Quantifying and Evaluating Student Participation and Engagement in an Academic Facebook Group

Thanos Hatziapostolou[1(✉)], Jorgo Gellci[1], Dimitris Dranidis[1], and Marina Ntika[2]

[1] The University of Sheffield International Faculty, CITY College, 3 Leontos Sofou, 54624 Thessaloniki, Greece
{a.hatziapostolou,jogellci,dranidis}@city.academic.gr
[2] South-East European Research Centre (SEERC), 24 P. Koromila, 54622 Thessaloniki, Greece
mantika@seerc.org

Abstract. Asynchronous online discussions offer many advantages in an educational context such as building a class community, empowering students to express themselves, facilitating exploratory learning and contributing to the development of cognitive, critical thinking and writing skills. Whether integrated within a Learning Management System or as an external website, one of the most common platforms for hosting such asynchronous online discussions is a discussion board. Recent technological advancements, however, offer a wide number of alternative tools. Among them, the 'Groups' feature from Facebook, currently the largest online social network, has attracted a lot of attention by the academic community and ample research demonstrates the benefits of the specific tool for educational purposes. Comparing Facebook Groups with a discussion board in terms of support for the instructor to appraise student participation and engagement reveals a drawback for Facebook Groups. While discussion boards are supported by a number of learning analytics tools, no such academic support seems to exist for a Facebook Group. In this paper we introduce InGauge, a novel educational tool that enables instructors to gauge the level of student engagement and participation within an academic Facebook group. Founded on educational theories for evaluating online engagement, InGauge can collect and analyse all activities within the group and generate a number of learning analytics reports. The most important academic feature, however, is that InGauge offers support for customizing an assessment model in order to meet the student participation requirements of any type of Facebook group that is used for educational purposes.

Keywords: Facebook groups · Measuring engagement · Student participation

1 Introduction

Engagement in discussion is considered a fundamental aspect in the constructivism learning theory, through which students can generate knowledge and meaning based on interactions with other learners and the environment [1]. Having as main benefits the increased engagement with the learning content, as well as, the development of high-order thinking and divergent thinking [2], one can safely accept that active engagement in discussions may contribute to the learning process and can facilitate the overall

S. Zvacek et al. (Eds.): CSEDU 2015, CCIS 583, pp. 486–503, 2016.
DOI: 10.1007/978-3-319-29585-5_28

learning experience. Since opportunities for learners to engage in discussion within a classroom setting is limited due to logistical and psycho-sociological factors [3], the use of online asynchronous discussion boards has long been established as a common method in engaging students in discussion beyond classroom hours. Such tools, frequently integrated within Learning Management Systems, can be utilised as a support mechanism to face-to-face teaching or within an authentic online learning setting. Realizing the teachers' needs for evaluating participation in online discussions, as well as, the learners' needs for motivation in order to participate, a wide number of methods and tools are being used in order to measure participation and engagement both in terms of quantity and quality.

Despite the success of online discussion forums, recent advances in Web 2.0 technologies and social networks, and most importantly, their wide adoption by students, led teachers to seek contemporary and more attractive ways of engaging students in online discussions [4]. Facebook, and more precisely its "Closed Facebook Groups" feature, is becoming a common platform for hosting online discussions gradually replacing old forums and collaboration capabilities of Learning Management Systems [5]. In fact, research studies [6, 7] have shown that students prefer Facebook compared to other alternatives for hosting online discussions, mainly because of the comfort they feel when engaging with Facebook as a platform.

In this paper we introduce InGauge, a novel online application that addresses the issue of measuring student engagement in academic discussions hosted in a Facebook group. Grounded on educational theories of measuring participation in online discussions, the system enables instructors to effortlessly extract and summarise all contributions and activities of the group members and to evaluate the levels of engagement both in terms of quantity and quality. InGauge also empowers instructors to configure a custom contribution evaluation model according to their respective academic requirements for a Facebook group in order to suitably quantify and measure the engagement level of students. Last but not least, InGauge can provide insights on student engagement with specific learning content since a teacher can associate topics and issues to be discussed in the group to specific time periods.

The rest of the paper is organised as follows. In Sect. 2 we formulate a theoretical background in order to justify the rationale for the need of the InGauge system. The topics examined include the pedagogical values of asynchronous online discussions and the use of traditional discussion forums, the importance of measuring engagement in online discussions and finally the use of Facebook groups as a platform to host academic online discussions. In Sect. 3 we introduce InGauge. We start by elaborating on the pedagogy and motivation behind the system and continue to present a high level description of the components and offered functionality. Section 4 discusses the current state of the system and suggests possible uses to instructors. Finally, the last section concludes and presents future work.

2 Background Issues

Constructivism is one of the most cited and appealing theories related to education in the recent years [1]. According to the constructivism theory, students are seen as active

learners that create meaning and construct knowledge through active engagement with the conceptual content using strategies such as talking in complement to listening, writing in complement to reading, interaction, problem solving and similar active learning approaches [8]. The classroom setting, according to constructivism, is considered a knowledge building community rather than a group of isolated students that listen to the input of the lecturer [1] and classroom discussion, being the most fundamental 'active' learning approach, is considered to be a crucial aspect of the learning process [9]. The role of internal and interactive dialogue in knowledge construction was explored by [2] and emphasised the importance of what is called the 'conversational model of learning'. Among the most important benefits are increased engagement in the learning task, elevated levels of motivation, development of high-order learning skills and divergent thinking [2]. Nevertheless, actively participating in classroom discussions and interacting with the instructor and peers can be challenging for a student. While there exist many logistical or psycho-sociological factors that negatively affect active participation in the classroom [3], two have been identified as the most important ones to students. The first factor is lack of participation opportunity [10]. It is easily understood that in classes with a large number of students participation naturally decreases, considering that giving each student the opportunity to participate would cause time management issues [11]. The second factor is fear of peer disapproval [12]. Students may fear that peers will silently disapprove and resent their monopolization of classroom discussion, or that they may appear unintelligent to others, in case of mistakes. Because, however, of the importance of participation in discussions in the learning process, technological solutions have been developed to enable learners to interact and discuss even in an asynchronous mode.

