Development of Virtual Teams and Learning Communities

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Students of an Internet based course in project management have during a 20 week period worked in teams of 4-6 persons. The course consisted of Swedish students living in Sweden or abroad making it impossible for many of the teams to have any face-to-face interaction. During the course the teams was assigned to a series of discussion questions and cases. The study is based on a survey of 287 students who have participated in the course, examining their experience of teamwork show that many of the classical team development issues also evolve in a virtual team. Furthermore, the study shows that students considered their team working efficient and that the possibility to communicate, discuss and share experiences was essential for their attitude regarding the development of a learning community.

Keywords Internet education; Teamwork; Team development; Virtual team; Learning community

1. Introduction

In recent years Internet has found its way into the class room and education at a university level. Research on the theme of on-line and internet teaching is growing and there is today a number of resources on the net dealing with education on the internet, books published and journals specialized in the area. The development of online courses is something that has developed over many years. Even though there are still many aspects on online teaching that needs to be developed. One possible approach to get a better understanding of the educational issues but also virtual teams in organizations is through investigating the experiences of virtual teams on online courses [1].

The purpose of this study is to study virtual teams. More precisely, to investigate if virtual teams develop over time and what variables may effect the creation of a strong learning community for collaboration and an efficient performance. The investigation is based on a large group of students divided into virtual teams of four to six people. Each team was assigned a number of cases and discussion exercises over a twenty week period. The results of this study have theoretical implications on how virtual teams develop as well as the understanding of what is important for creating communities and collaboration of virtual teams. Practical implications will be on successful virtual team development and most important, for educational purposes, on how online courses could be set up.

2. Development of virtual teams

While discussing teams it is vital to distinguish between different kinds of teams and their characteristics. Teams and groups are often seen as different labels of the same thing but sometimes teams are distinguished from groups by their cooperation, inter-dependency of tasks and responsibility for outcomes [2]. Hence, team is seen as one kind of a group but all groups are not teams as they do not perform or they lack cooperation skills to reach a specific goal.

In this paper virtual teams are of interest. Virtual teams are defined as geographically distributed groups where the team members communicate through electronic media to achieve a task [3]. Collaboration and the use of information communication techniques are thus essential for virtual teams and how they work and solve tasks.

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Following the reasoning above teams do not just appear out of the blue, they develop over time. There are several models or theories describing how this development occurs. Commonly they describe different phases the team develops through starting with a phase where the members of the team try to get to know each other while being polite to each other, this phase are sometimes referred to as the forming phase. When the members have learned to know each other they start to question the other members of the team and the storming phase begins. This phase is followed by the norming phase where the rules and the roles of the team and its members are set, followed by the performing phase where the team members can focus on the job and actually get the job done [4].

Virtual teams like other teams develop over time meaning that performance and efficiency for virtual teams would be likely to increase over time. The first hypothesis to test is:

H1: Performance of virtual teams develops positively over time.

Gersick [5] suggest a slightly different framework for the development of teams. She suggests that the timeframe for task is crucial for the performance of the team. Dividing the timeframe into five parts, the middle or the mid-point is critical. It is at this point the teams overlook their goals and strategies. If the team gets through this punctuated equilibrium they will perform similar to Tuckman's [4] performing phase [1].

Johnson *et. al*, [1] develops Tuckmans model into a loop of Forming, Norming, Performing and Conflict resolution. However, teams that do more than one task will get in to this cycle more than once. With this argument teams would perform better in the end of an on-line course than in the beginning or middle. The second hypothesis to test is thus:

H2: Performance of virtual teams develops over time and by the number of tasks.

As the virtual team develops aspects of what factors effect their development becomes of interest. Earlier studies on virtual teams point out a number of factors influencing the development of the team and how they work [3], [6]. This process is both dependent on socio-emotional processes on relationship building, cohesion and trust as well as task processes related to communication, coordination and the fit between task, technology in use and team structure [3].

The team development process is also a development of communities of practice (CoP). With a constructivist view virtual teams are able to learn by sharing experience, collaborating and solving unstructured problems. Development of CoPs, or team communities, would thus be essential for knowledge creation and understanding of new subjects. This leads to the third hypothesis:

H3: There are common factors for virtual teams' development of team community.

