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Improving the Analysis of Students' Participation & Collaboration in Moodle Forums

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1. Introduction

This chapter is entitled to analyze interactions and collaboratively learning of students in web 2.0 resources such as forums. As it is known, forums are a collaborative resource widely used in e-Learning due to the simplicity to create threads of discussion for a given topic. It is an asynchronous resource, therefore it does not require from other students to be connected at the same time to answer to a post or to read other students' posts. Since it represents another way of learning, such as 'learn by doing', teachers may need ways to evaluate the quantity and quality of the work done in them by students.

To begin with, the chapter presents an analysis of different software packages existing to create a forum system, and particularly, how they support analysis of interactions. We found that the best educational software to create and maintain a forum seems to be Moodle. However, all of them lack comprehensive mechanisms to track students' activity in forums. We describe the main features we consider that a system should have in order to provide such comprehensive support.

A new tracking system for forums has been developed in Moodle to alleviate this lack. It is described in the chapter, as well as the results obtained with it. The system has been used in a first year programming course in Computer Science degree during the last academic year. Finally, our conclusions on the results of our experience are explained and discussed.

2. Previous work

Nowadays, the traditional classroom has changed towards a more on-line one; therefore, teachers have had to find new ways of keeping an eye on students when they are working online, out of their site. Following to this, there is a review of previous works done in the analysis of students interactions in e-learning; first, focusing the analysis on Learning managements systems, and secondly, focusing the analysis on forums.

2.1 Analysis in Learning Management Systems

Teachers need more and more an aid from the e-learning system that provides information about how students interact with it. Thus, some applications that try to resolve the problem

of keeping an eye on the student while working out of sight of the educator have already been developed in different areas of e-Learning, such us (Ramani & da Rocha, 2000) describe tools for letting instructors easily view student participation in a Web-based class using charts and graphs to display student participation. (Reffay & Chanier, 2002) identify clusters and cliques within the online class. These tools focus not on the individual student, but rather on class activity as a whole. Although both sets of tools are interesting and potentially useful in aiding the understanding of Web Based discussion forums, they aren't build on an analysis of the discussion evaluator's workflow, which is a critical requirement for improving online teaching effectiveness.

In (Mazza & Dimitrova, 2005) they had developed an Application CourseVis that visualized interactions of students with an e-learning site, and then they moved towards Moodle and offered what they have called GISMO which is an application that can be installed into Moodle and shows basically different types of graphical information (bar charts, and matrix visualizations) basically 2D graphical information about the overall classroom accesses or the detailed information from a specific student. All it is offered are graphs of the accesses, the 2D visualization may have a third dimension that is colour (from light two dark shows the quantity of accesses), or shape (bigger circles show a larger amount of contributions from the student). Even though their visualizations are more advanced than Ramani and Rocha's, they still lack of interactions and improvement.

In University of Edinburgh they have made tracking and visualization of student use of online learning materials (Hardy et al., 2007), their tracking tools are non-invasive, whilst providing information not available in standard web server logs, the tools allowed a measure of control over what information is recorded. In Universidad Rey Juan Carlos (Hijón & Velázquez, 2008) it has been developed a tool fully installable into the Moodle system, called Merlin-Mo, that collects and offers a wide variety of tracking information about students accesses from different perspectives, allowing interaction with the visualizations and statistical analysis among other features.

2.2 Analysis in Forums

Determining learning behaviour in electronic media is a complex problem. A difficulty is that students mostly use these environments away from the classroom and out of sight of their educators. Without the informal monitoring that occurs in face-to-face teaching it is difficult for educators to know how their students are using and responding to these environments. Educators have had to seek new ways of obtaining information about the learning patterns of their students. This requires the development of effective methods of determining and evaluating learner behaviour in electronic environments.

