

FAT: A real-time (F)orum (A)ssessment (T)ool to assist tutors with discussion forums assessment

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ABSTRACT

Forums have secured a position of prominence in online courses. Interaction, collaboration and discussion are only a few examples of how forums can contribute to the students' learning process in online environments. However, due to their dynamic nature, active and vibrant discussions may consist of hundreds of posts making the assessment of students' participation and tutors' guidance difficult. To alleviate these problems and realize the full potential of asynchronous discussion forums, automated assessment tools and planning are required. In this paper, we introduce a novel Web-based Forum Assessment Tool, called FAT, for generating real-time analytics about students participation and interaction in online forums. Such information enables tutors to promote more precise pedagogical actions along the discussion and get most from the students and the forum. Moreover, as FAT provides tutors with several participation perspectives of the students (e.g. interactions, posting behavior, etc.), it facilitates the final assessment of each student. The tool presented is available online and generates analytics for discussion forums in the learning platform Moodle.

Categories and Subject Descriptors

K.3.2 [Computers and Education]: Computer and Information Science Education—*information systems education*

Keywords

Forum Assessment Tool, Real-Time Analytics, Student Assessment

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1. INTRODUCTION

Over the last decade discussion forums have played a key role in online educational environments. Their importance has been reflected by the large number of online courses that use them as a means for communication, interaction and collaboration. With the growth of Massively Open Online Courses (MOOCs), they are becoming one of the most common forms of interaction between learners and instructors. Arguably, forums help to cover important aspects of the teaching and learning process and also encourage social interactions between students and tutors.

Online environments differ from regular classrooms in several aspects. For instance, while students expect a prompt reply, the communication is asynchronous. Moreover, forums are not a one-to-one conversation (student-professor), but many-to-many [20]. Such facility has been the object of study in numerous research papers [15, 16, 8, 19]. The advantages of the asynchronous nature of discussion forums lend themselves to distance learning, and even face-to-face learning as more and more time pressure is exerted to student life. Modern students work part or even full-time and juggle family commitments. Hence, asynchronous tools allow students to plan their own schedule and participate in the discussions at their own pace. Furthermore, they can take time to reflect on what others have written before composing their own responses [7].

Forums allow interaction and exchange between students and tutors, working as a place to disseminate ideas and to trigger constructive learning – the creation of new ideas and knowledge, and importantly, remain as a verbatim record of the discussion that can be referred to subsequently [1, 5]. But online conversations can be difficult to get going if too few students participate. We agree that vibrant participation by most, or all, students is *sine qua non* for success of online discussion forums. To encourage such participation, institutions have moved from the optional extra approach of the early days [4], to one where forum participation is expected [11] and (often) contributes to the students' marks.

The effort required by instructors to monitor the flow of the conversation online, and properly assess each student's work becomes more and more apparent. An active and vibrant forum may have dozens or, especially likely with

MOOCs, hundreds of posts. Automated tools are required if the full learning potential of asynchronous discussion forums is to be realized.

In this paper we present a tool that provides real-time analytics for discussion forums in the learning platform Moodle¹. Briefly, the tool presents five different facets to visualize student participation: “Timeline”, “Graph”, “Profile”, “Posts” and “Topics”. The *timeline* facet shows the contributions posted by each student in different periods of the discussion. The *graph* visualization shows how each student interacted with each other and how important they are for a discussion. The *profile* view summarizes the participation of all students. The *posts* facet shows all contributions made by a specific user along with text analytics. Finally, the *topics* facet extracts semantic annotations from users’ posts and presents an overview of the discussion of each user through topics.

The rest of the paper is organized as follows. Section 2 reviews related work. Section 3 describes the tool and each of its facets with some relevant implementation details. Section 4 presents an empirical analysis of our tool. Finally, Section 5 concludes the paper and outlines future work.

2. RELATED WORK

Our paper concerns the assessment of students’ participation in forums, including a tool to assist tutors in the evaluation process. Therefore, this section presents related work examining the role of the tutor in guiding and assessing forum participation and tools with similar goals.

2.1 Role of the tutor

Initially, online forums were offered in addition to print-based correspondence courses, and were, alongside email and Web-based articles, considered optional “so as not to reduce access to students without internet or computer facilities” [4]. But the simple activation of this facility in online educational environments does not guarantee learning.

