

Social Media Enhanced Studying and Learning in Higher Education

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Abstract—Social media services have recently become well known especially among young people [1]. In social networking sites a user can participate intensively in activities in the service. To support collaborative study at Tampere University of Technology (TUT) and also to provide social networking tools for students especially at the beginning their studies, the development TUT's own social network site was begun in spring 2008. To make the system popular among students, developers and researchers at the Department of Mathematics and Hypermedia Laboratory at TUT designed interventions for fall 2009 when the semester began and new students started their studies. The earlier research [2] revealed numerous motivating aspects that should be somehow included in a study oriented social networking site. This paper will describe the research results of interventions to motivate students to use a social networking site in the context of studies. The results will show that such an environment with social aspects connected to studying and study life on various levels is a means of enhancing studies and basically a necessary tool, especially for students in the early phase of their studies in a new university. The motivation should be further encouraged by the system itself when it relies on students' own voluntary activity. Moreover, the intensive actions of developers, researchers and administrators can be used as tools in directing network activity development.

Keywords; social media, social networking, study support, motivations, interventions, mathematics

I. BACKGROUNDS

Web 2.0 based social media services (e.g., *Facebook*¹, *LinkedIn*², *Last.fm*³, etc.) have recently become well known especially among young people. There is clearly something appealing in web-based social services [1]. In social networking sites a user can participate intensively in activities in the service, share contents, debate and share opinions and create different kinds of groups for different needs. Why use social networking sites in the study context? Kärkkäinen [3] observed that one of the crucial problems in (Finnish) university level studies is that the very early steps at the beginning of studies are the most difficult for many students. One reason for this is that only a few new students know any of their peers at the beginning of studies in their new university.

To support collaborative study at Tampere University of Technology (TUT) and also to provide social networking tools for students especially at the beginning their studies, the development TUT's own social network site was begun in spring 2008. The development project is still running and the site has been improved.

Social network sites are defined as web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system [1].

II. TUT CIRCLE

The social networking site *TUT Circle* is a web based environment for students offering customized tools for enhancing social aspects of student life at TUT. The primary target is to provide an efficient and compact system to help new students at TUT to create new social contacts with each other and with students already studying at TUT, e.g., peer tutors etc. The secondary target is to help students form studying groups and circles for their own needs considering their motivations, attitudes, learning methods and orientations [4]. Supporting studies is one part of the whole.

The passivity in the use of the first version of *TUT Circle*, which was mainly designed to be a tool for collaborative studying at TUT, and the results of the study regarding students' motivation for social media enhanced studying and learning led the developers and researchers to include the context of studying and especially first year mathematics studies at TUT as a different kind of widgets offered to users through specific interventions. The research on students' motivations to use social networking sites in the context of studying showed that systems of this type should not be too complex to use and that the added value for the student should be something unique. A networking site in the context of a student's own university could suffice to motivate students to use the system if it works properly and provides only the tools needed for basic interaction and social activity [5]. Developing a new *Facebook* was deemed totally worthless [2].

¹ <http://www.facebook.com/>

² <http://www.linkedin.com/>

³ <http://www.last.fm/>

TUT Circle uses an open source CMF (*Content Management Framework*) *Drupal*⁴ that provides basic tools for content management and editing. With specific modules the system can be tailored to various needs. Therefore building up a social networking site on CMF is not a problem in Drupal. Technically development focused on improving the dynamics of the network. In TUT-Circle there is a personal dashboard for every user. The dashboard collects all activity of the user and the user's neighborhood into one page in a systematically ordered way and in real time. Even the activity of users outside the user neighborhood is shown on the dashboard, which enables the user to widen his/her network [2].

TUT Circle is in general a social network site with separate features offering support for studying at TUT at crucial points during the semester. These features are brought into the system through well-planned interventions. The priority is to support new students' social networking process in real life at TUT. Student life at TUT includes a variety of aspects of everyday life. TUT Circle provides a channel for individuals and groups to join together and share the same interests etc.

To make it much clearer that TUT Circle is not primarily a learning environment at all, new students that started their studies at TUT in fall 2009 received information about the system already in summer 2009 before arriving at TUT. This way the new students could familiarize themselves with TUT in general and got to know each other beforehand. This was thought to facilitate the start of studies at university level [2].

As a social network site TUT Circle provides all the common tools for interaction between individual users. Every user has his/her own profile where a wide range of information about user him/her can be shared with others. Typical profile information is e.g., name, gender, date of birth, year of starting studies at TUT and degree program. A user can also add something about his/her hobbies, interests, skills and life in general (e.g., biography, place of birth and current place of residence) [2].