2.1 Asynchronous Online Discussions and Their Advantages

Asynchronous online discussion environments, frequently called discussion boards or forums, have been used by academics for many years. Such environments are often integrated within online Learning Management Systems such as Blackboard and Moodle. Many universities have integrated asynchronous online discussions in their course curriculum realizing the benefits that they offer to students for active engagement with peers and instructors.

One of the main advantages offered by asynchronous online discussions is that they provide an equal opportunity for all students to engage in conversational activities. They allow students that need time in order to participate to have the same possibilities with other classmates [9]. They also create better possibilities for introvert or shy students to be an active part of the discussion [1], as well as, for non-native students who may be reluctant to participate in classroom discussions mainly due to linguistic problems [13]. Online discussion boards are a popular medium for these types of students to overcome their limitations, and at the same time, improve their communication and writing skills [14]. A second important advantage of asynchronous online discussions is that they provide participants more time to reflect on their thoughts before they formalise their contribution [15]. More time to reflect means that a student has the opportunity to examine a topic in more depth compared to a synchronous environment which demands

the continuous input of the participants [14, 16]. Due to the elimination of time constraints the learning process is significantly enhanced [17] since students are cognitively engaged by actively constructing knowledge through reflective explorations of ideas, conclusion drawing, and synthesizing these conclusions in the form of contribution to the discussion. Finally, a third very significant advantage of online asynchronous discussions is flexibility. They make the class accessible twenty-four hours a day, seven days a week, and allow students to engage and participate at their own pace. This flexibility in engaging with the course content and peers is greatly appreciated by learners and is used extensively for presenting their ideas as well as critically evaluate those of others [18].

Due to the aforementioned advantages, instructors are extensively integrating asynchronous online discussions as a supplement to face-to-face discussions of a conventional classroom setting [19]. Regarding the online platforms, however, that host such asynchronous online discussions, a shift is observed due to the recent advancements of web 2.0 technologies. While online discussion forums are still offered within Learning Management Systems, many universities are increasing their flexibility by promoting new possibilities of discussion outside the classroom through social media [14]. In other words, there seems to be an unequivocal upward trend into shifting online discussions to social networking platforms, primarily because of the fact that such social platforms are widely used by students.

2.2 Facebook Group: A Platform for Hosting Asynchronous Online Discussions

Social networking sites have become a common part of everyday life and this effect is more common on young adults and students [20]. The most popular online social network nowadays is Facebook [21]. Considering official data distributed by Facebook itself, there are 1.49 billion monthly active users on the site and more than 968 million daily active users as of June 2015 [22]. Moreover, an increasing usage of Facebook from mobile devices is being recorded, with more than 1.25 billion active daily users accessing from their mobile devices [22]. Especially the young adult age group seems to devote a considerable amount of time to social networking through Facebook, a fact that has altered the way of communication and social interaction [23] and has also affected campus life [24]. Realizing the huge popularity of Facebook and the fact that the vast majority of students do spend a lot of time on it, researchers and educators attempt to take advantage of this reality and continuously seek ways to exploit Facebook for learning and teaching purposes. After all, a platform where students continuously show high levels of engagement is believed to have the potential to promote active learning and collaboration between students [25] and may provide opportunities for forming communities for educational purposes [26]. In the context of asynchronous online discussions, the "Facebook Group" is the feature which has the potential for substituting the traditional online discussion forums built inside common Learning Management Systems, such as Blackboard or Moodle [5, 25].

Facebook groups as an instrument to accommodate asynchronous online discussions for academic purposes in order to supplement traditional face-to-face teaching has been explored by a number of research studies such as [27–30] with very positive outcomes.

In a case study [6] investigating the usage of the Blackboard discussion board compared to a Facebook Page used for academic purposes determined that Facebook proved to be the preferred discussion medium for the majority of students. In a similar study [31], a nearly 400 % higher usage rates were observed on the Facebook Group, compared to WebCT discussion board. The success of Facebook groups over traditional forums integrated inside LMSs is mainly related to the comfort and convenience that students feel when using a platform which they very frequently use in their everyday life [32, 33]. As stated in [4], by "meeting students at their place", the likelihood that they will be more motivated to engage with other peers and course content is increased. Overall, students seem to favor the use of a Facebook group for academic purposes [27, 30] and recognise it as a valuable medium for hosting online discussions [33, 34]. They perceive it as a dynamic learning environment that properly supports collaborative learning processes but also as a stimulator for participation [29] that can greatly increase the engagement level of student activities [28].

In the aforementioned research studies, the Facebook groups were created and administered by instructors primarily to supplement traditional face-to-face teaching. However, there are also examples of students themselves creating Facebook groups in order to have asynchronous online discussions with classmates in a pure e-learning setting such as in Massive Open Online Courses [35]. Whether as a supplement to traditional face-to-face teaching or used solely in an e-learning setting, Facebook groups has the potential to increase the participation and engagement of students compared with traditional discussion forums.