In a previous work [22] we have shown the important role of tutors in decreasing the number of dropouts in online courses. Briefly, tutors facilitate the learning process of the students by creating a friendly social environment, setting learning plans and goals and also allowing the transference, and creation, of knowledge between students [13]. Most of the off-line roles of the tutors can be replicated in online forums when they maintain continuous contact with the students and also are able to mediate the learning material and students’ opinions.

Wu and Hiltz [21] provide early evidence that instructors’ participation in forums is vital. They found that the asynchronous discussion afforded by forums did make the course more enjoyable and increase motivation, and that the amount of previous experience with distance learning courses did not appear to affect how enjoyable or motivating students found the online discussions on the observed courses. But the importance of the instructors’ involvement in setting topics for discussion, offering feedback and guiding discussion was highlighted by the students’ responses. Another evidence of instructor’s importance is presented by Clark [7]. He shows that depending on the way the forum is conducted and the strategy used to engage the students, the outcomes vary. However, the quality of the posts stays

the same.

An alternative approach is offered by Biesenbach-Lucas [6]. She describes the instructor taking a minimal role online: “Observer/evaluator, perhaps some participation” but following up online discussions with face-to-face discussions in class. This different approach, however is a result of different learning objectives, and demonstrates how forums can be used in different ways to achieve different pedagogical outcomes: Biesenbach-Lucas wanted her teacher training students to build their “positive interdependence, interaction, individual accountability, social skills, [and] self-evaluation.” With such a large number of strategies and methodologies to conduct educational forums, tutors must be able to rapidly adapt or even change the current methodology to fit the needs of a specific group of students. Indeed Biesenbach-Lucas describes how she adapted her input to meet the needs of different cohorts.

The structure of online discussion forums does not lend itself to easy interpretation by fellow students, or assessment, either in peer review or by instructors [2]. Kearns [12] for example, highlights the sheer volume of posts an individual might feel the need to read, and their distribution across many threads, groups and forums, and advocates the use of rubrics to fairly evaluate student participation in forums, with guidelines both for the quantity of posts, and some measure of their quality. For example, the quality of the initial post could be measured according to relevance, clarity and depth of understanding. Follow up posts graded according to frequency and supportiveness. Word count and timeliness might also be factors that affect grading.

Another interesting study conducted by Kol and Scholnik [14] attempts to determine assessment criteria in forums for language courses. Apart from the “reflection” and “interaction” criteria, they also argue that “reference” and “language” are important criteria when evaluating language learners. Our proposed tool incorporates three of the above criteria which facilitate forums assessment. Although the reference criterion is not explicitly available in our tool, we provide tutors with a visual presentation of the students’ participation in forums that assists them to read and correlate the contribution of the students with the content. All of which emphasize the importance of tutors monitoring and understanding the group interaction in their forums, planning their own interactions with the forum, and adapting guidance for individual students accordingly.

2.2 Assessment Tools

Hijon-Neira and Velazquez-Interbide [10] examine two tools that go towards providing the functionality required for assessing forum participation. Forum Plus (F+) and HSU Forums Enhancement² offer analytics on the messages level, informing tutors which posts were viewed and by whom. Due to the lack of information presented by these tools, the authors proposed a new module called *e-Forum* to generate a more precise analysis for teachers to follow up what happens in the forum and identify students’ participation to encourage those who read, but do not contribute, to collaborate. Although our tool provides more visualization modes to analyze student behavior throughout the course, the analysis of lurkers behavior may assist tutors in offering forum guidance.

¹<http://www.moodle.org/>

²<http://iss-tech.humboldt.edu/mellon/forum/>

Social Networks Adapting Pedagogical Practice (SNAPP)³ is a tool which was “developed to provide instructors with the capacity to visualize the evolution of participant relationships within discussions forums” [3]. SNAPP maps the relationships formed by students as they interact with each other on the forums. However, the participation metric it provides is limited to the number of posts submitted overlooking passive participation of the students. As we show further, our tool goes beyond what SNAPP offers and provides several facets for an in-depth analysis of the students participation.

A similar tool for the analysis of discussion forums in educational environments is presented by Pendergast [17]. His tool gets as an input forum data obtained from the LMS Angel Learning⁴ and presents to tutors the number of posts and replies along with the number of characters written and read by each student. Although our tool also has these characteristics, it differs from this tool in a number of new features introduced and a user-friendly interface. Moreover, there is no need for the user (tutor) to manipulate the data to get the analytics.