Among basic user actions like status updates and private messaging between users every user can request some other user to be his/her friend in TUT Circle. The friend requests must be accepted before the relationship is formed. Through these friend requests and by accepting others' requests a user's neighborhood in the environment widens and more options for social activity become available. For example, in a user dashboard friends' activity is shown with higher priority. Furthermore, the system can more precisely suggest other users of network as potential friends for a particular user. These suggestions are based on social network theories concerning friend's friends etc. Simple SNA (*Social Network Analysis*) [6, 7, 8] methods and algorithms are used to find potential users.

To enhance the dynamics of activity all content in TUT Circle can be tagged with keywords. These tags help users to find contents on particular topics dynamically without using complex searches etc. Tags also support social networking when users can easily list all users e.g., according to some specific interest or hobby. Tags describing geographical information such as place of residence and place of birth can be shown for all users or restricted to user's neighborhood using *Google Maps*⁵ based map widget [2].

Groups in TUT Circle provide more efficient tools for collaborative activity in the environment. Every user can create his/hers own group. The purpose of the group is not restricted and topic can be anything that is relevant. Every group has member management tools and the visibility of a group in TUT Circle can also be modified by a group administrator (the creator of the group). A group has tools to help collaborative activity and even group studying and learning in web environments. In a group members can chat, write news, manage events, write blog posts and edit wiki pages collaboratively. Sharing resources (e.g., files, images, etc.) is also an option [2].

The discussion board has a static structure that helps users to find the correct forum for their posts more easily than in discussion boards with user modifiable tree structure of discussion topics. Under every default topic users can initiate new discussions about subtopics related to the primary topic and these subtopic trees are user modified. The default topics consider many aspects of student life at TUT. One topic is discussion about first-year studies; another is student life in general. Topics related to leisure time and living in Tampere are also included, likewise a flea market where students can easily sell and buy items (e.g., course books, furniture, etc.) from each other [2].

The questions feature enables every user to ask a question anonymously. This feature was developed because according to the research students found it easier to ask even a stupid question out loud if it was possible to do so anonymously. Every user can answer these questions and the answers are given with a name. This gives active respondents social credit when they help others with their responses. It also gives visibility for a respondent when his/her answer to a question is shown on dashboards [2].

Furthermore, the questions feature is used to support studies in Basic Engineering Mathematics. Through an intervention special groups in the context of mathematics are brought into the system and users are directed to join them. In these groups users studying mathematics at TUT can ask questions about mathematics anonymously and an online tutor answers those questions. Clearly every user can also answer any question. This way lecturers teaching Basic Engineering Mathematics can recommend the TUT Circle for students as a system for supporting studies and truly rely on the fact that support really can be obtained [2].

Other features designed to support study are mainly special widgets available to users through interventions. These widgets are surveys etc. One example is a *Mathematics Horoscope* which through a 15-question survey tells the user how he/she is oriented to study mathematics, his/her mathematical skill level and how he/she could study mathematics at TUT to learn certain topics better. Students also get some tips on how to improve their study methods [9]. The analysis of the survey is based on a study conducted at TUT on students' skills, orientations and methods in learning mathematics [4].

III. MOTIVATIONS TO USE WEB COMMUNITIES IN STUDYING

According to McMillan and Chavis [10], there are a four features of sense of community; (1) feelings of membership

⁴ <http://drupal.org/>

⁵ <http://maps.google.com/>

(i.e., a member has a feeling of belonging to, and identifying with the group), (2) feelings of influence (i.e., a member has feelings of having influence on and being influenced by the community that emerge from enforcing and challenging norms within the group), (3) feelings of reinforcement of needs (i.e., a member feels support from others, has status in the group, and meets other people's needs while having his/her own needs met) and (4) feelings of shared emotional connection (i.e., members feel having a relationship and a shared connection with others due to frequent and high quality interaction) [10].

In the earlier research [2] it was noticed that the nature and purposes of a social networking site affect users' motivations to use the systems. Simple and easy might even be considered lame, but on the other hand an excessively complex service might overload users' capabilities in system usage [11]. Furthermore, it has been observed that in addition to exemplifying principles of usability and accessibility, the system should be visually fascinating and technically modern and workable (see Table I) [2]. The connection between the service and the context should be obvious, i.e. student life related activities and topics should be easy to bring into the service. "Using the service it's easy to find other students in the same phase of studies. This will help a student to take studies more personally, when the networking service gives a user a sense of belonging", one student earlier encapsulated the general mood in his answer. Another student claimed: "When users' first experiences of system usage were positive the information about the system started to spread to other students, for example, in coffee table discussions." After all, the quality of a social networking site depends on the quality of the community within it [2].

