

Task Allocation In Team Projects: Findings from an Experimental Online System to Support Students

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Abstract

Business organisations use global teams for systems development, so it is important for students to develop global team working skills as well as face to face team working skills. In Higher Education the team project is one of the best ways to develop a number of these skills. This paper describes a software support system, designed to automate the process of allocating project tasks to individual team members, and to study the effect of this function upon the task and maintenance roles of team working. Teams of 10 to 15 undergraduate students, carrying out systems development projects, took part in trials over three successive years, following an action research approach to the investigation. Results show that the software system helped the team leaders to allocate tasks, taking into consideration individual team members' preferences. The resulting knowledge base was useful to highlight skill shortages, and enable team members to be paired off to complete tasks. Students felt more confident that other team members were capable of successfully performing allocated tasks. Suggestions for improvements ranged from linking the system to project planning tools, to providing information and guidance on what is required to carry out the different project tasks.

Keywords

Task allocation, team project, online tools, global team, team working skills

Introduction

As more business organisations use global teams for solving problems or systems development, it becomes important for students to have experience of tools to support global team working, and develop global team working skills as well as face to face team working skills. Campus based students are increasingly using online support for their learning as well as the traditional face to face support offered by tutors and peers. Such structured support is known as blended learning, and may result in wider possibilities for students or for a tendency towards being isolated in their learning. There is agreement that team-working skills are important for undergraduate students to acquire, in preparation for working in business, but successful teamwork is more difficult to achieve when students have fewer opportunities to meet face to face.

In Higher Education the team project is one of the best ways to develop a number of skills, including team working, and use of CMC (Computer mediated communication) tools. Students are learning about team working processes, at the same time as learning about the subject matter, applying theories learned. Any support provided to students to help them with their team working needs to be flexible, to enable students to work at convenient times and places, and should promote their understanding of issues of team working, both on campus, in the workplace and globally. A tool to help students with team working should help them to make connections with other team members, and provide instant access to information and links to other learning resources. Connections to other team members may be as synchronous or asynchronous communication, or by providing access to stored information about the team and the project status.

The aim of this study was to investigate whether an automated system would help student teams to divide and allocate the project tasks between themselves, and what effect it would have upon the maintenance roles of team working. The next section gives some of the relevant background literature that informed the development of the system, this is followed by an outline of the design and implementation of the experimental system, the results of the investigations into how the students used the system and finally

the main findings are summarised, with some analysis of the impact the system had upon the student team project work.

Background literature

Many researchers have divided team working elements into maintenance and task roles, e.g. (Hartley, 1997), work and basic assumption roles (Bion, 1961), product and process roles, e.g. (Belbin, 2000; Brown, 2000; Hartley, 1997; Johnson & Johnson, 1997) or task, maintenance and process roles, e.g. (Syer & Connolly, 1996). These have in common the notion of two (or three) interrelated roles necessary to achieve successful team working. Task roles include analysis, problem solving, decision-making, planning and design or build. Maintenance roles are concerned with individuals' feelings and relationships between team members, continually working towards team cohesion, and preventing negative conflict from arising through polarising of individual desires and beliefs, which would inhibit performance of the team (Syer & Connolly, 1996). Task and maintenance roles are interconnected and both have been shown to be essential for successful team working in the work place and within the higher education setting.

There is agreement about the factors that affect the success of a co-located team, and a summary of the critical ones identified by Berge, in a study comparing the educational and work contexts, is as follows:

- Goals – a clear mission for the team, with defined outcomes;
- Skills – the team needs to be composed of people with the required skills;
- Leadership – someone to motivate and keep an eye on the path to the goal;
- Roles – in addition to leaders, each team member has a role to play;
- Processes – planning, decision-making, problem solving and sharing;
- Interpersonal relations – generating a commitment to the goals without conflict arising;
- Accountability – maintaining standards of work, praising good work;
- Client involvement – the outcomes of team work need to be communicated to the client and other stakeholders (Berge, 1998).

One of the most commonly accepted models of team processes is that coined by Tuckman: Forming, Storming, Norming and Performing (Tuckman, 1965)). This model reflects the stages that teams pass through as they work together over time. In the learning organisation or educational context, a further stage, informing, is also important, because there is much to be gained by reflecting on the processes the team have gone through in order to achieve their goals (Garratt, 1994). The storming stage may be composed of varying degrees of conflict between team members, but through negotiation and coming to a shared understanding, a trust develops at the norming stage, during which the real work begins.