2.3 Measuring Engagement in Asynchronous Online Discussions

In order to actively participate in an online discussion, students need to be motivated to do so [7]. Unarguably, within an academic setting, an apparent form of motivation is to formally assess the volume and quality of interaction in online discussions as a component of a unit's final mark. Extensive research actually suggests that a successful online discussion is directly related with its assessment [36–38]. In order to be able to assess students' online participation, it is necessary to identify, measure and evaluate each individual contribution of each learner in the discussion forum. Moreover, this evaluation is essential also as a form of feedback to students regarding their performance in the group collaboration [2].

A successful evaluation of students' engagement in online discussions should take under consideration both the quantity and quality of contributions, since a large number of posts does not necessarily signify high levels of critical thinking or cognitive engagement. Regarding qualitative analysis of online discussion messages, a number of frameworks and methods have been developed such as the Moderators Assessment Matrix [39] or Gricean cooperative principle theory [40] and even data mining techniques. Nevertheless, the overall complexity and the time required by an instructor, to measure the levels of cognitive engagement by looking for specific patterns according to a set of theories, may inhibit the wide adoption of such qualitative appraisal techniques. On the other hand, only using quantitative evaluation methods may yield misleading results in terms of student engagement. Research has shown that students tend to learn quickly to

play 'the game of assessment' where they post only to get the marks, but their postings are superficial and lack in quality and critical thinking [41, 37]. In order to overcome this problem, [37] acknowledge the reaction of other students to a posting as a direct quality indicator, and as one of the most important forms of qualitative evaluation. Contributions that stimulate a lot of interaction and responses by other students rank higher in quality compared to contributions that fail to engage other students [37] and, therefore, generated interaction can be considered as a form of automatic peer review. Furthermore, [42, 43] suggest that both the individual, as well as, the group overall should be evaluated. According to them, collaboration is a complicated activity that requires both individual and group effort. Therefore, in order to achieve successful cooperative learning, both the group and the individual must be assessed. A simple, frequently used scheme is having group members assessing contributions of their peers, who take then an average individual grade [37]. Assessing based on the number of responses or interaction generated can be thought as an automatic way of receiving peer review from group peers.

Learning Management Systems which incorporate online discussion forums usually offer tools for measuring students' engagement in online discussions. Blackboard, a proprietary LMS, offers a performance dashboard through which an instructor can view discussion board statistics and accordingly grade the student engagement and performance. Moodle, an open source LMS, offers similar functionality with the Participation-Forum plugin but also provides advanced insights in student engagement through plugins like BushGrapher and Snapp 1.5 which can visually represent discussion forum activity and relationships. Nevertheless, as discussed in Sect. 2.2, the Facebook groups feature is gaining momentum as the platform to host asynchronous online discussions for educational settings. A thorough research that has been carried out revealed no educational tool that addresses the issue of measuring student participation in a Facebook group. There exists only one system which is called Grytics [44] that was launched in spring 2015. While Grytics provides a wide number of analytics for Facebook groups, it is mostly targeted towards companies and does not offer parameterization for academic purposes. Lastly, it requires payment and the free-of-charge plan only analyses the last fifty posts within a Facebook group. Therefore, to the best of our knowledge, the InGauge system presented in this paper is the first free educational tool that offers the ability to evaluate student participation and engagement for online asynchronous discussions which are hosted in a Facebook group.

3 InGauge: An Engagement Analytics Tool for Academic Facebook Groups

InGauge is a pioneering web-based application that addresses the issue of measuring student engagement within an academic Facebook group. Grounded on educational theories regarding measuring engagement in online discussion forums, InGauge (main dashboard depicted in Fig. 1) offers instructors a number of ways not only to realise and appropriately evaluate student and group participation, but also the means to identify learning content that may require attention.

Fig. 1. InGauge main dashboard.

The following sections discuss the pedagogy and motivation behind the InGauge system, provide a high level description of the offered academic parameterization and present the learning analytics that can be generated. We also briefly discuss development and performance issues.

3.1 Motivation and Pedagogy

A number of research studies [36–38] have revealed that successful online discussions are directly related with the assessment of a course and that many learners need an incentive to participate in class discussions [9]. However, several other studies [18, 19] support the opposite and have concluded that although students are largely in favor of online discussions, they prefer the contribution to be voluntary. Whether assessed or not, research studies [13, 45] have shown that participation in online asynchronous discussions is a good predictor of students' achievements and final marks, and a correlation between participation in online discussions and students' grades has been identified. For example, one study [46] determined that students with high marks were more actively engaged in the unit's discussion forum. Furthermore, another study [47] concluded that students that had a higher degree of participation in online discussions submitted more complete assignments compared with students who had a lower level of interaction. It can thus be concluded that the ability to measure participation and

engagement in online group discussions can assist instructors in estimating student performance.

As already mentioned, while the Facebook groups feature is capturing a lot of attention by academics as a platform to host asynchronous online discussions between learners, an extensive research that was conducted revealed that there is no educational system that provides any kind of analytics for student participation in the group. After realizing this opportunity, we determined that academia uses Facebook groups for online discussions in numerous intermixable ways and with different supporting pedagogies. One approach is to use a Facebook group to supplement traditional face-to-face teaching. A Facebook group can also function in a pure online learning setting as the only means for students to collaborate and communicate. Another variation is that a Facebook group can be instructor initiated and administered whereas other groups are initiated and maintained solely by students. Finally, participation in group discussions may be either mandatory and assessed or voluntary and not assessed. All these alternative approaches of using a Facebook group for academic purposes had to be taken under consideration in order to provide a system that is flexible enough to cover the various needs of instructors, as well as, modular enough to adapt to the students' needs.

3.2 High Level Description of Ingauge Core

InGauge enables instructors to extract and summarise all students' activities within an academic Facebook group. An instructor must be the administrator of the specific Facebook group in order to have access to this data and all other functionalities offered by InGauge. After logging in with a Facebook account, InGauge can automatically detect all groups for which the logged on user acts as an admin, and, through a panel, offers the opportunity to select which group(s) will be analysed.

