

# Promoting Social Networks among Computer Science Students

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**Abstract.** The main scientific aim of this study was to investigate how Computer Science students regarded their social networks among study colleagues. The study was conducted at the Research Lab for Educational Technologies (University of Vienna) in order to find connecting factors for improving students' networks by means of curricular design as well as in single courses. Social Networks drawings and accompanying detailed descriptions provided by students were analyzed according to network analysis measures and set into relation with qualitative content analyses. Additionally qualitative interviews on how course instructors can foster social networks among students were conducted. Empirical results show that university courses provide good opportunities to build networks among students. As expected, students are more likely to experience a supporting network if they have more contacts as well as stronger ties to those colleagues. Furthermore, our results clearly indicate that virtual communication via e-mail or chat plays a significant role in maintaining contacts among study colleagues. Finally, there is reflected the influence of students' habits to communicate via new media upon their social networks as well as upon the didactical concept of university courses.

*Index Terms* – Social Network Analysis, Students' Communication, Computer Science Education,

## INTRODUCTION

Studying and learning are processes which an individual does not perform on his/her own. Learning always is embedded in a community [1]. Even if a person is collecting knowledge from a book, he/she is asynchronously communicating with the writer of the book who transfers his/her knowledge by means of the "medium" book.

Learning at university means for students first of all acquiring knowledge and competences, as well as becoming part of the scientific society. With respect to gaining knowledge in university context, learning is to be described as knowledge transfer from the scientist to the student. The

scientist as part of a community transfers his/her knowledge to students, which makes them a part of this community. But it is not only the scientific community students are involved into. They are a part of the community of learners, part of a social network of students, where knowledge is also acquired. As learning always takes place in a social setting [1-3], it takes place in relationships between people and environment. The course instructor "works to establish communities of practice in which conversation and participation can occur" [4].

Numerous studies indicate that stable social networks among students are a key factor for students' achievement in the course of the studies [5] [6] and prevent drop outs.

Furthermore, engineering is usually performed cooperatively, where, additional to technical skills, interpersonal competences play an essential role in getting a job done. Various studies have shown that employers think of communication and teamwork competences as being very important and regard them as desired competences of engineering graduates [7] [8]. Thus, the facilitation of interpersonal competence in order to build stable social networks can be seen as an important aspect in computer science education.

We use the social network analysis in our education of computer science students in order to get insight into the reality of social networks of our students, and to develop measures to promote these networks by means of curricula and teaching methodologies. Our study aimed at finding out how networks among students may be described and how they evolve. We analyzed the existing informal environments that facilitated the establishing and strengthening of these networks.

The paper is structured as follows: in the first part we describe the theoretical background of our work and the study design. In the second part the results of our studies are described and interpreted. In the third part the results are analysed with respect to the development of didactical concepts and methodologies of university courses, the role of the course instructor and E-learning platforms. At the end there are identified trends for future studies.

### THEORETICAL BACKGROUND

#### *Social Network Analysis*

A social network consists of a number of people and their relationships to each other. It is, in the simplest form, illustrated in terms of a map, where individuals are represented as nodes and their social relationships as ties.

Social network analysis is the mapping and measuring of these relationships and the flow between the people belonging to the network [9]. It aims:

- at describing patterns of relationships among individuals of the network
- at analyzing the structure of these patterns, and/or
- at discovering their effects on individuals [10].

Social network studies are conducted in various environments, for example in organizational or educational settings. Particularly in the educational setting, some studies have examined the influence of social networks on individual performance. Various results show for example, that an individual's centrality (the degree to which an individual of the network is connected to other actors of the social network) influences the learning performance, outcomes, satisfaction and gives superior access to information, knowledge and social support [11]. Many social network studies analyse computer-supported collaborative learning settings, where social networks built among students are much different from those of traditional learners in classrooms [12].

#### *Factors for Establishing Networks*

There is a wide variety of individual and psychological factors involved when a network is built.

According to social psychologist theories it is expected that a stable and supporting social network evolves if there are enough possibilities to meet and communicate, no matter if online or offline. According to the propinquity effect, people are more likely to form friendships with those whom they encounter frequently [13]. Thus, we asked the students to describe their communicative practices beside the description of relations within their network. It is furthermore expected that relationships are stronger and longer lasting if students additionally meet each other in other contexts than university-related ones.

With respect to the course design, the course atmosphere is an important precondition to get in touch with each other and to start building a network [14]. Especially when it comes to discussions or team work during classes, the course instructor may be the one to create a comfortable course atmosphere, where every student feels welcome to involve himself/herself into the group process. Research on the Person-Centered approach shows how the instructor can establish a positive atmosphere and climate of trust in a course by communicating the three attitudinal conditions realness, acceptance and empathic understanding [15].