Such is the case in Integrated Participation Evaluation Tool (iPET), is a web-based application combining social network analysis and visualization to enable distance learning instructors and students to improve their participation in online discourse and so improve their overall learning experience (Saltz et al, 2007). The tool can be seamlessly integrated with commercial Web-conferencing systems such as Blackboard or WebCT and Akita Corporation´s WebBoard. They track different levels of participation in asynchronous forums namely: concrete participation of each student, such as: 'have they created an introductory post?' 'Which steps have they followed in the participation?' trying to understand general participation patterns, for example: to quickly identify people at risk because of lack of participation (class overview). Students' details module, that focuses on a

specific participant's activity. The tool shows different graphs with the participation of the students.

Another work (Poggi & Di Blas, 2007), present results from the analysis of a set of asynchronous message boards within a project where students meet in real time, shared 3D virtual environments, and keep in touch through online forums. They show how forums can support more or less effectively collaboration and discussion tools, what challenges must be faced, and how the tool's evaluation must take into account the components and set of goals of the entire learning experience.

In (Palloff & Pratt, 2005) the study says that forum discussion intervention has a double importance: in one hand, like a tool to set up and enlarge the acquired knowledge, in the other hand, like a pillar in the creation of learning communities.

3. Objectives

The general objective is to develop a way of analysis of students' interactions in a web 2.0 resource such as a forum. As it is known, a forum is a powerful resource to discuss different topics using Internet and a software that supports the functionality. When teachers use a forum as a mean of communication in two ways: firstly, teachers with students, and secondly, students with students, it is important for them to have effective ways of analyzing how students communicate, cooperate and share knowledge. Essentially, if it is possible to 'learn by doing', this is to say, if students that edit or read post in forums as a mean o participation in an e-learning activity get better knowledge about the course contents. To do so, teachers need an effective way to analyze this participation in forums, in an easy way, using user friendly interfaces that show to them the forum tracking information already processed, without needing the use of an extra tool for the analysis or visualization of interactions. Thus, a way to do so is by an application that allows analysis of how students participate in a forum by:

- Identification and storage of interactions data in an effective way for further analysis.
- Providing an effective way of data confidentiality, offer security options to assure this data is only visited by teachers and administrators. Define the roles to accomplish the required security.
- Knowing how they participate, are they only reading or also writing posts. What sort of pace of learning they use, how long are their contributions. It is important to be able to make an analysis of a particular student or the overall class. Provide ways of analysis and comparison of the amount of written contributions towards the reading ones.
- Knowing when they participate, or what time variables are usually used, when do they participate and how long are these participations. Offering possible representations of participation in a chronograph or monthly participation distribution in the forums.
- Provide effective ways of visualization of participation data. Offering different ways of looking at data. Thus, easy to use interfaces. Providing of the summary of contributions to forums by student or the overall class.
- Offering detailed information of forum contributions, either answering to another person thread or starting new threads of discussion. Possibility of knowing detailed information about each student.

- Statistical analysis of answering times data, such as, estimated time to answer a topic or the overall forum. Possibility of comparison of forum contributions by students. Analysis of first and last posts by a student. Overall analysis of posts by topics written by students.
- Analysis of first and last student contribution within a course and other statistical measures that lead to participation comparison.
- Summarizing of topic/post by each student and by the overall class.
- Detailed analysis of topics related with posts.
- Identification of only lurkers' students. Relationships among lurkers and participants.

4. Evaluation of alternatives

An analysis of different software to create and maintain forums have been done. The most used and more extended applications have been analyzed and compared to be able to pick the one to develop the software for analysis, once found that the statistical analysis they provided was not enough. The applications are:

- MvnForum (Mvnforum, 2009) it is a wide scope opensource forum, easy to use and configure. It is based on Java J2EE (Jsp / Servlet). The statistics this forum produces are simply the total number of: categories, forums, themes, messages, users, last user, users online and invited users.
- PhpBB (phpBB, 2009) is a free open source package based on php to proporcionate a forum system, with wide personalization possibilities. The statistics this forum offers are total number: post, users, last user registered, online users, hidden users, invited users, day with more affluence of people into the forum.
- JavaBB (javaBB, 2009) is java based software, developed to be used in communities; it is also based on phpBB. The statistics this forum produces are total number of: articles published, users registered, last user registered, number of users connected.
- Simple Machines Forum (SimpleMachines, 2009). It is written in php and uses a MySQL database. It is designed to provide the general features a news board has in a way that has less impact on server resources use. The statistics are more complete that the ones offered by previous forums, they produce the following 'general statistics': total number of users, posts, topics, categories, online users, day with more users online, online users 'today', total number of pages visited, average of registers by day, posts by day average, topics by day average, last user, users by day average, woman and men comparison of online users average, most visited pages by day average. Also offer the top 10 of: persons with more post, topics sorted by answers, topics sorted by visits, users with more topics and users with the higher online time. Lastly, it offers historical statistics of new topics, new posts, new registered member, highest number of online users and visited pages.
- YaztForum Software (YaztForum, 2009) is open source forum software written in java. It allows the creation under many Data Bases. The statistics they produce are number of topics, posts, and last post date.
- Moodle (Moodle, 2009) is an open source LMS software to create e-Learning or Hybrid learning courses. It contains a forum application integrated to manage forum created within this courses. It is written in php and can be used on a MySQL data

base among others. It is widely used. The statistics it produces are completer than the forums seen before, but its visualizations are very poor; it only offers a table visualization showing the general information about the forums in the course like: forum, threads on that forum, threads started by, replies and last post, participants, posts by participants.

The following Table 1 shows a comparative analysis of the selected product to create forums and analyze participation in them.

	modifiable	Widely extent	Design for e-Learning platforms	Programming Language	Enough interaction & participation analysis	Enough Visualitaion to enhace analysis
Foros						
MvnForum	✓	✓	✓	✗	Java	✗	✗
phpBB	✓	✓	✓	✗	php	✗	✗
javaBB	✓	✓	✗	✗	Java	✗	✗
SMF	✓	✓	✗	✗	php	✗	✗
Moodle	✓	✓	✓	✓	php	✗	✗

✓ – The application has the characteristic

✗ – The application does not have the characteristic

Table 1. Comparative chart of forum software

After analyzing the applications stated above and the general features that should have the application that analyzes participation and collaboration in forums, none of the forum had a good application for analysis and visualization of participation therefore it is necessary to create one. By looking at the table, it can be seen that the forum that best suits our requirements is Moodle. Therefore, the new module for analysis of participation and collaboration would be created for the Moodle forum.

5. Technologies

Widely used technologies used in the development of the application are: HTML, PHP, JavaScript, MySQL, and XAMPP.

There have been used open source libraries also written in PHP to generate the statistics and graphs from the data received as the user presents queries to the system, such as Open Flash Chart (Open Flash Chart, 2009) is a library written in php that uses flash for dynamically generate data statistics.

6. Evaluation of existing applications

After deeply analyzing new modules developed for Moodle LMS, four have been found that were made to work directly on the forum module, what gives an idea about its importance, especially when talking about collaborative learning and participation, either in Higher Education as in life-long learning. From them, only two had some functions that could be used to analyze participation in a learning activity, and they are the following:

6.1 Forum Plus (F+)

It is a new module that has created functionality to enhanced Moodle Forum for Group Discussion and Collaboration and has a 'Reflection Board' that show some statistics about users activity in the forum. It offers reports of:
- Most frequently read messages
- All messages read and by whom (history)
- Rules activated by teachers to notify him/her:
    - Number of messages posted by the user (i.e a rule has to be defined to activate a signal to notify the teacher if a user never has taken part in a discussion)
    - Presence or absence of messages associated with a specific topic (a rule can also activate lack of participation)
    - Activity on the forum (posted messages)

Figure 1 & Figure 2 shows the data statistical data this new module offer to teachers.