3. The course – Projects: Organizing, Leadership and Control

The course was a basic project management course given in Swedish over a 20 week period. Over the years the course attracted more and more attention seen in an increased number of applications. At the third year it was the most applied course at Umeå University (435 first hand applicants). The purpose of the course was to teach students and practitioners basic project management techniques, involving organizing, leadership and control methods, utilizing the benefits of Internet regarding time and space. The educational approach was new to the department so there was no prior information or experience within the organization to utilize. However, the support from the management support was very good. The Dean of the business school clearly stated that the new course had to be something different and not a two dimensional flat copy of a campus course. There were also some supporting functions available at the university.

The educational platform that was chosen[1] was similar to many platforms on the market. The platform was provided by the university containing functions such as library, lectures and different tools for communication. The communication area includes News, FAQ, Discussion forums, E-mail, Chat and last Direct massages. The platform allowed the course to be built around the interactions between students and teachers, involving different types of lectures, document handling systems and discussion forums. It was in this environment students were supposed to participate and solve several cases in teams as well as individually. Some of the students had met on a four hour kick-off activity, but many of them only met on the Internet, including all of those working abroad, i.e. students living in Quatar, Brazil, United States, Norway, Canada, South-Korea and Germany.

Besides the time and space independence benefits the Internet solution offered the possibility to have mostly external speakers, "anonymous" discussion forums, simulations and virtual on site visits. All of these features were used in order to widen the perspective on project management and organizing. In addition there was some literature requirements involved. The distinguishing features of the course are found in table 1.

The structure of the course is a set up on three levels. The highest level of participation contained all the students (about 130); "Course level", the second highest level "Group level" contained 30-40 students, while the lowest level were the "Team level" containing 4-6 students. Access was only assigned to a specific team and a specific group beside the overall the course access, limiting the areas of discussion.

Table 1: Distinguishing features

Discussions: The discussions were built upon an educational approach called "Storyline". The discussions were first conducted on team level for preparation and then summarized on group level where the discussion between the teams continued. Due to the large number of students each year (roughly 120 persons) no organized discussions were held on course level, the number of discussions ranged between 5-8 over the years.
Team cases: Over time the exact number of team cases differed between 3-5 cases. These tasks were solved on team level, involving 4-6 persons. The cases level of difficulty was intentionally increased as well as the time to come up with a solution decreased. Thus creating more pressure on the students, forcing commitment.
Individual case: One individual case was given during the courses as a possibility to evaluate the single student
Written exam: The exams were written by the students individually under a time period of approximately one week.
Lectures: The lectures ranged between 3-15 minutes. The lectures was broadcasted using streaming technique, this made unauthorized spread of the material somewhat more difficult. The lectures involved practitioners as well as academics from a wide range of business/organizations and schools, national as well as international.
Literature: 2 out of 3 books were in Swedish while the third was an English text book on project management.

4. Research methodology

The hypotheses proposed above are tested using data collected through an on-line survey to persons passing the on-line project management courses 2002, 2003 or 2004 at Umeå School of Business and Economics, Sweden. The choice of using an on-line survey was due to that the population is spread over the world. They are also used to work with on-line surveys as a part of evaluations of the course.

The mailing list of persons passing the course contained 287 persons to which invitations were sent. Of these e-mails 38 addresses bounced back, reducing the sample to 249 persons. After four reminders the number of respondents was 155 or equal of a response rate of 62 %.

The survey contained questions on how they have worked and communicated in the teams during the course. Data were also collected on how they perceived their work, in the beginning, in the middle and at the end of the course. Finally demographical data on age, sex, educational background and work experience was collected.

There are five sets of independent variables. The first set of independent variables is the importance of different media for learning. Questions were asked on a 4-point scale from not important to very impor-

[1] www.pingpong.se

tant. Items asked for were course literature, video clips (lectures), discussions with the team, the whole class and around cases. The second sets of independent variables are three questions regarding the group efficiency at three points, the beginning, mid-course and at the end of the course. These questions were asked on a 5-point scale from very inefficient to very efficient. The third set is a single question on how often a person logged on to the educational platform. The fourth set of variables asked questions on how often the persons used different types of communications. The different types were physical meetings, phone calls, e-mails, discussions forums, direct messages and last chat, asked on a 5-point scale from never to always. The last set deals with how the teams organize themselves in problem solving, cooperation, communication, experience utilization, decision making leadership and conflict resolution.

