the 3rd week, according to the suggested scheduling by teachers in the initial session, which asked students to do that before the 2nd eyewitness session (5th week, Figure 1).

Moreover, few posts or editions contributed with new hypothesis of aspects to keep in mind for the environmental improvement plan (Figure 11 and Figure 12). This fact could be due to the proposed environmental actions could come from the tested students experience on possible environmental actions and its already verified effects (verified by themselves or by information obtained from other sources), and could have lead to the lack of selection of "New hypothesis" contribution type. We expect that in other experimental more creative type of work (in any case with a greater character of interpretive work), students will include a greater proportion of contributions related to new hypothesis to improve the work plan or for knowledge building.

Students effort along the 10 weeks was reasonably distributed and according to the suggested indications by teachers ("do not leave the work for the end..."). In fact, there was little work carried out by the students only in the 5th week, distributing the reminding time with a certain weekly effort in document discussion and edition, even in weeks different from the immediately previous to the eyewitness sessions with the teacher.

Previous observations lead to consider that this pattern of more balanced distribution of effort in time (with respect to leave it all for the end) could be encouraged implicitly by Wiki methodology of collaborative documents edition itself [9].

These contributions were generally not carried out by all students in each group, but for each week, the number of students that contributed was about 50%: 10 students out of 19 registered, for group T3 (Figure 13), and 7 out of 13 for group T4 (figure not shown). Nevertheless,these numbers obviously oscillated along the process, from 18 or 12 people the third week, for groups T3 and T4, respectively (which meant all except one person, in both cases), to 5 people the fifth week for group T3 or two people the second and fourth weeks for group T4.

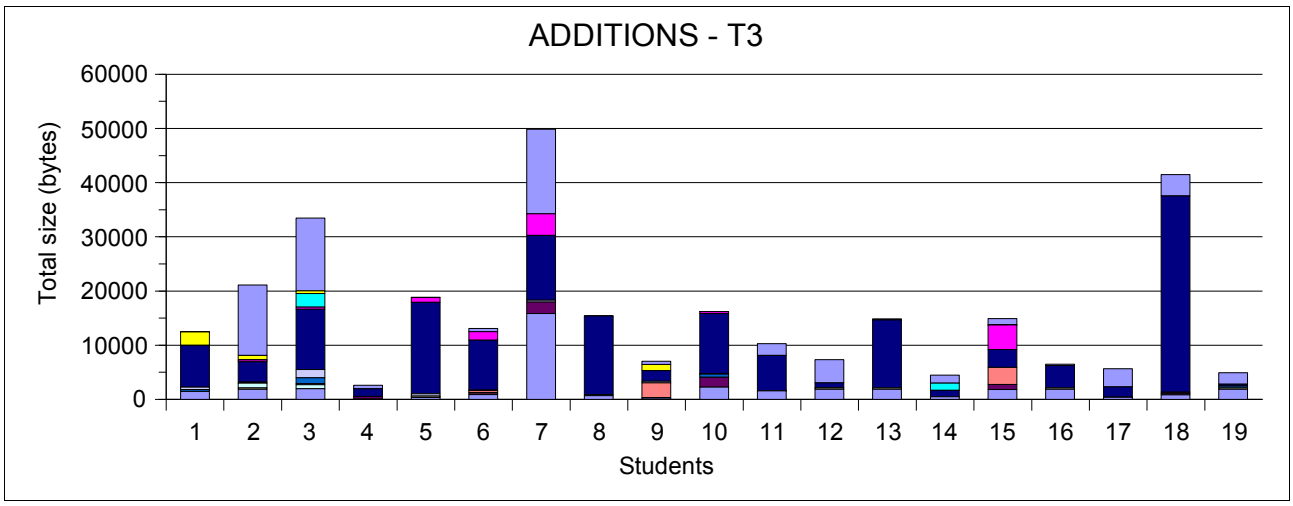

Figure 9: Students Contributions as additions of content, in bytes group T3, for the whole period of 10 weeks. An average for all students in group T3 can be found in Figure 7.