Within a Facebook group, the primary activities of the group's members that can currently be extracted and summarised include making a post, making a comment and 'liking' a post or a comment. By collecting and summarizing these activities, a member's participation in the group can be effectively measured since, higher frequency of such activities, suggest higher participation. A final activity that one can notice within a Facebook group is the 'seen' feature. The specific feature indicates which group members have seen a post or a comment. Seeing a post or a comment can still be considered as participation in a group even if it is passive (just viewing). The first version of InGauge, which was released in March 2015, used the specific feature as part of the algorithm that distinguishes the type of student participation and it was indeed very valuable. Unfortunately, the latest version of the Facebook API (v2.4 introduced in July 2015) deprecated the functionality of extracting the group members who have seen a post or a comment. As a result, we had to update our system and algorithms to only use the three aforementioned interactions namely making a post, making a comment and 'liking' a post or a comment. However, measuring this type of interactions within a group solely represents the quantity of the activities and cannot indicate anything about the quality of the contributions. As research suggests [48], one of the main indicators of the quality of a post is the interaction that it receives from other peers in the group. Within a Facebook group this interaction can be measured by extracting the comments

and 'likes' that a post receives. This measurement, although quantitative in nature, evaluates the quality of a post in regards to participation. In summary, InGauge uses five variables overall, to measure student participation: posts, comments and 'likes' that a student contributes to the group, and finally, comments and 'likes' that a student's contribution receives from peers in the group.

However, merely extracting and summing the aforementioned five types of activities in order to estimate student participation is not sufficient, even if both the quantity and quality dimensions are addressed. The reason is that, in this manner, all five types of activities are considered equivalent, which is clearly not the case. For example, a post or a comment should not have the same contribution value as a 'like' since posts and comments can be considered as active actions whereas a 'like' can be characterised as a passive one. In a similar frame of thinking, a student post that receives interaction (comments) from twenty peers may be indicated to have higher quality compared to a post that does not initiate interaction. When comparing comments and posts, it is evident that the difference in quality between the two is relative and cannot be easily evaluated. However, a post can be considered as the initial action for contributing to the group discussion, whereas a comment as reaction or response.

From all the above, a need rises for differentiating the value of each type of contribution. InGauge addresses this issue by incorporating a component called Contribution Evaluation Model. The specific evaluation model, depicted in Fig. 2 above, allows an instructor to configure the individual weight for making a post, making a comment and 'liking' a post or a comment. Regarding the quality aspect of a group member's contribution (comments and likes that a post receives), an instructor does not have to directly set any weights. InGague uses the weights entered in the contribution evaluation model in a similar manner by giving emphasis on active rather than passive participation. More specifically, the weight of receiving a comment in a post is formulated by adding the weights set for making a new post and making a comment. Receiving has the same value (weight) as clicking like on a post. By combining the extracted number of activities with the weights set in the Contribution Evaluation Model, InGauge calculates a score that represents student participation by taking into account both qualitative and quantitative aspects.

Up until this point we have tackled the issue of measuring student participation within an academic Facebook group. Measuring engagement is far more complicated, and requires additional factors to be taken under consideration. As research suggests [48], in addition to points collected from participation, the frequency of active contributions is an important factor that is required in order to evaluate the level of engagement in comparison with peers and the group overall. For example, a student that has scored 100 points in participation in a period of one week, but then has no contribution in the following two weeks, cannot be considered to have the same engagement as a student who has scored a total of 100 points uniformly distributed within the duration of the three weeks. Another factor that we suggest should be taken under consideration and is implemented as an optional setting within the contribution evaluation model in InGauge is the expected participation performance for a specific period of time (Fig. 3 above). This setting enables an instructor to establish a margin between satisfactory and unsatisfactory performance for a group member in terms active participation (making posts

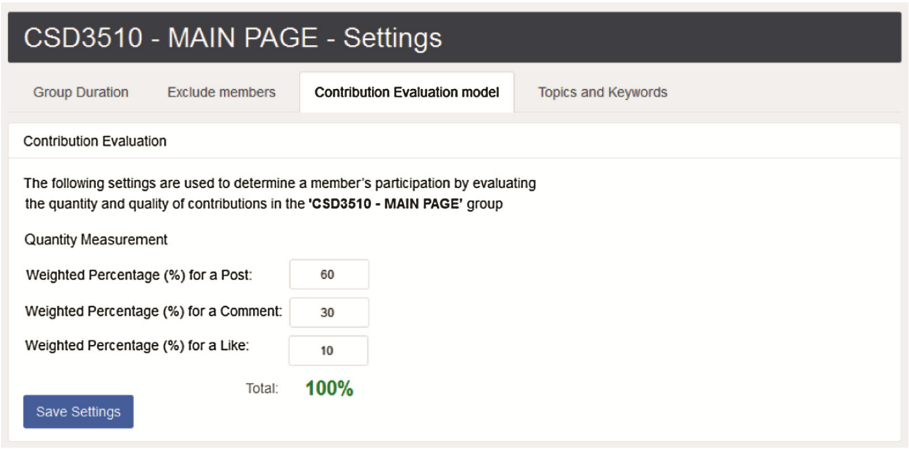

Fig. 2. Contribution evaluation model.

and comments). The pie chart within Fig. 1 is a learning analytic directly related with the specific setting as it allows the instructor to distinguish students who are passive (just 'liking' posts), students who are active but have not yet met the expected minimum performance and students who are highly active and are contributing much more than was expected.