In this context, the course instructor can moderate the group-process in team work: *"The moderator keeps a certain distance from the discussions and helps to give each participant an opportunity to express his/her views, and directs the whole process of group work to make it run smoothly."* [16]

Another learning and teaching method that may promote social networks is research-oriented learning [17]. In such a learning process, learners are guided to a situation in which they have to research in order to find answers to their explicitly formulated questions. The course instructor acts as facilitator and offers an environment in which students feel free to ask questions concerning the research object. The facilitator supports students with his/her professional competence in the process of finding answers to their questions, and encourages students to reflect their learning and research progress. Such a learning and teaching method implemented in a course offers the possibility for students to feel as part of the scientific community with access to professional knowledge and competence (offered by the facilitator). The facilitative role of the course instructor and the students' experience of being a researcher who finds answers to particular research questions promote a positive atmosphere where students' networks may evolve.

### RESEARCH QUESTIONS

Our studies addressed the following research questions:

- Do students have the impression they have a supporting network of study colleagues?
- How did these networks evolve?
- How can these networks be described?
- How can course instructors support the building of networks among students?

### STUDY 1- SOCIAL NETWORK ANALYSIS

#### *Study Design*

Our network analysis study included two parts:

First of all, we asked students to draw their current ego-centered social network of study colleagues with a PowerPoint template. Students could indicate strong and weak ties as well as the frequency of their social contacts in the network drawings. In an enclosed file they were asked to describe the contacts of their network (how they got to know the persons in their networks, how they would describe their relationships and its development, communication frequency and media used in the relationship).

Subsequently, we asked the students to fill out a short online questionnaire with open answering format including the following questions:

- Do you have the impression that you have a supporting network of study colleagues?
- How did this network evolve?

Generally the participation was on a voluntarily basis, but it counted as an active contribution to the course.

Sample and Study Context

20 out of 21 students drew and described their personal networks, 18 students answered the online questionnaire. The study was conducted in a course on "Project Management – Communication and Soft Skills" for Computer Science students at the Research Lab for Educational Technologies (University of Vienna) in the winter term 2006. The course is part of the Computer Science master programme which indicates that the participants had already received a bachelor degree in Computer Science. As this course was held as a technology-enhanced learning course, it included both presence phases in class and online elements. Cooperation among students was a central component of the course. The course was based on active, experiential learning and accompanied by an e-learning space for knowledge intensive inputs and materials. The course was chosen for the study since the students' reflection on their social networks in the form of drawing and writing also supported course learning goals.

Analysis

In a first step, social network analysis measures, such as number and diversity of relations and ties between nodes in the network, were performed for the 20 detailed network drawings. The qualitative data was analyzed by using the qualitative content analysis [18].

Results- Do students have the impression they have a supporting network of study colleagues?

Students wrote around 4001 words about their personal networks in the online questionnaire. We categorized students' personal impression of having a supportive network, as depicted in Figure 1. Most students (11, 61%) clearly indicated that they have such a network (e.g. "My Network was built during the studies and it was very helpful"). Two students (11%) wrote that their network existed only during some periods of their study (e.g. "my network of study colleagues from the bachelor study period unfortunately broke. Thanks God I got to know completely different people in the master study"). Four students (22%) had the impression that they did not have a supporting network. Here are some of the students' reflections: "Unfortunately, my friend wanted to finish his study after graduating with the bachelor degree because of occupational and private changes. I wanted to study the master programme and thus, our paths went separate ways. Now I am studying alone. "

"At the beginning of my study I did not know anybody. During the tutorial for students of the first semester I met and got to know other students. The tutors were very keen to support us in having a good start at university, which was a great help for me. After the tutorial the contact to the other students got less frequent. There was more or less contact to other students in courses, depending on the course type – seminars or lectures. I did not have a social network of

colleagues who could have supported me during my study. But I am sure that such a social network would have facilitated many things during study."

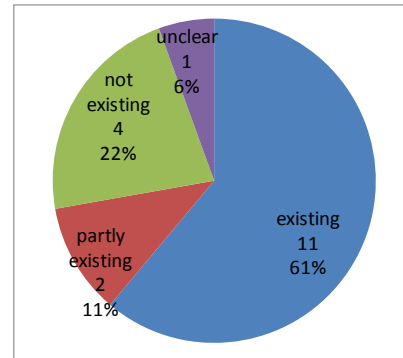


FIGURE 1: EXISTENCE OF A SUPPORTING NETWORK (N=18 STUDENTS)

Results- How did these networks evolve?

With respect to the starting points of networks, students listed several opportunities in which they could get to know their colleagues better who later built up their network (see Table 1 for details). Descriptions of 18 students about how they got to know their colleagues could be used for this analysis. Teamwork in courses is probably the most efficient way to get to know colleagues better, but there are many more possibilities for students to get in touch with each other.