The dependent variable team community is an index describing how well a group is working together. This variable is a summarized score of four items and a combined degree of how the group experience a social community, have a willingness and promptness to respond, have a willingness to share knowledge and experience and how well they were closely united as a group. Together the four items have a Crombach-alpha of 0.879. A higher value on the team community variable indicates that the group has been more successful of working together as a virtual team.

5. Analysis

The results are discussed in two parts. The first part describes the general description of those answering the survey. The second parts analyses data of how small groups been working on an on-line course.

Looking at the data of those that have answer the survey a majority have an educational background from social science and business (54 %) or from natural science and engineering (34 %) and areas as education, humanities and medicine have all three together only (13 %). Combining groups of work experience tells that 86 % of those answering have a working experience of more than three years. Data describe that 60 % were females and 40 % were men. The whole group had an average age of 33 years.

Since the teams were put together by the teachers the team members were unlikely to know each other before the course hence they started to know each other as they worked together on the assignments. This would mean that team efficiency improves over time as the members get to know each other

Table 2: Occasions for pair t-test

Pair #	Occasion 1	Occasion 2	Occasion 3	Correlation	p
Pair 1	Efficiency in the beginning	Efficiency at mid-course		0.548	0.000
Pair 2		Efficiency at mid-course	Efficiency at the end	0.668	0.000

Table 3: Regression model of team community

Coefficients(a)	Unstand. Coeff.		Stand. Coeff.	t	p
	B	Std. Error	Beta		
(Constant)	-0.017	0.25		-0.067	0.947
Cooperation	0.16	0.088	0.155	1.822	0.071
Utilize experience	0.179	0.065	0.192	2.771	0.006
Leadership	0.223	0.068	0.242	3.293	0.001
Direct messages	0.146	0.039	0.205	3.715	0.000
Discussions in group forum	0.208	0.074	0.176	2.811	0.006
Problem solving	0.174	0.083	0.162	2.108	0.037

R^2=0.682; F= 42.473; P<0.001

Tests of the first and second hypotheses are done by comparing the level of efficiency experienced of the team members at two occasions. The method used for the test is a paired t-test. See table 2 for the used pair. The paired t-test show that hypotheses H1 are confirmed and that group efficiency for virtual teams follow the same pattern as classical teams, that is, they become more efficient over time. Hypotheses H2

is also confirmed since efficiency increases from mid-course to the end of course. This increase is achieved after the teams have finished several discussion tasks and cases.

The third hypothesis test regards the factors related to team community. The test measures how the level of team community is related to different media for learning; how often persons logon to the educational platform, type of communication and ways to organize the team work. A stepwise regression shows that some variables have larger impact on the level of team community. The result of analysis is shown above in table 3.

6. Discussion

In traditional campus courses the teacher had a very active role. This is not the case in the reported Internet based course. We argue that an e-learning course is largely dependent on virtual teams of students and their performance and activity to share, communicate and explore knowledge. The design and structure of an Internet-based course need to be on a peer to peer basis. Their communication, trust and meaning are shared between students and the teacher becomes the facilitator of the peer to peer communication acting as a sounding board taking on a more passive role.

Results from the regression (table 3) shows that virtual teams develop their team community for learning if whey can sort out initial issues of cooperation, utilization of experiences, leadership and problem solving. Doing so teams hopefully develops trust between the team members as they know that other team members share and contribute with there experience and knowledge for the good of the team. Development of the team increase team efficiency and here the discussions in group forum and direct messages are important for decision making and for the learning process.

As H1 and H2 suggests virtual teams have the same development as regular teams, it could thus be suggested that the understanding of virtual teams may have more to gain from comparing them to regular team theories.

Looking on anecdotal evidence between the three years it seems as there needs to be mechanisms facilitating the interaction between the different team members but also between the different teams. In this case the Storyline learning methodology was beneficial for the interaction and discussion.

The process of developing a team community is essential for the collaboration on the team level and it is also important for the whole course thus we suggest that further research may focus on the identified variables suggested in table 3 and develop the understanding of what makes them more or less efficient.

7. Conclusions

Our aim of this paper was to look on team development in virtual teams and what factors affect team community in an online course. Results indicate that team development follows patterns of normal teams and that a number of tasks over a course make the team pass the punctuated equilibrium [5] more than once and by that improve their performance. Furthermore, the development of team community is related to how the teams organize, communicate and collaborate.

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