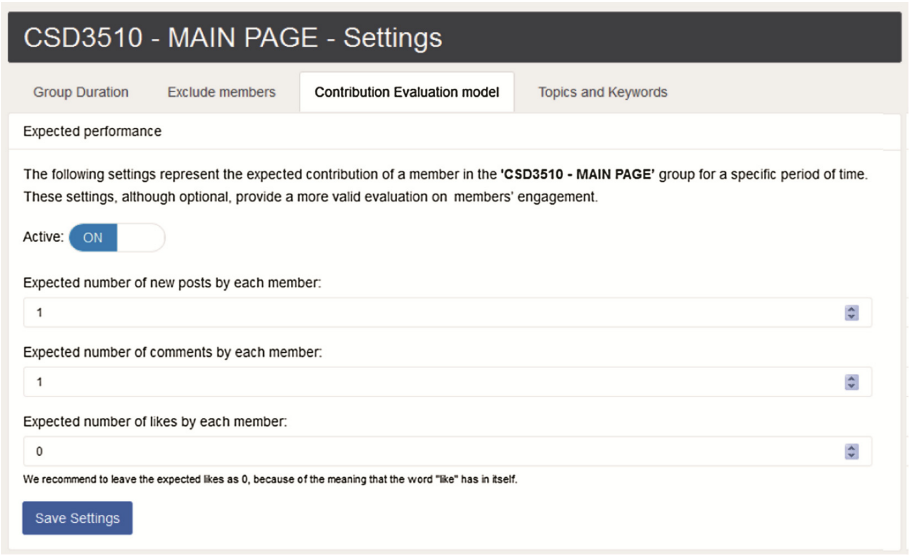

Fig. 3. Expected performance settings in InGauge.

The details of the student engagement calculation algorithm are quite complex and due to space limitations, the interested reader may refer to [49]. In summary, the algorithm that we developed takes under consideration the following parameters:

- The overall points obtained from active participation (quantity of contributions);
- The overall points obtained from receiving comments/likes and the number of unique engaged participants (quality of contributions);
- The overall points obtained by all other peers in the group for a selected time period of interest;
- The expected number of posts and comments per time unit set by the instructor;
- The time passed since the last post or comment of the student.

We strongly believe that InGauge not only is novel in addressing the issue of measuring student participation and engagement within an academic Facebook group, but does so in ways that are firmly grounded in educational theories regarding online discussions. In addition, since our goal was that InGauge will be used solely for educational purposes, we incorporated a number of settings that are mostly applicable in an academic environment. These settings include:

- The instructor can choose to exclude certain group members from the analytics. Since the participation of the members of the group affects the overall engagement of the group, there may be cases where certain members have to be excluded in order to have more valid analytics. Examples of such members include the instructor(s) and teaching assistants.
- The instructor can set the dates for the duration of the Facebook group (e.g. an academic semester) but also set dates for smaller academic periods (e.g. weekly lectures) for which analytics will be produced. For example, if a course is delivered on a Thursday, the instructor can set the weekly period from Thursday until next Wednesday as opposed to the default week setting of Monday to Sunday found in other systems.
- The instructor can provide keywords and tags for the weekly periods. These keywords can represent the topics that are being discussed in class during specific weeks. The instructor can then determine for which topics the students were more or less active in terms of participation in the group.

In summary, the settings that InGauge offers enable an instructor to set a custom assessment model that will evaluate student participation in the Facebook group but also provide features to parameterise the administration and monitoring of the group overall and the generated results in order to meet most requirements of the delivery of any academic course.

3.3 InGauge Learning Analytics

Learning analytics is defined in the current research as an emerging field [50] that employs different methods and techniques, such as machine learning, artificial intelligence, information retrieval, and data mining [50, 51] to improve learning and instruction mainly by revealing analytics about online student engagement to instructors

[52, 53] and/or learners [53]. There exist different types of learning analytics with different levels of importance. A recent study [54] explains that learning analytics software can benefit users at three different levels. The first is the most basic level. The data provided are related to access frequency, time spent in a course, and the number and nature of instructional interactions such as assessments (e.g. tests or exercises), content (e.g. articles, videos) and collaborative activities (e.g. discussions or blog posts). The second level is about providing more detailed data. These data are interpretations of students' instructional activities. For example, identifying at-risk students and warn the instructor about those students who haven't seen the exam material yet. These interpretations can also benefit from linking the instructional activities with students' data, such as gender, age, and major, to provide insights about learning patterns of cohorts of students. The third level analytics software can provide predictive data to predict students' behavior and learning patterns by linking the learning system database with the educational institution's information system and perform different methods and techniques to develop student outcomes alert systems and intervention strategies [4].

The learning analytics that InGauge provides are situated in levels one and two. It is easily understood that third level analytics are very difficult to be provided since Facebook is an external proprietary platform and cannot be easily integrated with an educational institution's information system or learning management system. In addition, even for level one and level two analytics there exist certain limitations due to the restrictions imposed by the Facebook API. For example, access frequency and time spent in a Facebook group cannot be determined and grouping analytics by gender or age may be inaccurate since they depend on the profile settings of each group member. The learning analytics offered by InGauge can be classified in two categories: overall analytics for the Facebook group and analytics for the individual members of the group. The overall analytics (Fig. 1) for the Facebook group include:

- The total number and percentage of posts, comments and likes
- The daily average number of posts, comments and likes
- A bar-chart distribution of posts, comments and likes
- A pie chart that distinguishes passive, active and highly active members
- Percentage of posts commented, liked and both commented and liked
- The average engagement score
- The average number of unique commenters

The first four analytics are related with the quantity of student participation whereas the last three are related with the quality. The analytics for the individual members of the group include:

- The total number of posts, comments and likes
- The average post quality
- The average unique commenters, comments per post, likes per post
- The total engagement score

As it can be seen in Fig. 4, the group members analytics are displayed in tabular format and can be easily sorted by any of the above scores in either ascending or descending manner in order to allow instructors to determine the most and least active

students. It is also worth to note that the above analytics, as well as, the ones for the group overall, can be generated for custom periods of time (e.g. a specific academic week, or for the duration of the group).