Fig. 1. Forum Plus statistics, identification of inactivity and average messages

Gruppo	Iscritti	Utenti Attivi	Utenti Inattivi	Lurker	Msg. scritti	Msg. scritti/Utente	Msg. letti/Utente	Upload/Utente
et001	6	6	0	0	86	14.33	44.83	1.33
et002	6	6	0	0	90	15	35.83	0.5
et003	7	7	0	0	85	12.14	30.86	1.14
et004	7	5	1	1	49	7	12.71	0.29
et005	7	7	0	0	75	10.71	47.29	1.14
et006	6	6	0	0	38	6.33	17.83	1.17
et007	5	5	0	0	55	11	30.4	1
etutor	0	0	0	0	0	0	0	0

Fig. 2. Forum Plus statistics, summary of users' activity

6.2 HSU Forums Enhancement

The Humboldt State University has built new Forum Enhancements into the Moodle forum module. This project includes enhancements related to visualize and analyze collaboration and participations that offer:

- Sequential View of posts
- Sort posts in order by name or topic creation date
- Expand/Collapse discussion topic display

None of these applications for the Moodle forum fulfill the initial requirements. There is lack of information about students' interactions on them and there is no possibility of data selection by the user as required, allowing to set queries into the system for further interactions assessment. Furthermore, the information the modules display lack of graphical analysis, making it hard for the user to rapidly assess students' forum interactions. Therefore, the new module for students' interactions in the Moodle forum would cover this lack of functionality.

7. Main Contribution

The new module developed for Moodle is called e-Forum, is fully joinable into any running module, and uses all its administration features, such as those that imply security and appearance. The former, since the permissions Moodle users have are also used to enter the new application, thus only teachers, administrators and course editors (following the Moodle nomination) can access to it. The latter, since all user settings like host language, are also used into the system.

Once the user is into Moodle, just by clicking on the e-Forum option (see Figure 3) the application would be shown to the user.

Fig. 3. e-Forum fully access into Moodle

The system has been divided into three main modules, the first one that show the information about all the students as a whole, considering the whole class but detailing, when needed, the information about each student. The second one shows the analysis about a selected student individually. And the last one, offer some predefined queries that complete the analysis.

7.1 Grouped Analysis

The first module for analysis is about all the students to analyze:

- Total numbers of contributions made by students, where users can obtain data about the total number of contributions students have made.

- Forum detailed contributions; the system would show a detailed chart of contributions made by students.
- Forum participation distribution, where users can obtain a table with the monthly distribution of participation making a difference among topic, post and the sum of both.

General to all options are the data restriction, the selection of a visualization type and the time restriction for that data. Thus, for any of the options explained in this part, the users' first step is to select a course, a forum within that course and a topic within that forum, or leave the default value of 'all of them' when desired. The second step is the selection of a visualization type for the data; the options are a pie chart, a bar chart or a data table. Finally, user would have to select a data range for the data selected. Figure 4 shows the interface of this first part of the analysis with the data selected for the total number of contributions made by students' option.