Knowing facts about someone is not necessarily the same as knowing someone, but may play a large part in moving from *Us/Them* to *You/I* and to *We*. Newell et al proposed three types of trust: companion trust, commitment trust and competency trust. Using 4 cases of a US company, working globally with team workers in Ireland and India, they concluded that vendor/client perception and low levels of companion trust and commitment trust led to difficulties finding help and coordinating the activity (Newell, David, & Chanel, 2007).

The transferable skills necessary for effective team working include: an appreciation of the factors contributing to group dynamics; recognising the relationship between individual, team and task; activities that build up trust; appreciation of the stages a team develops through and the impact of leadership. Skills for employability are defined in a broad manner, for example this list of the team working skills that are exhibited by a successful team:

- Be well led and managed;
- Communicate well;
- Make best use of its resources - most importantly the skills of the team members;
- Establish the means to evaluate how the team is performing (Canterbury, 2003).

Individual skills for co-located team working are well documented, e.g. (Beranek, Zuser, & Grechenig, 2005; Johnson & Johnson, 1997), and specifically for teaching systems engineering (Beranek et al., 2005). When organisations require staff to work across the globe in teams, the technology and tools employed to support the team workers become of prime importance, to form usable networks between the team members (Lipnack & Stamps, 2000), leadership in particular is more complex, and needs to be learned through experience (Maznevski & DiStefano, 2000). However, Patti argues that meeting face to face is still essential for global teams (Patti & Gilbert, 1997). Although students are now more computer literate, consideration of which transferable skills are necessary for global team working, and how they should be incorporated into teaching, has been little researched, except to acknowledge that the skills required are different, and need to be learned, e.g. (Mulder, Swark, & Kessels, 2002). Additional skills, particularly required for global team working, include: recognising cultural differences; the ability to share knowledge; using technology to enable communication and different styles of leadership (Sheppard & Dominick, 2003).

In higher education, team projects, particularly in the computing and information systems disciplines, are a good way to promote team working in an experiential learning environment (Griffiths & Partington, 1992). Cooperative working in a team includes collaborative elements, as well as interdependent and group processes, parts of the work may be accomplished individually, but each is held accountable for their tasks (Johnson, Johnson, & Smith, 1991). Identifying the tasks needed to complete the project, the individual capabilities that can be brought to the tasks, and developing individual skills (task and soft skills) are elements of student team projects that need attention (Adair, 1986). A trusting environment encourages commitment and freedom to express views and ideas, and promotes concentration on the tasks to be completed. However, the task and maintenance roles are cyclical, as both are essential in team working, neither comes first nor leads directly to the other. Knowing about each other, capabilities and preferences can be a factor in developing trust, for instance a “shared language”, understanding, or shared knowledge base (Powell, Piccoli, & Ives, 2004). There is a possible relationship between trust in teams, allocation of tasks and agreeing ground rules (Bos, Olsen, Gergle, Olsen, & Wright, 2002), particularly the idea of a shared mental model through task allocation (Edmondson, Dillon, & Roloff, 2006).

When students work online on team projects, the trust and shared understanding may not be as easily achieved. For example, Bohemia recognised that there was less communication when teams were not co-located (Bohemia, 2004), and Alexander found that students were less satisfied when working in virtual teams (Alexander, 2006). Paulus considered different types of tasks for student working in online teams, and concluded that application tasks were better at fostering cooperative working, and synthesis tasks for collaborative working (Paulus, 2005). Lou was concerned that online courses promote knowledge acquisition at the expense of problem solving skills, and found that inter group projects could be more effective at developing problem solving skills (Lou, 2004).

Groupware was designed to support the task oriented roles of team working, but there is limited support for the maintenance roles of team working, which tend to be problematical both on campus and in the workplace (Edwards & Clear, 2001). Groupware has been developed for supporting dispersed teams of workers, but groupware was not designed specifically for use with students, so does not always provide adequate support to help them to recognise the issues relating to team working (Brereton et al., 1998). Team project work is one form of collaborative learning, but the interactions of students within team projects is different to interactions noted within learning communities (Chapman, Ramondt, & Smiley, 2005; Collings, Richards-Smith, & Walker, 1995). Support for learning communities may not be adequate for the particular requirements of supporting team project working (Hung & Chen, 2001; Jones & Isroff, 2005; Merryfield, 2003).