10 records per page Search:

Name	Total Score	Posts	Comments	Likes	Average post quality	Avg. Uniq. Commenters	Avg. Comms. per Post	Avg. Likes per Post
Alexandra Cristina Pătrașcu	5.20	2	5	25	1.00	0.00	0.00	2.00
Alireth Shadowsing	1.50	1	2	3	2.00	0.00	0.00	4.00
Beren	8.00	5	8	26	1.70	0.00	0.00	3.40
Dragos Andriciuc	7.00	0	14	28	0.00	0.00	0.00	0.00
Edi Hoxhalli	4.60	2	7	13	0.25	0.00	0.00	0.50
Ilya Dobrodeev	0.00	0	0	0	0.00	0.00	0.00	0.00
Kosmas Theodoulidis	1.50	0	5	0	0.00	0.00	0.00	0.00
Lumbardh Idrizi	2.30	1	4	5	11.25	5.00	6.00	9.00
Maria Gaci	4.20	4	0	18	6.36	1.75	3.25	4.50
Marina Anmls	0.00	0	0	0	0.00	0.00	0.00	0.00

Showing 1 to 10 of 21 entries ‹ 1 2 3 ›

Fig. 4. Group members analytics.

3.4 Development and Performance Issues

InGauge is built in the Ruby language using the Rails framework. Authentication is performed using the OAuth open standard which requests permission from Facebook in order to be able to access a set of data from a user profile. The Facebook Application Programming Interface (API), which enables third party applications to communicate and interface with Facebook features, is used to query the activities of a Facebook group and extract all posts, comments, likes etc. InGauge's interface with the Facebook API is not direct but for simplicity purposes it is implemented using the Koala library [55]. Koala is a Ruby wrapper for the Facebook API, and plays a great role in simplifying the HTTP requests to Facebook. After extracting raw data from Facebook, all calculations are performed on the client-side using Javascript. This decision was taken for performance reasons as Javascript is faster than Ruby [56]. Having in mind the high level of complexity of the calculations, we performed a number of tests and we determined that Javascript allowed for considerable difference in performance. The two main Javascript front-end libraries that we utilise are JQuery and Twitter Flight. Regarding storage requirements, the MySQL database is used to store the preferences and settings that an instructor sets for a specific Facebook group in order to analyse the group's level of engagement. It is worth to note at this point that all calculations for determining the participation score and the engagement level are performed on demand and results are not stored in the database. The reason is that since students can interact with group posts

from any point of time, participation is dynamic and can change at any point of time. Finally, user interface components are implemented using Bootstrap, Twitter's front-end open source framework.

4 Discussion

InGauge was designed and developed at the authors' institution and it is currently fully-functional and in closed beta release. Our plan is to have an open beta version ready by December 2015 and make it available to the general public for beta testing purposes in order to determine whether design changes are required. We strongly believe in the potential of InGauge as an educational tool and therefore, we will promote it to high school and higher education instructors who use Facebook groups for academic purposes, as well as, instructors who lead Massive Open Online Courses. The most apparent value of InGauge is that it can easily automate the process of evaluating student engagement in online discussions in the case that participation in the Facebook group is assessed. In general, when participation in a Facebook group needs to be evaluated, the ability to configure a custom assessment model through the Contribution Evaluation Model described in Sect. 3.2 can be proven very valuable for instructors in meeting the requirements of the use of the Facebook group or the needs of the specific groups of students. For instance, a Facebook group within a New Product Development unit that is used to host a brainstorming session for a class project should give more emphasis on new posts as opposed to a group that hosts an idea screening session which should emphasise on comments. Whether participation is assessed or not, InGauge can be proven an extremely valuable academic tool for instructors who use Facebook groups. The measurements that InGauge provides in combination with the offered configurations can help instructors to identify problematic situations not only for participation in the Facebook group but also for the taught material and the course overall. For instance:

- It can provide insights on student engagement for specific topics since instructors can match subject matters with specific periods of time. For example, if a Facebook group is used to supplement face-to-face teaching, a Computer Science instructor may realise that the engagement of the group was much higher for the weeks that recursion was covered compared to the two weeks that dealt with computational complexity.
- It can also easily pinpoint to an instructor at any point of time students who demonstrate low or no participation or students who demonstrate passive behaviour by merely 'liking' posts and comments. An instructor can then approach these students to determine if they require any form of academic attention.

We certainly do not imply that simply by using InGauge, student engagement within a Facebook group will increase. Nor do we imply that Facebook groups are better than traditional online discussion forums. As research studies [57, 58] indicate, simply creating the environment for the discussion, by providing the technology and even a main question to be discussed, is not enough to ensure the success of an online asynchronous discussion. Among a wide number of factors that can influence student

participation, instructor intervention [9], peer-pressure [59] and ego motivation [60] have been identified as the most important ones. InGauge can effectively assist instructors in facilitating student online discussions within a Facebook group by providing measurements on participation and engagement.

5 Conclusions and Future Work

This paper introduces InGauge, an innovative web-based application that measures student participation and engagement in an academic Facebook group. Currently, to the best of our knowledge, no similar educational tool exists. Based on established educational theories, the system allows for customization and configuration of a number of parameters that enables instructors to differentiate the quantity and quality of student interactions in the group. It also empowers instructors with the ability to monitor the behaviour of individual students and the whole group over time, thus facilitating identification of possible problematic areas.