Fig. 4. e-Forum, all students interface

In the example the course selected has been the Programming first year course MTP, all forums within that course and all topics on the forums. The visualization selected has been all the possible ones: table, bar and pie chart; finally, the date restriction has been the current year, but the forum selected was only used on that course during the month of May therefore has data only on May. The table visualization (see Figure 5) offers a summary of the total number of forum contributions by months represented on the y-axis and by students represented on the x-axis, color codes helps the user to analyze data, since a darker tone means a higher amount of contributions and the absence of tone also means absence of contributions.
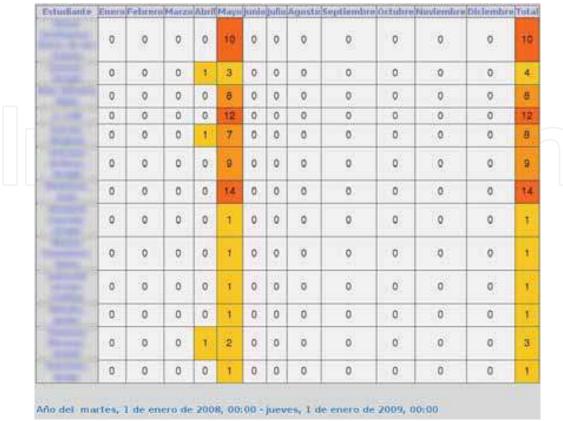
Estudiante	Enero	Febrero	Marzo	Abril	Mayo	Junio	Julio	Agosto	Septiembre	Octubre	Noviembre	Diciembre	Total
	0	0	0	0	10	0	0	0	0	0	0	0	10
	0	0	0	1	3	0	0	0	0	0	0	0	4
	0	0	0	0	8	0	0	0	0	0	0	0	8
	0	0	0	0	12	0	0	0	0	0	0	0	12
	0	0	0	1	7	0	0	0	0	0	0	0	8
	0	0	0	0	9	0	0	0	0	0	0	0	9
	0	0	0	0	14	0	0	0	0	0	0	0	14
	0	0	0	0	1	0	0	0	0	0	0	0	1
	0	0	0	0	1	0	0	0	0	0	0	0	1
	0	0	0	0	1	0	0	0	0	0	0	0	1
	0	0	0	0	1	0	0	0	0	0	0	0	1
	0	0	0	1	2	0	0	0	0	0	0	0	3
	0	0	0	0	1	0	0	0	0	0	0	0	1

Año del martes, 1 de enero de 2008, 00:00 - jueves, 1 de enero de 2009, 00:00

Fig. 5. Table visualization of total number of contributions in e-Forum

The monthly bar chart represents the students on the y-axis but the x-axis represents the total number of contributions, a graph for each month appears, as well as a summary of the course at the end. In Figure 6 the students' contributions in May are represented, in the visualization, each bar is finished by a number to help comparison. Finally, the pie chart representation is shown in Figure 7, where the students' percentage of participation is represented and color coded to help understanding, for more precise analysis, users can place the cursor on the sectors to visualize the exact percentage quantity.
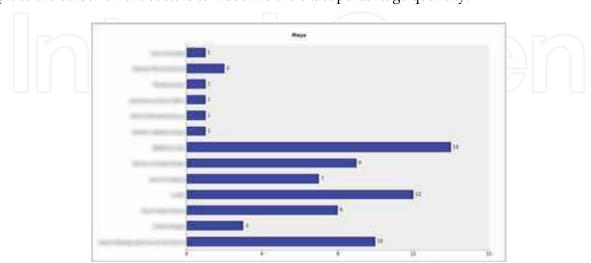

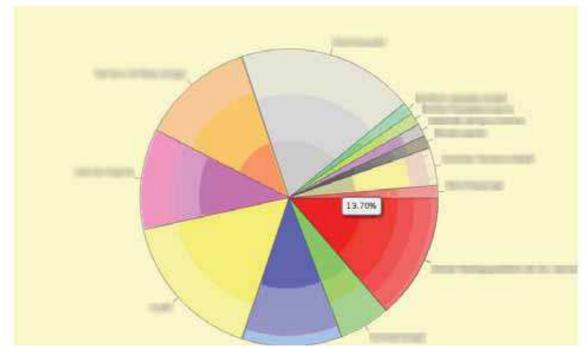Fig. 6. Bar chart visualization of total number of contributions in e-Forum

Fig. 7. Pie chart visualization of total number of contributions in e-Forum

The second option of this first part is the 'Forum detailed contributions'. When user click on this option the interface changes because the system would offer and ad-hoc representation of data made to help easy users' understanding, therefore user does not have to make any choice on the visualization type, the best suitable option has been defined in the query design at its development. This ad-hoc visualization offers a table for each student detailing for each post written: which forum and which topic it was written in, to which post it answers, to what student it answers, when it has been posted, when it has been modified, the title message and the body message by placing the mouse pointer over the body cell. Figure 8 represents the forum detailed contributions query results made by all students for all forums and all topics in MTP-Gestión course during the week of May 15th, 2008; the visualization offers a table for each student, each entry in the table represents a post and all the linked information related to that post that has been explained before. In the first table represented, the body of a post has been automatically displayed by placing the mouse pointer over the message title.