Students are not so interested in joining a networking service that lacks users to be connected with, but it was noticed during TUT Circle first version usage that an empty networking service does not gain any content. For example, according to Nielsen, [12] most users (90 %) are lurkers who just read messages and only 9 % produce contents once in a while. Only 1 % of users can be considered to produce contents constantly. Despite these limitations the sense of belonging to the student web community is deemed important: "For many youngsters starting their studies at university might be somewhat difficult, because older peers often start their studies somewhere else or stay in their home town. Especially if the high school and the university are in different towns it is inevitable that old friendships get weaker and new friendships are formed with other university students. Sometimes it is hard to get to know new friends out of the blue. It usually takes days, often weeks. Studying generally feels better, when one does not have to study alone... In the web it is easy and comfortable to meet new people and discuss with them. Starting a discussion and joining one is often easier in the web than face to face. In a social networking site in the context of university studies one can seek and find new and old students from a specific study program and get to know them already before actual start of studies as well as during the studies. This could be a convenient ice breaker for many students. Discussion face to face could be easier at the first meeting, when both could recognize one another."⁶

TABLE I. ASPECTS INCREASING AND DECREASING STUDENTS' MOTIVATION FOR STUDY ORIENTATED SOCIAL NETWORK SITE USAGE [2].

	Motivating	Non-motivating
Background and reputation of system	Voluntariness Free of charge Positive usage experiences General popularity Trendy Fashion craze	Narrow focus Bad or dubious reputation Unknown system Uninspiring
Basic idea and targets	Centralization of information Collaboration Social networking Improvement of communication Connecting studying and leisure	Nothing new Everything about anything in one place Similarity to other services available
Usage needs	Networking Social interaction Enriched user profile University related information sharing Study support Connecting users with similar interests etc.	Irrelevant features The system is not supported to be adjusted to individual user behavior Lack of interactivity
Functionalities	User-to-user relations Messaging Groups Discussions Resource sharing Managing events (incl. calendar) Collaborative content production	Complex widgets Irrelevant games
Content	Information about student life University related content General discussion board with clear structure and relevant topics (e.g., living, studying, jobs, buy or sell, ...) Study schedules	Lack of content Too much information Irrelevant or too specific discussion topics (e.g., discussion about one single course etc.) Spam messages
Usability	Easy to use Clear and simplified user interface	Too complex structure Content cannot be found easily Long chains of navigation
Layout	Eye-catching layout Trendy theme	Machine-like Lack of pictures and images
Technical sustainability and flexibility	Fast and stable system Fault tolerance Fully functional Open interfaces User agent independence	User feels like a test user Unstable system Parallel systems cannot be synchronized Lack of mobile version
Moderation	Continuous surveillance and development Bug fixing Responses to feedback Short service breaks (prior notice sent to users)	Slow and/or inaccessible administrator Lack of surveillance No control Long service breaks Feedback is ignored

⁶ A quote from a student's answer in the research data



Figure 1. TUT Circle profile page with RSS feed from *Audioscrobbler*⁷ (Last.fm) and *Twitter*^{TM8}.

IV. RESEARCH DATA AND DATA ANALYSIS

To make TUT Circle popular among students, developers and researchers at the Department of Mathematics and Hypermedia Laboratory at TUT designed interventions for fall 2009 when the semester began and new students started their studies. During summer 2009 the focus was on encouraging the activity of new students so that in fall the study supportive widgets would have been easily-obtained and used by students. Furthermore, the activity was monitored and the development of networks in TUT Circle studied using social network analysis methods and applications.

In autumn 2009 data was also collected from 38 hypermedia students regarded as early adopters. They were asked to sign up for TUT Circle and analyze aspects, functions, or features motivating users to use the service. In this evaluation students used a specific *WeSQu* tool and its User Motivation section. *WeSQu* is a web-based tool for evaluating web service quality, e.g., in terms of reliability, accessibility, visual design and community properties [13, 14, 15].

WeSQu's theory is based on research in HCI (human-computer interaction), psychology, and pedagogy as well as on evaluation research, which has its roots in the theory of usefulness of computer systems. The usefulness of web-based services includes usability and utility sections. The framework is needed to define the factors crucial to the implementation of web services for a varied group of users. The main issues within this evaluation framework are usability, added value as well as accessibility and informational quality of web services [16, 14, 17, 18].