TABLE 1: OPPORTUNITIES FOR GETTING TO KNOW STUDY COLLEAGUES

University related Opportunities	Nominated by # different students	# Contacts from all students
<b>Joint classes</b>		
Courses in general	10	39
Elective course combination (KFK)	11	28
Lab courses	7	18
Lectures	6	16
Teamwork in courses	4	7
Practicals (e.g. programming)	3	7
Specific Communication course	4	4
Working groups for solving lab exercises together	1	6
<b>Study colleagues</b>	8	12
<b>Tutorials for freshman students</b>	2	4
<b>Inscription</b>	2	2
<b>Exams</b>	1	3
<b>Course registration</b>	1	3
<b>Study term abroad</b>	1	3
<b>Self-initiated learning groups for exams</b>	1	2
<b>Further opportunities</b>		
<b>School colleagues</b>	8	10
<b>Through Friends</b>	4	7
<b>Work colleagues</b>	1	3
<b>Single nominations</b>		
<b>Same route to/from university, Kindergarten, in free time, as a tutor</b>		

*Results- How can these networks be described?*

Figure 2 shows a typical example of a personal network drawn by one of the study participants. In the centre of the network the circular “EGO”-node represents the student himself. All the other rectangular nodes represent study colleagues of the student. The thickness of the line linking different nodes stands for the intensity of the relationship. Students were asked to use three types of lines: Dashed lines mean a weak relationship, which is only study-related. On the other side, thick, solid lines indicate friendships with study colleagues (strong relations). Standard lines can be used for any intermediate relations.

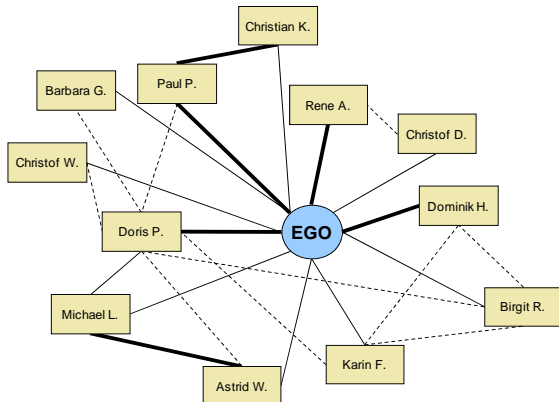


FIGURE 2: EXAMPLE OF A SOCIAL NETWORK DRAWN BY A STUDY PARTICIPANT

As summarized in Table 2, number and diversity of relations and ties among nodes of the network were extracted for the 20 detailed network drawings. On average students drew 12.45 relations to study colleagues in their networks, whereas about the same number of relations was marked as weak (4.53), intermediate (5.00) and strong (4.05). As expected, students who had the personal impression of having a supportive network drew more relations (14.18) than students who did not have a supporting network (9.25). A similar result could be found for ties among nodes. Students who had a supporting network drew more ties among nodes in their network (15.64) than students without a social network (1.50). Maybe students who don't think they have a supporting network on one hand generally know fewer colleagues and on the other hand they know colleagues who are less networked or less informed about relationships between their colleagues. Nevertheless, analyses of variance did not show significant differences in the number of relations between the groups of students who have a supporting network, who partially have one or who don't have any. This could also be due to the small sample size.

TABLE 2: NUMBER OF RELATIONS IN NETWORKS

	Experience of Supporting Network	N	Mean
# Relations with “EGO” node	Non existent	4	9.25
	Partially existing	2	8.00

	Existing	11	14.18
	Total number	20	12.45
-	# weak relations	20	4.53
-	# intermediate relations	20	5.00
-	# strong relations	20	4.05
# Other Relations in the network	Non existent	4	1.50
	Partially existing	2	8.00
	Existing	11	15.64
	Total number	20	11.20

As far as the students' way to communicate with each other is concerned, students wrote that they meet 98% of their network contacts face-to-face (45% meetings at the university, 28% private meetings outside university, 26% unspecified). They also write e-mails (55%) or call (50%) about half of the study colleagues in their personal network. Furthermore students chat with 32% of their network contacts.

STUDY 2- QUALITATIVE INTERVIEWS

During the winter term 2006, we also conducted a series of qualitative interviews within the framework of research on network building among students which lasted between 15 and 20 minutes. Those interviews were performed by two carefully instructed interviewers with the aid of an interview guideline. All the students' answers were simultaneously typed word-by-word on laptops. According to the interview guidelines, one of the questions was: “How can course instructors support the building of networks among students?”