While the system is currently in beta release, we are already planning a number of enhancements, such as offering the functionality of comparing engagement levels in different groups and providing graphical representation of interactions between students in the group. However, we are also very keen in determining ways of strengthening student participation. Currently, we are addressing the issue of ego motivation and peer-pressure in order to further motivate students to participate in an academic Facebook group. We have created a gamified approach and we are in the process of integrating virtual achievements (badges) that will be automatically awarded to students and posted in the Facebook group upon reaching specific engagement levels. In addition, we are working on parameterizing InGauge in order to provide access to students and enable them to view their detailed performance in terms of participation and engagement compared anonymously with peers and the group. The above features will further enhance the value of InGauge as an educational tool, addressing student engagement for educational Facebook groups in addition to its engagement analysis capabilities.

References

1. Li, Q.: Knowledge building community: keys for using online forums. TechTrends **48**(4), 24–29 (2000)
2. Thomas, M.J.W.: Learning within incoherent structures: the space of online discussion forums. J. Comput. Assist. Learn. **18**(3), 351–366 (2002)
3. Weaver, R.R., Qi, J.: Classroom organization and participation: College students' perceptions. J. High. Educ. **76**(5), 570–601 (2005)
4. Hurt, N.E., Moss, G.S., Bradley, C.L.: The "Facebook" effect: college students' perceptions of online discussions in the age of social networking. Int. J. Scolarship Teach. Learn. **6**(2), 1–24 (2012)
5. Pempek, T.A., Yermolayeva, Y.A., Calvert, S.L.: College students' social networking experiences on Facebook. J. Appl. Dev. Psychol. **30**(3), 227–238 (2009)
6. DiVall, M.V., Kirwin, J.L.: Using Facebook to facilitate course-related discussion between students and faculty members. Am. J. Pharm. Educ. **76**(2), 32 (2012)

7. Mokoena, S.: Engagement with and participation in online discussion forums. Turk. Online J. Educ. Technol. TOJET **12**(2), 97–105 (2013)
8. Jonassen, D., Davidson, M., Collins, M., Campbell, J., Haag, B.B.: Constructivism and computer-mediated communication in distance education. Am. J. Distance Educ. **9**(2), 7–26 (1995)
9. Andresen, M.A.: Asynchronous discussion forums: success factors, outcomes, assessments, and limitations. Educ. Technol. Soc. **12**(1), 249–257 (2009)
10. Johnson, M., Robson, D.: Clickers, student engagement and performance in an introductory economics course: a cautionary tale. Comput. High. Educ. Econ. Rev. **20**, 4–12 (2008)
11. Bonwell, C.C., Eison, J.A.: Active learning: creating excitement in the classroom. In: 1991 ASHE-ERIC Higher Education Reports ERIC (1991)
12. Howard, J.R., Henney, A.L.: Student participation and instructor gender in the mixed-age college classroom. J. Higher Educ. **69**(4), 384–405 (1998)
13. Webb, E., Jones, A., Barker, P., van Schaik, P.: Using e-learning dialogues in higher education. Innovations Edu. Teach. Int. **41**(1), 92–103 (2004)
14. Biesenbach-Lucas, S.: Asynchronous discussion groups in teacher training classes: perceptions of native and non-native students. J. Asynchronous Learn. Netw. **7**(3), 24–46 (2003)
15. Hammond, M.: A review of recent papers on online discussion in teaching and learning in higher education. J. Asynchronous Learn. Netw. **9**(3), 9–23 (2005)
16. Lamy, M.N., Goodfellow, R.: "Reflective conversation" in the virtual language classroom. J. Lang. Learn. Technol. **2**(2), 43–61 (1999)
17. Garrison, D.R., Anderson, T., Archer, W.: Critical thinking, cognitive presence, and computer conferencing in distance education. Am. J. Distance Educ. **15**(1), 7–23 (2001)
18. Arend, B.: Encouraging critical thinking in online threaded discussions. J. Educators Online **6**(1), 1–23 (2009)
19. Wu, D., Hiltz, S.R.: Predicting learning from asynchronous online discussions. J. Asynchronous Learn. Netw. **8**(2), 139–152 (2004)
20. Grosseck, G., Bran, R., Tiru, L.: Dear teacher, what should I write on my wall? A case study on academic uses of Facebook. Procedia Soc. Behav. Sci. **15**, 1425–1430 (2011)
21. Junco, R.: The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement. Comput. Educ. **58**(1), 162–171 (2012)
22. Facebook Newsroom, August 2015. http://newsroom.fb.com/company-info/
23. LaRue, E.M.: Using Facebook as course management software: a case study. Teach. Learn. Nurs. **7**(1), 17–22 (2012)
24. Jenness, S.E.: Rethinking Facebook: a tool to promote student engagement. J. Aust. N. Z. Student Serv. Assoc. **38**(1), 53–62 (2011)
25. Selwyn, N.: Faceworking: exploring students' education-related use of Facebook. Learn. Media Technol. **34**(2), 157–174 (2009)
26. Pollara, P., Zhu, J.: Social networking and education: using Facebook as an edusocial space. Soc. Inf. Technol. Teach. Educ. Int. Conf. **2011**, 3330–3338 (2011)
27. De Villiers, M.R.: Academic use of a group on Facebook: Initial findings and perceptions. In: Proceedings of Informing Science and IT Education Conference (2010)
28. Kent, M.: Changing the conversation: Facebook as a venue for online class discussion in higher education. J. Online Learn. Teach. **9**(4), 546–565 (2013)
29. Meishar-Tal, H., Kurtz, G., Pieterse, E.: Facebook groups as LMS: a case study. Int. Rev. Res. Open Distance Learn. **13**(4), 33–48 (2012)