Usability means that the user interface of a web-based application must be easy and effective to use so that the user can concentrate on the information content instead of the interface. When software is usable it is easy and efficient to

use, easy to remember, has few errors and it is subjectively pleasing [18]. The added value of web services can be evaluated as in conventional services. Is there something special or something new for users? An essential part of quality is also accessibility, because web design today is designed for individuals in various contexts with different devices [19, 20]. The fourth part of quality is the informational quality of any web service. To be of high quality the informational content of a web service should meet the five main criteria: accuracy, authority, objectivity, currency and coverage [21, 22, 23].

In addition the foregoing quality experiences of web services are also subjective and depend on the user's personality, expertise, needs and use situation and context [24, 25]. *WeSQu*'s User Motivation section concentrates on means of awarding the user for using the system, how different user groups are considered, how the system can be personalized and how easily service content can be followed. In addition, the students were asked to analyze the extent of evaluation.

The total amount of text data collected was 160 pages. The data was analyzed using theme analysis, which is suitable for research pursuing more profound knowledge about a phenomenon and having theory based data collected. In practice theme analysis is data slicing and rearrangement in different categories. The purpose is to find themes explaining the research problem, i.e. relevant topics are identified and separated from text data. A strict connection between data and theory is crucial in theme analysis [26].

V. RESULTS

In the evaluations the same topics from the earlier research (see Table I) were emphasized. In addition, the following was highlighted in students' answers:

- New features should be added into the networking service a bit by bit. It was considered that beginning system usage is easier if a platform is fairly simple at first. To maintain interest there was appreciation for new functionalities introduced in the platform, when the network was organized and properly formed.
- A networking site is a suitable tool for promoting different events for students. The option to add geographic information [27] into the Google Maps widget [2] was deemed very motivating: "...Profile section is fairly versatile and it is very easy to add information, e.g. a map with a tag representing one's own home or home town."⁹
- A profile level indicator was considered a good feature. It was also appreciated that a user can give only the personal information he/she wants to share: "Different kind of interests are also clearly visible if wanted. This helps to find similar or certain new friends and can also enhance the motivation to use the service when one can show what kind of music and movies he/she likes. It is also convenient that titles of songs listened in Last.fm (see Fig. 1) can be imported to TUT Circle."¹⁰
- It was motivating to follow friends' events, content and profile information.

⁷ <http://www.audioscrobbler.net/>
⁸ <http://twitter.com/>

⁹⁻¹⁰ A quote from a student's answer in the research data

- E-mail messages about new features and content feeds are increasing the participation in content producing in the social networking site. In addition, content feeds in a user dashboard were considered to be motivating: “The dashboard gives a great overview of all new content and activities.”¹¹
- A function to register like or dislike of content and features was desired, likewise listings of the most popular content, users, actions, etc.: “...The ‘like’ function gives a user an opportunity to give positive feedback on content produced by another user.”¹²
- RSS feeds were considered convenient functionalities: “A chance to export an RSS feed from a discussion board also motivates users, likewise the option to produce one’s own content.”¹³
- Some students emphasized the importance of anonymity in web community activity.

After all, TUT Circle was seen to increase a sense of belonging, because in the system it is “easy to discuss local issues and get to know the people at TUT”¹⁴. Wellman [28] refers to this phenomenon as “glocalization”; the ability of the Internet to both expand user’s social contacts and bind them more closely to the place where they live.

For basic usage monitoring in TUT Circle *Google Analytics*^{TM15} is also used. Using this data the network activity can be analyzed from the perspective of interventions executed. The results of this analysis support the results of motivation research. It is obvious that a social networking site in the context of studying requires constant steering when system usage is not mandatory at any level. Proper interventions can be seen as means to accomplish such network steering, but even successful interventions are not enough alone to maintain system usage at a satisfactory level.

As can be seen in Fig. 2 the usage level can be enhanced by interventions. Obviously, an intervention should be appropriate to users and to the system itself to be successful. It is fairly easy to implement successful interventions of any kind to increase activity in the system for a short period of time,

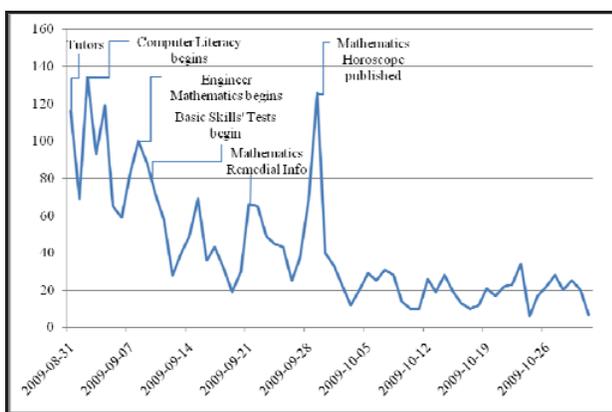


Figure 2. Daily visitors in TUT Circle. The most of the peaks can be explained by interventions executed.