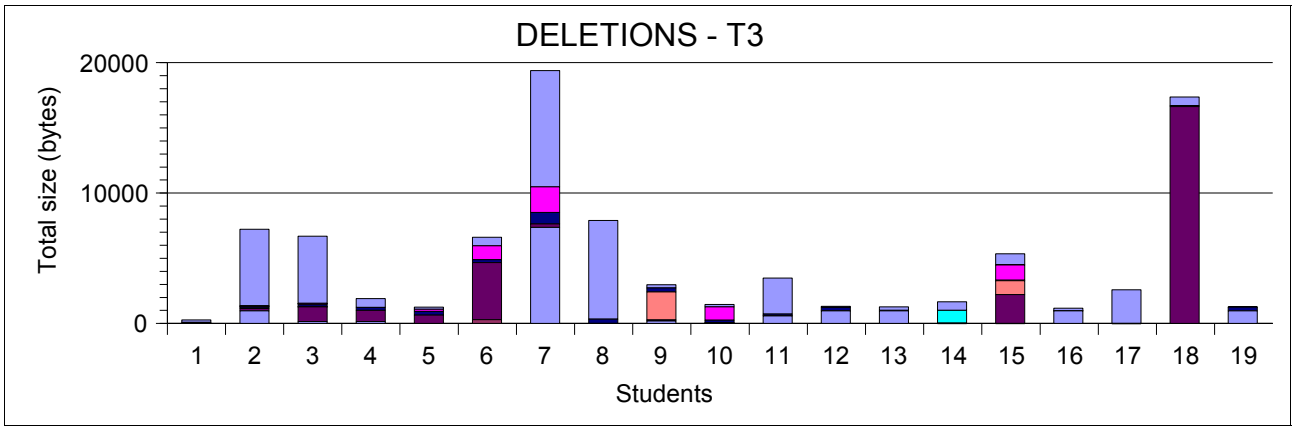

Figure 10: Students Contributions as deletions of content, in bytes group T3, for the whole period of 10 weeks. An average for all students in group T3 can be found in Figure 6.

Value from 10th week should not be considered (1 student for group T3, Figure 13, or 0 students for group T4, not shown), since it is product of their own internal organization of group work, as only the editors-in-chief were the responsible to make the last editions, if any (group T3), if the editor in chief didn't take the information out from the Wiki prior to the last week (group T4) towards their office computer program in their local computer, with the aim of making the last markup modifications for the version that was going to be printed, etc.

4.CONCLUSIONS

4.1 Strengths and weaknesses

The described method under this experience shows some strengths and weaknesses.

4.1.1 Strenths

This methodology,

- allows the students to be more participative on their own learning process, and therefore, it allows them a greater self-regulation of their effort invested to develop the specific and cross competences and it allows them to enlarge the significant learning of knowledges, as well as competences and attitudes.
- allows to have quantitative data that characterize the contributions of each individual of a work group or in scenarios of cooperative learning [27].
- means a substantial improvement the individual evaluation of student learning (absolute or relative) along the process in not eyewitness activities (autonomous work of the student or group of students); traditional methodologies make it very difficult, if not practically impossible.
- facilitates the personalized tutorship "in time" so that each student can realize what aspects he/she has adequately developed, what other aspects have not been adequately developed (and remedy can be put in time), within the framework of the New European Space of higher Education [8].
- allows that teachers distribute more homogeneously through time the task to supervise, validate or correct and feedback students by their contributions carried out.

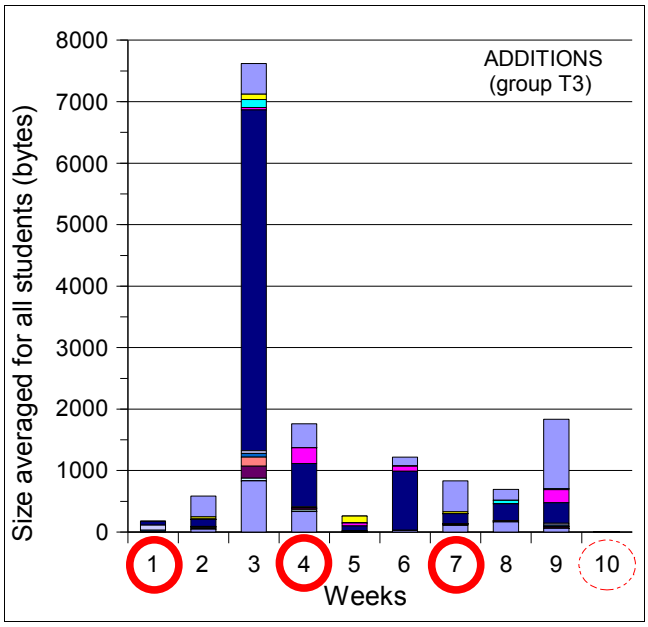

Figure 11: Weekly evolution in size of additions, averaged for all students in group T3. Weeks with eyewitness session with teachers are marked with red circle. Printed document had to be submitted by week 10