30. Petrović, N., Petrović, D., Jeremić, V., Milenković, N., Ćirović, M.: Possible educational use of Facebook in higher environmental education. In: ICICTE 2012 Proceedings, pp. 355–362 (2012)
31. Schroeder, J., Greenbowe, T.J.: The chemistry of Facebook: using social networking to create an online community for the organic chemistry laboratory. Innovate J. Online Educ. **5**(4), 1–7 (2009)
32. Findings, K.: What are students doing with technology? Students Inf. Technol. ECAR Res. Study **6**, 55–72 (2010)
33. Fouser, R.J.: From CMS to SNS: exploring the use of Facebook in the social constructivist paradigm. In: 10th IEEE/IPSJ International Symposium on Applications and the Internet, pp. 221–224 (2010)
34. Ractham, P., Firpo, D.: Using social networking technology to enhance learning in higher education: a case study using Facebook. In: 44th Hawaii International Conference on System Sciences, pp. 1–10 (2011)
35. Poplar, D.: MOOC evolution and one poetry MOOC's hybrid approach, December 2014. http://www.educause.edu/ero/article/mooc-evolution-and-one-poetry-mooc%E2%80%99s-hybrid-approach
36. Jiang, M., Ting, E.: A study of factors influencing students' perceived learning in a web-based course environment. Interface **6**(4), 317–338 (2000)
37. Swan, K., Shen, J., Hiltz, S.R.: Assessment and collaboration in online learning. J. Asynchronous Learn. Netw. **10**, 45–62 (2006)
38. Swan, K.: Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. Distance Educ. **22**(2), 306–331 (2001)
39. Brace-Govan, J.: A method to track discussion forum activity: the moderators' assessment matrix. Internet High. Educ. **6**(4), 303–325 (2003)
40. Swan, K., Hall, M.: Evaluating online conversation in an asynchronous learning environment: an application of Grice's cooperative principle. J. Internet High. Educ. **10**, 3–14 (2007)
41. Oliver, M., Shaw, G.P.: Asynchronous discussion in support of medical education. J. Asynchronous Learn. Netw. **7**(1), 56–67 (2003)
42. Johnson, D.W., Johnson, R.T.: Computer-assisted cooperative learning. Educ. Technol. **26**(1), 12–18 (1986)
43. Johnson, D.W., Johnson, R.T.: Positive interdependence: key to effective cooperation. In: Hertz-Lazarowitz, R., Miller, N. (eds.) Interaction in Cooperative Groups: The Theoretical Anatomy of Group Learning, pp. 174–199. Cambridge University Press, Cambridge (1995)
44. Grytics – Analytics for Groups, July 2015. http://grytics.com
45. López, M., Luna, J., Romero, C., Ventura, S.: Classification via clustering for predicting final marks based on student participation in forums. In: Proceedings of the 5th International Conference on Educational Data Mining, pp. 148–151 (2012)
46. Davies, J., Graff, M.: Performance in e-learning: online participation and student grades, **36**(4), 657–663 (2005)
47. King, K.P.: Educators revitalize the classroom "bulletin board" a case study of the influence of online dialogue on face-to-face classes from an adult learning perspective. J. Res. Comput. Educ. **33**(4), 337–354 (2001)
48. Dringus, L.P., Ellis, T.: Using data mining as a strategy for assessing asynchronous discussion forums. Comput. Educ. **45**(1), 141–160 (2005)
49. Gellci, J., Hatziapostolou, T.: An algorithm for measuring engagement in Facebook groups. Technical report TR-10, The International Faculty of the University of Sheffield, CITY College (2014)

50. Ferguson, R.: Learning analytics: drivers, developments and challenges. Int. J. Technol. Enhanced Learn. **4**(5/6), 304–317 (2012)
51. Chatti, M.A.: A reference model for learning analytics. Int. J. Technol. Enhanced Learn. **4**(5/6), 318–331 (2012)
52. Dietz-Uhler, B., Hurn, J.E.: Using learning analytics to predict (and improve) student success: a faculty perspective. J. Interact. Online Learn. **12**(1), 17–26 (2013)
53. Mattingly, K.D.: Learning analytics as a tool for closing the assessment loop in higher education. Knowl. Manage. E-Learn. **4**(3), 236 (2012)
54. Picciano, A.G.: Big data and learning analytics in blended learning environments: benefits and concerns. Int. J. Artif. Intell. Interact. Multimedia **2**(7), 35–43 (2014)
55. Koala Gem website - GitHub arsduo/koala, October 2014. https://github.com/arsduo/koala
56. Fabiano P.S.: When to Ruby on Rails, when to Node.js, October 2014. https://fabianosoriani.wordpress.com/2011/09/11/when-to-ruby-on-rails-when-to-node-js/
57. Guldberg, K., Pilkington, R.: A community of practice approach to the development of non-traditional learners through networked learning. J. Comput. Assist. Learn. **22**(3), 159–171 (2006)
58. Mazzolini, M., Maddison, S.: Sage, guide or ghost? The effect of instructor intervention on student participation in online discussion forums. Comput. Educ. **40**(3), 237–253 (2003)
59. Yang, X., Li, Y., Tan, C.-H., Teo, H.-H.: Students' participation intention in an online discussion forum: Why is computer-mediated interaction attractive? Inf. Manage. **44**(5), 456–466 (2007)
60. Dillon, C., Greene, B.: Learner differences in distance learning: finding differences that matter. In: Moore, M.G., Anderson, W.G. (eds.) Handbook of Distance Education, 239, p. Routledge, London (2003)