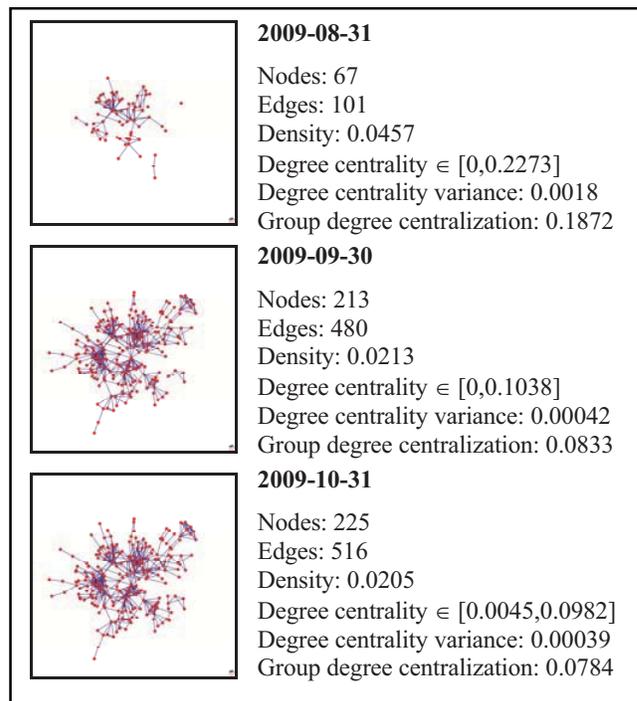


Figure 3. SNA graphs and figures of the evolution of a social network in TUT Circle. It can be seen that the most intensive network evolution occurred in September 2009. However, while the network gained more users its density was declined as well as its group degree centralization. This is explained by several network cliques. There is only few users interacting with many other users in the web based student community.

but successful interventions steering system usage to be more self-oriented are much more difficult to design and execute.

At the beginning of the semester the peer tutors gave the first information and true examples of TUT Circle usage as well as demonstrations on Computer Literacy and Engineer Mathematics courses. Due to this promotion most of the new users were registered in the system and actually more or less started to use the service. However, the sustainability of system usage level was rather sensitive to changes. For example, when new contents did not appear usage was slight. On the other hand, when a new intervention was executed, the usage level soared, for instance, with Mathematics Horoscope by over 150 percent compared to the average usage level of the preceding usage period. However, the interventions did not ensure long-term system usage.

In TUT Circle there is a tool that is used to collect log data in XML (*Extensible Markup Language*) format about different network actions. The data can be used for SNA that enables enriched network information production. Based on log data and together with SNA methods different visualizations can be produced. Visualizations can be used to support the analysis of social networks e.g. to detect changes and weak signals, to gain an overall view of the social network as a whole, and to concretize development of the network [29].

¹¹⁻¹⁴ A quote from a student’s answer in the research data
¹⁵ <http://www.google.com/analytics/>

TABLE II. PROPORTIONS OF MOST POPULAR PAGES OF ALL DAILY PAGE VIEWS IN TUT CIRCLE DURING THE MATHEMATICS HOROSCOPE INTERVENTION.

2009	User Dashboard	User List	Discussion Forum	Questions	Own Profile	Mathematics Horoscope	
						Survey	Results
09-28	11.2 %	4.3 %	4.6 %	2.1 %	3.7 %	0.0 %	0.0 %
09-29	13.6 %	3.8 %	2.7 %	1.8 %	2.2 %	4.9 %	4.2 %
09-30	16.5 %	3.4 %	3.1 %	3.1 %	2.8 %	5.0 %	5.0 %
10-01	19.5 %	3.5 %	2.0 %	3.5 %	2.5 %	5.0 %	4.0 %
10-02	14.8 %	3.8 %	3.3 %	1.1 %	1.6 %	1.1 %	0.5 %

SNA was used to analyze network evolution during the intervention process. Analysis was concentrated on friendships formed in TUT Circle. Basically, a friendship between two users is formed through a request-acceptance process. These connections are considered undirected. Moreover, connections are considered dichotomous so that no value was added to describe a connection as intense etc., because analyzed log data included only information about friend requests and accepted or ignored requests.