The third and last option of this first part is the 'Forum participation distribution'. The interface has also changed by clicking on this option, since the data visualization will be displayed monthly, thus the time frame selection should also be monthly. In the example, 'last month' option has been selected for all forum and all topics in the course MTP-Gestión selected. Results have been displayed in another ad-hoc table visualization that offers the monthly participation distribution in a forum, first column 'week' represents the week within the month selected, and second column 'student' identifies the student to offer in the right columns the total amount of written topics, posts and the total of both (see Figure 9)

Fig. 8. Ad-Hoc table visualization of detailed forum contributions

Fig. 9. Ad-Hoc table visualization of forum distribution participation

7.2 Personalized Analysis

The second module is for the personalized analysis of a single selected student. The first two options for the analysis are the same its precedent had, but personalized to a user selected student that, the options will be then:

- Total numbers of contributions made by selected student, where user can obtain data about the total number of contributions a student has made.
- Forum detailed contributions; the system would show a detailed chart of contributions made by a selected student.
- Last post information, where user can obtain a table with the information about when a student has written his last post/topic.

From the interface seen before, only two changes have taken part, one is that a window to select a student has been placed, and the other is that there is a fourth type of visualization to choose from, the line graph (see Figure 10).
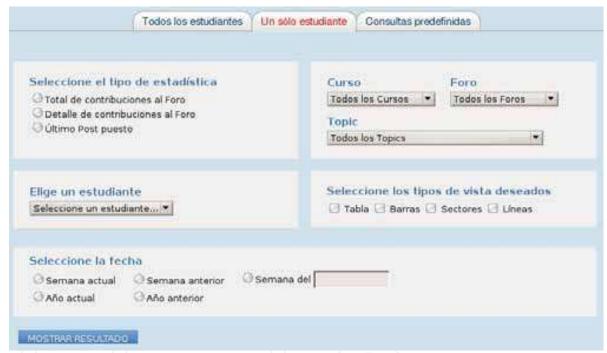

Fig. 10. e-Forum interface for a single selected student

As before, interface changes the options for the user to select by clicking on a type of analysis or another, but in this part, the analysis is always based on an only student. On Figure 11 results of a selected student total number of contributions is represented; were line graph visualization has been selected and the time frame of 'current year'. As it can be observed, the x-axis represents the months of the year, and the y-axis represents the amount of posts written by this selected student (name have been hidden). Also, by placing the cursor over the graph coordinates, the total amount of data represented (written posts) is displayed in a text label.

Fig. 11. Line graph visualization of a student total number of contributions in e-Forum

7.3 Preset Analysis

The third and last module is for the predefined queries analysis, for a more general analysis of participation and contribution, the study is also made over all the students on a selected course, it offers a kind of summary of participation and contribution to the forum from different views; therefore, only the query and the course are the entries to the visualizations that are predefined in the representation type chosen, in the time frame selected and in the forum/topic/post selection (see Figure 12).

Fig. 12. e-Forum interface for predefined analysis

The predefined analyses are (always based on a course selected, or all of the courses):
- Analysis of the relationship topic/post: visualizes the ranking of the total amount of post, topics written by each student.
- Open topics detail by forum: visualizes the forum names on the course selected and the total number of topics open in each of them.
- Topic detailed number of post: offers the topics opened for each forum and the total number of post in each of them.
- Only lurkers' students or students that have only read never written posts.
- Average time response to a topic: shows a table with the average time to respond a topic for each forum in the course (see Figure 13).
- Relationship between reading posts and writing posts: shows a table representing the total amount of written posts and read post by each student.