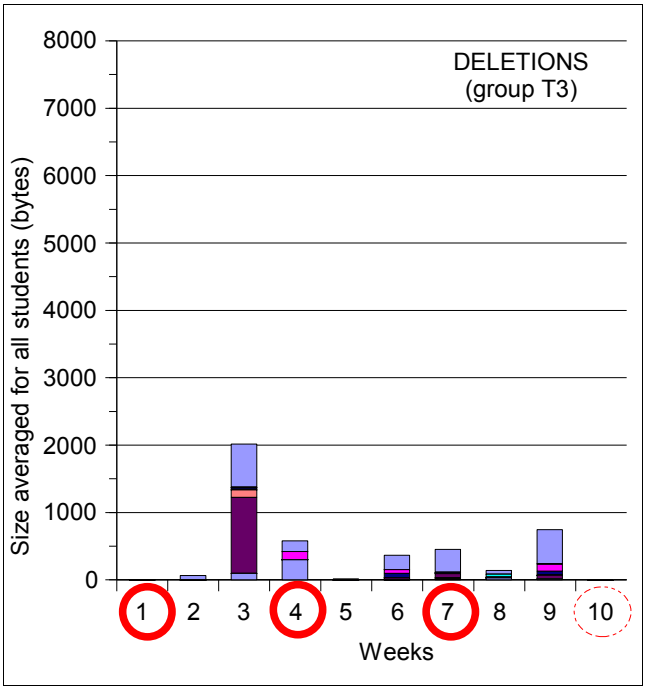

Figure 12: Weekly evolution in size of deletions, averaged for all students in group T3. Weeks with eyewitness session with teachers are marked with red circle. Printed document had to be submitted by week 10

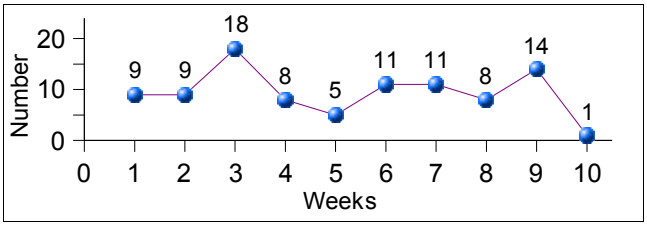

Figure 13: Number of students that contributed per week in group T3 (additions, deletions, or both; 19 students registered)

4.1.2 Weaknesses

On the other hand, this methodology also implies some other aspects considered weaknesses of the system. Thus, this methodology,

- computes "quantity" of contributions (sum of bytes added, sum of bytes deleted) but it does not appreciate the intrinsic quality of the edited text. Therefore, the critical reading, validation and appraisal of students contributions by teachers is likewise necessary.
- can be employed inadequately if it is used to promote "police control" of students actions. Nevertheless, the main potential of this method is not just final evaluation for student accreditation, but serving data for tutorships with students along the process of the learning activities, in order to detect and revert whatever handicaps that prevented some students improving their contributions to group work or cooperative learning “in time” (much prior to assignment submission to teacher).
- use to have some students which refuse to use it, if they previously have had a negative experience with Wiki methodology, due to an inadequate use or lack of adequate prior instruction about the best practices for the usage of Wikis, etc. [13]
- involves that teachers dedicate more time to the evaluation of the student contributions (type and sums of sizes), that supposes to multiply by three the traditional amount of time dedicate to evaluate (only) the final product of a person or group, without taking into account the whole process prior to printing (0.45 h. per 10h of class per student in groups T3 and T4, respect to 0.14 h. per 10h of class per student in group T1, a reference group with traditional methodology [13]. And this educational methodology might suppose between the two and three fold the time invested by the teacher in global for all the associated activities with the subject: preparation, development (eyewitness classes, tutorships, other managements), evaluation and trips. Further data from new study cases needs to be collected to better estimate the costs of this new information gathered by teachers about students learning evolution in time.

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