Through SNA analysis it was possible to create a time series of visualizations representing a network of active users in TUT Circle. The graphs were created using *Pajek*¹⁶ software and its *Kamada-Kawai graph layout algorithm*. Furthermore, detailed information about network was evaluated through SNA analysis using *Matlab*¹⁷ software.

In SNA graphs network actors are represented as nodes and connections between actors as edges. Characteristic network figures like density and group degree centralization give more detailed information about a network under study.

Network density simply describes how many connections (edges) there are in the network. It gets its maximum value 1 when every possible edge exists in the network. When there are no edges in the network the density is 0. Degree centrality is a proportion of an actor's existing connections of all connections which can be formed with other network actors and thus gets its maximum value 1 when a given actor is connected to every other actor and minimum 0 when the actor has no connections. Network degree centralization describes the rate of a single actor's effect on other actors' interactions on the general level of the network under study. This indicator is assigned a value from 0 to 1 and the higher the centralization index the more interactions there are in the network [6, 7, 8].

A closer view of Fig. 2 connected to SNA visualizations (see Fig. 3) shows that the interventions done did indeed accelerate TUT Circle usage but did not significantly increase the level of social networking in the system. Moreover, it can be seen that the effect of the interventions on general activity in terms of content production and interaction between users was not significant, even though users did return to the system due some certain intervention. In fact, SNA figures such as network density and group centralization indices show that new registered users behaved in the community like all the other users. The network did not become more connected when new

users were introduced into the system. Most of the users were connected with their friends, but the interventions did not significantly influence new friendship creation. Basically users only participated in activity related to the intervention and ignored other features offered by the system.

An example of this kind of behavior is an intervention considering the publication of a new feature in TUT Circle. Fig. 2 presents the frequency of daily visitors and the frequency of Mathematics Horoscopes, created daily. The Mathematics Horoscope is a questionnaire that profiles a user's mathematical competencies, study methods and targets with 15 questions. Clearly this new widget motivated users to return to the environment and use the new feature. An e-mail announcement on Tuesday 29th September 2009 activated the TUT Circle users instantly and the effect on system usage level was truly significant. But users were not active regarding anything else in the environment. This can be seen in Table II. Usage of any other function did not increase. Moreover, when the users had once created their Mathematics Horoscope this feature was simply forgotten.

VI. CONCLUSIONS

Crucial properties of web communities are functionalities supporting networking, community evolution and activity [1]. Services are offering various means supporting community members to connect each other and communicate, for example, private and public messaging, commenting, updating statuses, feeds of new contents, popularity listings and different user search options. A challenge for a new web community is still motivating to content provision and production. Although there is a need for a community, only a part of registered users really start to use the networking service. Creating friendships, friend lists and filling in one's own profile interest most users, but actual discussion is still at a low level. Is it actually enough for students to have this kind of tool only to get to know each other, or are there still some other expectations for network activity? In addition, in designing web community functionalities consensus between user privacy and showing interesting content should be found.

Different actors feel their identity in a web community in different ways. It is essential in interactions between individuals that enough personal information can be received so that identification is possible in the community. In contrast to face to face situations, where people are physically present, user identification in web communities is based on information profile information provided by the user him/herself. In profile information a user describes him/herself and on the basis of this information other users are able to identify the user and imagine what is he/she like. There are still some users preferring to act anonymously so that their physical identity is not revealed [1, 30].

Clearly interventions can be used to enhance network activity. A well-designed intervention can increase the usage level significantly, but the long-term effects to motivate students to use a social networking system in the context of studying requires obvious added values for users to be reached through the intervention process. This means that the intervention itself does not feed motivation, but it certainly can activate users.

¹⁶ Pajek is a Microsoft® Windows® based SNA software that is free for non-commercial use, <http://pajek.imfm.si/doku.php>

¹⁷ Matlab® is a high-level language and interactive environment that enables performing computationally intensive tasks, The MathWorks™ Inc., <http://www.mathworks.com/products/matlab/>

Connecting the activity in real life and the activity in the social networking site should be seen as adjacent. When something crucial and relevant happens in the real world, some aspects of it could also be processed in the web community. This is still an automated process in only few areas of student life and studying in general. Therefore, an intervention can be used as a steering method that directs students to take advantage of the opportunities provided by a social networking site.

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