PRÁCTICA OBLIGATORIA

Topic	Media de respuesta
Duda sobre Ficheros	22 minutos, 8 segundos
Dos dudas acerca de la práctica	2 días, 3 horas, 34 minutos, 18 segundos
Dudas respesto a los listados	2 días, 3 horas, 29 minutos, 4 segundos
fase2	22 horas, 35 minutos, 12 segundos
duda al crear fichero	3 días, 1 horas, 45 minutos, 51 segundos
valor para los años	41 minutos, 58 segundos
Ejercicio 2	15 horas, 5 minutos, 54 segundos
Pasaporte	4 horas, 19 minutos, 54 segundos
DESBORDAMIENTO	6 horas, 51 minutos, 25 segundos
Listados	1 horas, 22 minutos, 59 segundos
YA ESTÁN COLGADOS LOS FICHEROS DE CARGA DEL APARTADO 3	1 día, 19 horas, 30 minutos, 13 segundos
duda ficheros binarios	4 horas, 14 minutos, 50 segundos
Problema CARGA de FICHEROS del apartado 3	10 horas, 5 minutos,
fase 4	1 día, 21 horas, 20 minutos, 38 segundos
Nota sobre la 4ª entrega	37 minutos, 11 segundos
Total	**22 horas, 7 minutos, 46 segundos**

Fig. 13. Table visualization of the average time response to a topic in a forum

8. Conclusion

We have developed a new module that improves dramatically the analysis capabilities of student´s interactions that the Moodle forum module provides. It offers a friendly user interface that is fully integrated into the Moodle LMS. The functionality of this application has been developed following Moodle standards, so it is easy to enlarge it. Furthermore, it was developed in two languages, English and Spanish, but other languages can be easily incorporated.

The new module produces a very complete analysis from three complementary perspectives: the course as a whole where students are individually identified, a detailed analysis of each individual student, and a global analysis of forums. The visualizations have been carefully selected to offer the user a predefined graphical representation, but she may change the representation flexibly.

First, it is possible to identify in a selected forum who are the students that most participated, just by looking at a colored table that makes it easy to distinguish among them. Alternative visual representations of the same data, such as bar or pie charts, make it

possible to clearly identify students who work hard from those who do not. The analysis can be enriched by identifying only-lurkers' students, or by displaying a rank, ranging from 'harder workers' to 'lesser workers'.

Second, individual student analysis is also possible, in order to obtain more accurate information about the number and style of individual contributions. For each user, accumulated data can be obtained about her contributions to different forums identified by topic. In addition, the user may read and evaluate those contributions in detail by going over the graphical information with the mouse pointer.

Third, a general overview of what happens in the forum system may be easily obtained. The average time response into forums allows watching, at a 'bird's eye view', what forums or topics are more lively. Other general visualizations (as well as individual) can be displayed to show the relationship between students that rather read more than contribute, or the rate of this relationship in each part of the forum system.

All in all, e-forum produces a very simple and complete analysis for teachers to follow up what happens in the forum system. Therefore, teachers can obtain measures to analyze and identify students' participation in web-based learning activities, and can obtain the necessary feedback to adopt measures that foster participation of students needing assistance, to encourage only-lurkers to collaborate, and to compare forums and topics to easily identify non-lively ones.

9. Acknowledgements

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Advanced Learning

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The education industry has obviously been influenced by the Internet revolution. Teaching and learning methods have changed significantly since the coming of the Web and it is very likely they will keep evolving many years to come thanks to it. A good example of this changing reality is the spectacular development of e-Learning. In a more particular way, the Web 2.0 has offered to the teaching industry a set of tools and practices that are modifying the learning systems and knowledge transmission methods. Teachers and students can use these tools in a variety of ways aimed to the general purpose of promoting collaborative work. The editor would like to thank the authors, who have committed so much effort to the publication of this work. She is sure that this volume will certainly be of great help for students, teachers and researchers. This was, at least, the main aim of the authors.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Raquel Hijon-Neira and Angel Velazquez-Iturbide (2009). Improving the Analysis of Students' Participation & Collaboration in Moodle Forums, Advanced Learning, Raquel Hijn-Neira (Ed.), ISBN: 978-953-307-010-0, InTech, Available from: http://www.intechopen.com/books/advanced-learning/improving-the-analysis-of-students-participation-amp-collaboration-in-moodle-forums

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