Saltz et al. [18] present iPET, a Web-based tool which aims to document students participation in forums, and has some of the functionality of FAT, including a Community View module and a Student Details module, which offer a graph view of student participation. However, FAT extends and improves some of the capabilities to manipulate the data, especially in the graph facet, to reveal hidden relationships. Moreover, unlike them, our tool is available to the open-source learning platform Moodle while their tool is provided only for commercial learning environments (such as Blackboard Learning System).

3. FAT: FORUM ASSESSMENT TOOL

The advantages of our tool are based in its ability to examine the discussion forums at various scales. Instructors can get a “bird’s-eye view” of the ebb and flow of participation in the forum, while noting each participants’ role in keeping the conversation going. At the same time, the tutor can examine the networks of relationships built up as students answer posts or initiate topics. By manipulating these graphs, instructors can make sure that the gregarious posts of particular individuals do not disguise the isolation of a less outgoing student. With the same tool, the participation of each student can be measured in terms of simple metrics, both in absolute numbers and a proportion of all the contributions to the forum. This section describes the main features of FAT divided into five facets named “Profile”, “Graph”, “Posts”, “Timeline” and “Topics”. The facets facilitate students’ assessment and assist tutors in the promotion of actions to enable a collaborative and fruitful environment as well as the exchanging of ideas and knowledge creation in discussion forums.

3.1 Profile

The “Profile” facet presents a short descriptive summary of a student participation in a specific discussion forum. As shown in Figure 1, the student profile is composed of the number of discussions started by him/her, the number of replies issued by him/her and some basic information about

³<http://www.snappvis.org/>

⁴<http://www.angellearning.com/>



Figure 1: Student profile: An overview of the participation of a particular student.

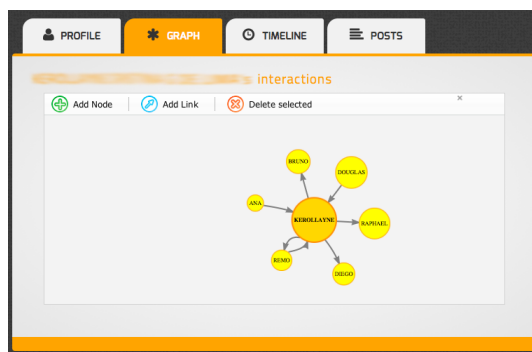


Figure 2: Graph: Interactions of a particular student.

whom he/she had interacted with (more detailed information is presented in the other facets).

Such information is valuable to assist tutors with the basic identification of student behaviors and engagement. For instance, the number of replies/discussions started may reveal how active the student is, or his/her tendency on start new discussions. With this information at hand, tutors can decide which is the best strategy to guide a specific forum. Tutors may use students’ behavior to create a more interactive environment and to induce (or enable) a collaboration between them.

Two common student behaviors are: students only reply to others (or reply only to tutors’ posts); or start a discussion but never come back to follow-up with the others. With the lack of tools to show the behavior of students in discussion forums and given the poor structure of online forums offered by virtual learning environments, tutors’ efforts are hampered to some extent because a manual inspection of the forum would be arduous and time-consuming. “The eternal scrolling encountered in monitoring and in assessing poorly planned exchanges convinces some to swear-off online discussions.” [2]. Moreover, the forum dynamics may vary throughout the duration of the course and, therefore, the information gathered by a tutor at any one point may become dated or useless.

3.2 Graph

A very informative feature provided by our tool is the “Graph” facet. This facet allows tutors to visualize the in-

interactions between students and to manipulate their view of the relationships, adding and removing nodes and links in the graph. A node represents a student or a tutor and a link represents the interactions between them. The graph that represents the interactions is directional, i.e., the links that connect two nodes have a direction associated with them. The directions of the links are determined according to the exchange of messages between the students (or student-tutor). An incoming link from a node indicates that someone replied to him/her whereas an outgoing link symbolizes that the current student replied to someone else (see Figure 2).

The manipulation of the data opens up new opportunities in the analysis of the student participation. Hiding and showing nodes can reveal graph patterns, for instance groups of students that share the same interests, or identify posting behaviors, etc. Depending on the graph topology of the resulting interactions between students, tutors will be able to visualize the impact of each student on the conversation. To illustrate this, imagine a graph in a star format, where many nodes (lets assume that they are only students) reply to only one node (lets assume in this example that this is the tutor). As a common topology, we can see the importance of the role played by the tutor: if we manipulate the graph and remove the tutor from it, all other nodes may be disconnected, i.e. isolated.