Sample

The sample involved 20 students of the Computer Science curriculum at the University of Vienna. Both students in their last bachelor year and Master students were selected, comprising thus students who had already been studying between 7 and 20 semesters. Furthermore, the female/male ratio was kept about the same as in reality. Around 30% of all students studying Computer Science are women, so seven of the 20 interviewees were women, 13 were men, all aged between 21 and 35.

*Results- How can course instructors support the building of networks among students?*

Interestingly, many students of the sample thought course instructors could not promote the building of networks among study colleagues (25%) or were skeptical about it (30%). 45% of students thought it was possible. Regardless of this general appraisal depicted in Figure 3, all students came up with interesting ideas how instructors can foster contacts among study colleagues.

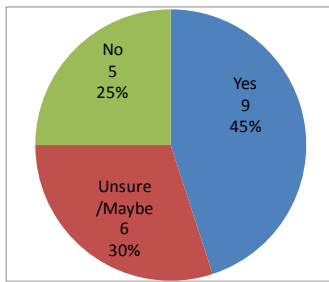


FIGURE 3: CAN COURSE INSTRUCTORS SUPPORT NETWORKS AMONG STUDENTS?

Assigning team tasks to students was one of the options mentioned by students. Students, for example, put it this way: “Team tasks stimulate students to communicate with each other. Such a task could be, for example, writing a term paper together” or “Teams of persons who do not know each other could be formed. But there is some risk that such team members could not get along with each other. Thus, there should be a possibility to change the team.”

Beside this obvious possibility, students also mentioned that instructors could:

- include socialization games in their classes,
- initiate the exchange of contact data like e-mail addresses,
- organize socializing events (e.g. “a get-together organized by the institute of the faculty at the end of the semester, after a course),
- or facilitate an open course atmosphere (e.g. “Instructors should facilitate an atmosphere in which individuals are respected and understood and where the sense of a respectful group develops. Nobody should have the feeling of becoming part of a “title-oriented production-machinery”).

Nevertheless students also explained that the possibilities offered by the instructor are limited because he/she cannot force students to meet privately or become acquainted with each other (e.g. „I think this is very difficult because each one decides which persons one wants to spend time with or not. It is not a challenge to facilitate the first contact among students or to exchange email addresses. But I am not sure if it is really possible that an instructor could cultivate intensive and regular contact across borders of a course”). Table 3 summarizes students’ nominations.

TABLE 3: HOW CAN COURSE INSTRUCTORS SUPPORT NETWORKS AMONG STUDENTS?

	# Nominations
<b>Yes</b>	9
Teamwork	7
Course atmosphere	4
Initiate exchange of contact data	3
Organizing socializing events	2
More intense teamwork	2
Socialization games	1
<b>Unsure/Maybe</b>	6
<b>No</b>	5
Depends on each one	4
Not by force	2

CONCLUSION

According to our studies, social networks among Computer Science students are either built in joint classes or have been built before, in school. Teamwork in lab courses and elective subject combinations are the most common ways for students to get to know each other better. Students who don’t think they have a supporting network generally know fewer colleagues. Furthermore they know colleagues who are less networked or are less informed about relationships between their colleagues. Students who had the personal impression of having a supportive network named more relations than students who did not have the experience of a supporting network.

Students, who do not have such a dense network like this, are related to students who experience the same. Network descriptions showed that there are a lot of individual and psychological factors involved when a network is built. These factors may not be influenced by course instructors or the design of the curriculum. What may be influenced is, according to the qualitative interviews that were conducted, the course atmosphere as precondition to get in touch with each other and to start building a network. Especially when it comes to discussions or team work during classes, the course instructor may be the one to create a comfortable course atmosphere, where every student feels welcome to involve himself/herself into the group process. Furthermore we researched students` habits of using private media for communication within the networks because social networks are always communication networks [19]. Our results clearly indicate that virtual communication is used to build networks among students. This leads to the conclusion that E-Learning platforms used in university courses can be used to promote these networks if space for informal communication among students is provided [20]. Forums as well as VoIP-tools or chats integrated in E-learning meet students’ habits of using private media. Taking this into account and implementing these ways of communication into the didactical concept of E-learning platforms on one hand and the didactical design of university courses on the other hand, social networks can be promoted by course instructors and universities. By identifying students’ communication habits and by considering them in learning context, the basis for successful learning is provided. This means that learning should always be attached to previous knowledge or experience [21]. Examples of learning communities that are built by means of E-learning platforms which meet communication habits of young students’ culture can be found in the field of private language learning (www.livemocha.com, www.babbel.com, www.myhappyplanet.com). In Europe, the COOPER-project [22] is developing a complex learning and collaboration platform for university students, lecturers and international university projects, partly integrating these technologies.

Building and evaluating a learning and communication platform to promote this thesis will be object of further studies.

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