Unlike other assessment tools, our tool shows a graph representation focused in the individual. Hence, tutors can set individual learning goals and track the progress for each student in the discussion forum. Many other graph topologies are discussed in [9] and can be used as reference to the analysis of the data.

3.3 Posts

A simple but essential feature of our tool is the “Posts” facet. Again, due to the forum structure, tutors spend precious time scrolling up and down to check what is being discussed and by whom. So, in the post facet we aggregate all posts written by a given student (see Figure 3) allowing tutors to see all contributions at once.

Even though the posts are out of their original context, tutors were participating in the original forum and can easily link the posts and the original discussion. Moreover, with the information provided in the other facets, the tutor will be able to identify the impact of each post and also the overall impact of the student in the discussion.

The “Posts” facet also provides information about students’ posts, such as the readability score. We implemented the Flesch-Kincaid Reading Ease, Gunning Fog Index, Coleman-Liau Index and SMOG Index. These indices assist tutors in the assessment of students posts since the vocabulary used in the assessment can be taken into account. Such a feature is crucial in language courses, for example.

3.4 Timeline

Another important and a novel view is the “Timeline” facet. For each student, we create a timeline of his/her contributions against all others throughout the discussion.

The timeline assists tutors to see how contributions posted by a student drives the conversation. In many cases, students participate in the first moments or in the very end of the discussion and, hence, the contribution to the discussion is very low. The impact of the contribution is almost null,



Figure 3: Posts: Information about students posts.

since there is low collaboration and less students (if posted towards the end) will read the posts.

The important aspect of the timeline lies in the participation of the user in different moments. The students must participate, collaborate, interact, exchange, etc. Without all these steps there is little evidence that the student is participating beyond the minimum required for getting a grade. Figure 4 shows an example of the timeline, red represents the student in which we are interested to see his/her contributions.

3.5 Topics

An additional feature of our tool is provided by the “Topics” facet, where semantic annotations are used to summarize the most common topics mentioned by each student in their posts. The process to extract entities and topics from the text is based on DBpedia Spotlight⁵ and in our previous works [15, 16], respectively. DBpedia Spotlight is used to recognize, annotate and link entities contained in the students posts with external knowledge bases (such as DBpedia⁶).

For example, after the post “The history of Catholicism is displayed through religious artifacts...” is processed by DBpedia Spotlight, the entity “Catholicism” is extracted and linked to the Web resource <http://dbpedia.org/resource/Catholicism>. This resource contains structured information about catholicism and is connected to several other resources on the Web that allows us to extract related information (e.g. topics).

In this manner, the second part of the process is responsible for exploring related information about catholicism and retrieve broader terms that encompasses it. The process uses as a starting point the entities found in the students’ posts, and external knowledge bases that contains structured information about it. For example, in the case of the post mentioned above, we start from the entity “Catholicism” and navigate up through broader terms that generalize this entity. A possible broader term (or topic) for catholicism can be “Religion”. The whole process for the topic extraction is described in [16].

After all entities and topics are retrieved, the topics facet displays the entities and topics found for each student along with the number of occurrences of each term. This information is used to generate a topic cloud of the most frequent

⁵<http://dbpedia-spotlight.github.io/demo/>

⁶<http://dbpedia.org>

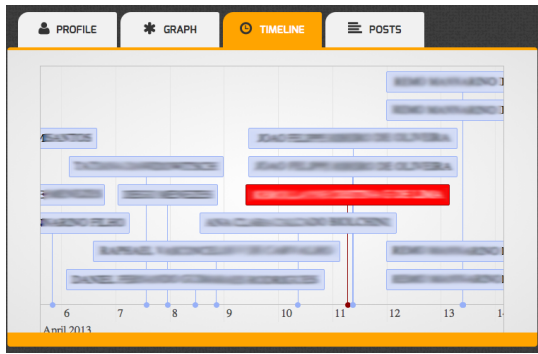


Figure 4: Timeline: Contributions of students over time.

terms in the discussion for each student. The topic cloud allows tutors to have an overview of entities and topics discussed by each student during the discussion. Although the posts contain the whole text (see Section 3.3) and are more precise, the entities and topics mentioned by each user can serve as a hint to what students were discussing in the forum.

3.6 Overview functions

In addition to the aforementioned facets, all of which are based on the activities of specific students, FAT reports present and overview the whole discussion forum. For this, FAT again provides a timeline view, but instead of showing the participation of a specific student in different periods of time, it displays activity across the whole discussion. The information presented in the timeline is grouped per day and shows the number of posts exchanged. Moreover, FAT also reports the average of interactions between the students, the popularity of posts and the average of posts per person along with a graphical representation of the variability of the students' participation.

4. EMPIRICAL ANALYSIS USING FAT

In this section we perform an empirical analysis of discussion forums using FAT as well as an overview of a few common use cases and behaviors of students and tutors during the discussions. For this empirical analysis, we took into consideration 163 real-world discussion forums in Moodle, where each of them contained at least 40 posts. In total, all forums exchanged 10,929 posts. The analysis was divided into three categories: "Posting behaviors", "Collaboration" and "Tutors".

4.1 Posting behaviors

A very common behavior witnessed in the analysed forums is when a single student dominates the forum with numerous posts. Even though the contributions provided by the student are relevant to the discussion, tutors may need to intervene in favor of the flow of the discussion. Most importantly, students must understand that a forum is a space dedicated to the exchange of ideas, discussion and brainstorm. That is, a many-to-many place where the opinion of each participant in the forum contributes to the creation of a collective knowledge. Note that tutor's intervention is not intended to stop individual opinions, but to incentivize students that did not contribute or posted less. This is a quite simple behavior to be captured by our tool, since the num-

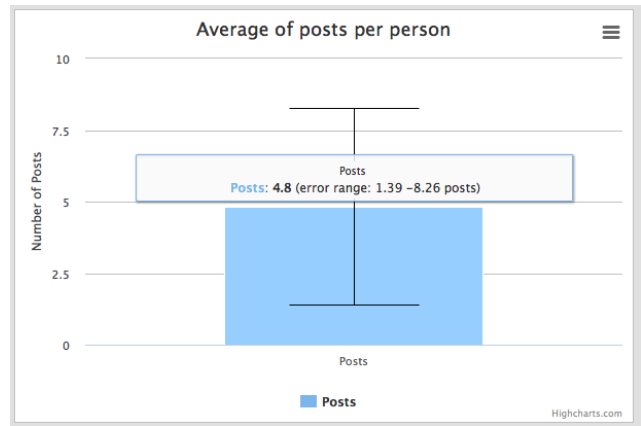


Figure 5: Average of posts per person and its dispersion. This example shows a forum where the number of posts per person varied considerably.

ber of posts and replies is specified for each user. Moreover, FAT provides charts that assist tutors to easily identify such behavior by showing the average of posts per participant and its dispersion (standard deviation). A small standard deviation indicates that the participation of the students were similar in number whereas a large deviation indicates that the number of contributions by student vary much from the average (see Figure 5).

Another typical behavior observed in the forums was that many discussions started very quickly and with a great synergy, but after a few days they lose momentum and the number of posts declines considerably. The loss of momentum of the discussion may indicate that the topic discussed was exhausted and the tutors must step in to re-kindle the discussion, to propose new directions or to conclude it. The timeline facet enables tutors to easily identify when the number of posts are dropping warning tutors that an action is needed in order to keep the discussion alive. Or, if the discussion is over, tutors may decide to close the thread and start a new discussion. The closure of a forum thread following the drop of number of posts allows a vivid discussion and avoids late posts by late students that do not contribute to the course of the discussion. Figure 6 shows five different posting behaviors found in the 163 forums analysed. 36% of the forums analysed follow the behaviors mentioned above, where 24% of the participation of the students increase in the very end of the discussion while 12% behaved in the opposite way, i.e. students' participation followed a decreasing curve.

Another scenario worth mentioning is related to the lack of participation of some students during forum discussions. Due to the dynamic nature of forums, tutors often do not perceive the absence of some students. FAT enables tutors to recognize students with low participation and, obviously, the ones who did not participate at all. In early stages of the discussion, tutors may take some actions such as contact students with low participation in particular to understand the reason of their absence and also to encourage them to give their opinion.

4.2 Collaboration

Collaboration is an important aspect of discussion forums.

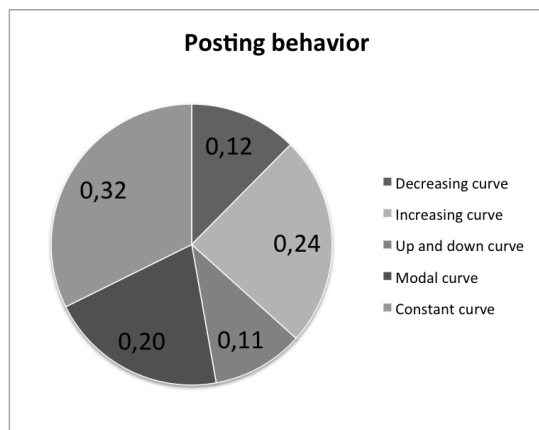


Figure 6: Posting behavior extracted from the 163 analysed forums.

Productive collaboration through forums can also build social links between students. Students who do not know each other initially can create new links with others by discovering that they share ideas or points of view in common. A possible advantage of forums in this respect is that relationships can be built upon shared thoughts and beliefs without being prejudiced by appearance or differing backgrounds. As instructors can monitor the links being built up between students, they have the opportunity to create topics that encourage discussion, even argument, provoking students to share their points of view. As a result, students get exposed to each other's points of view and may begin to understand alternative viewpoints.

During the pilot programme, FAT's graph facet has proved very useful to instructors analysing collaboration and interaction. For each student, it shows how they are interacting with each other, if they are only repliers, or if they never reply, stopping the conversation, and blocking collaboration (Figures 1 and 2 exemplify such behaviors).

It has also become apparent that while the collaboration can be encouraged by the instructor, the main actor is the student. Instructors must be aware that most of the students will try to answer and interact with them, but not to each other. In our analysis we found that tutors posts received more attention than posts posted by students. On average, tutors are replied by 24.9 students ($\sigma = 11.08$) while students are replied by only 1.23 ($\sigma = 2.17$). This happens more when forum participation contributes to student's final grade and so students are more interested in being visible than collaborating. When instructors observe such behaviors using the graph tool, they have the opportunity to bring other students into the conversation move the debate towards the many-to-many ideal of discussion forums.

4.3 Tutors

Commonly, forums in virtual learning environments start with a provoking question posted by the tutor. The preparation of such questions is key to the positive development of the discussion, since depending on the topic and discipline the forum must be used to counteract the opinions of the students. Successful provoking questions often split the class into several groups with different points of view. The result-

ing discussion enables the exchange of knowledge between groups, and the construction of new ideas. On the other hand, unsuccessful provoking questions create a place where everybody (dis)agrees and there is no discussion resulting in a forum with low interaction rates. In either case, the presence of tutors, informed by the FAT tool, can manage the discussion and highlight positive aspects in a constructive discussion, or offer another provoking question if the first attempt only caused conversation stopping disagreement.

Tutors also used the tool to monitor their own impact on group dynamics. Occasionally when tutors replied too promptly to students' queries, the forum was in danger of replicating a synchronous chatroom environment. In some forums we found that there was 1 tutor post for every 3 students posts (average of posts per tutor in all forums: 11.5 ($\sigma = 10.3$)), while there was 1 student post for every 40 posts in the forum (average of posts per student in all forums: 2.2 ($\sigma = 3.2$)). In such a question and answer mode, the instructor's position as an authority is reinforced and students try to follow the instructor's opinion. To enable the constructive outcomes of learning forums, tutors must not only participate, but also observe the participation of the students. It was evident that tutors must avoid directly answering students, but instead intervene in ways that makes students think. In the forums analysed is very common to see through the timeline facet that some tutors get into the habit of coming to the forum every few days to respond to between five and ten students' posts. There is evidence that such behavior is prejudicial to the progress of the forum, because tutors are supposed to be present and interfere when the discussion needs, and not to demonstrate their presence every three to four days by replying to all participants.

Strategies displayed by some tutors in the FAT tool trial included involving students in the discussion by connecting colleagues with the same or even different thoughts on the topic under discussion. By making connections and enabling the collaboration between students, the forum will be richer and constructed by the students contributions rather than simply the record of a student-tutor question and answer session. Successful forums also serve as a place for reference. After the discussions, tutors (or even students) can document the topics discussed emphasizing the different points of view of the students.

5. CONCLUSION AND FURTHER WORK

This paper introduced FAT, a novel Web-based Forum Assessment Tool, for generating real-time analytics of students participation in online discussion forums. FAT provides tutors with a range of features that facilitates students assessment and forums guidance. Moreover, an empirical analysis of discussion forums conducted with FAT revealed key aspects of students' behaviors, collaboration and tutors guidance that are often missed if a proper tool is not available. FAT is available at <http://research.ccead.puc-rio.br/fat>.

As future work, we plan to explore the possibilities of including an element of peer review, building a function wherein students might rate each other's posts against an instructor defined rubric, greatly decreasing (although not eliminating) the workload of the instructor. We would like to explore how this activity might be incentivised through gamification.

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