The variety of ICT tools available, to enhance communication and broaden the range of learning material available, provide different levels of affordance to students, depending upon their motivation and their ability to use the tool (Conole & Dyke, 2004), also instruction to make the most of tools on offer may be needed (Dohn, 2006). Many tools are based on individual use, rather than any attempt to support groups of learners (Lakkala, Lallimo, & Hakkarainen, 2005), and there are few tools designed for supporting student team project working (Chapman et al., 2005; Gatlin-Watts, Carson, Horton, Maxwell, & Maltby, 2007).

Learning together, supported by technology, requires tools specifically designed for the environment of a distributed learning activity, such as team projects. These tools should help team members to communicate data, and information between each other, to promote shared understanding, trust and cohesion, a component of student satisfaction, and be always available to them. In the next section a system developed to automate the task allocation function of team projects is described, which was aimed at gathering data from team learners, analysing this data and providing evaluated information to all team members.

Design of the system for task allocation

An earlier study suggested that one difficulty the student teams experience was deciding who should do which parts of the project (Whatley, Staniford, Beer, & Scown, 1999). Management of task allocation was also found to be significant for student satisfaction with team working and their ability to produce a satisfactory outcome to the project (Drury, Kay, & Losberg, 2003). Thus the initial function chosen for the software support system was to automate the process of allocating the different tasks to individual team members. The system was designed to be available online, so that students working from home could equally gain access to the tool. An action research approach, based on successive prototypes of the tool was designed and implemented, in order to study the effect of this function upon the task and maintenance roles of team working.

The team project support system stores facts and information about individual team members, and the team project as a whole, on a central server, and allow each team member free access to the system to input their relevant data and to access the outputs from the system. Over the cycles of its development, the system was coded either in Java or PHP, and the facts stored on a MySQL database on the university server, with interfaces for the users, over the Internet, in the latest version.

The tutor is required to set up the database with skill areas, generic skills, such as leadership, report writing and project management, and a series of technical skills covering the range to be encountered in typical projects, such as web design, Java programming and UML (Unified modelling language). The team leader adds each team member to the system, and team members are asked to indicate their proficiency at each of the skill areas, by rating themselves on a scale from 1 to 6, poor to good. They also indicate their preference on a similar scale, from dislike to like. When all of the team members have indicated their ratings, the system applies rules to the facts in the database (Figure 1), and outputs suggested allocations to the tasks, and possible training needs. The team leader can use these suggestions as a basis for discussion and negotiation with the team members to decide the final task allocations for the project.

<p>Allocation of task (first) - If student A likes X and is able at X Then student A could do X.</p> <p>Allocation of task (second) – If student B is good at X and has not expressed a dislike of X Then student B could do X.</p> <p>Suggested training needs - If student C likes X, but is unable at X Then student C could be offered tutoring in X</p>
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Figure 1: Rules used for reasoning to allocate tasks and training needs to individual team members

The study and findings

At the University of Salford part of the undergraduate teaching of information systems is in the form of Team Projects, where students work in teams of between 10 and 15 members, drawn from first, second and final years of the undergraduate programmes in business information systems, business information technology and e-commerce. The projects are provided by clients, representing local businesses and organisations, who present real world problems for the teams to solve over about 20 teaching weeks.

Typical projects include designing and implementing web sites or database systems and researching the feasibility of a proposed system.

Previously, students have expressed limited satisfaction with the experience of working on these team projects, because there have been issues surrounding unequal distribution of work, lack of motivation from some team members, lack of relevant skills within the team and poor time management leading to a less than optimum solution to the client problems. These findings have also been reported by other researchers, e.g. (Ruel & Bastiaans, 2003; Wells, 2002). Indeed tutors often remain unconvinced of the usefulness of team projects (Dunne & Rawlins, 2000). Livingstone recognises that students will experience difficulties in their projects, but that they can often be turned to a positive experience (Livingstone & Lynch, 2000).

Because the students are allocated to teams by the tutor, and are from different years of study, they do not always have prior knowledge of each other's capabilities, upon which to base their allocations or begin to develop trust that each is able to perform their part in the project, also recognised by Politis (2003). Also, many of our students today are working from home whenever possible, so it is prudent to provide support that is accessible from wherever they choose to work.

A longitudinal study over three years was undertaken, with small changes to the prototypes at each cycle, and gathering information from the system users, team leaders and members, through questionnaires, interviews and focus groups. This feedback was used to amend the system operation, to determine the impact the system had upon their team project processes, and to find out more about some of the features of student team project work that cause difficulties, and may be better supported for developing appropriate employability skills.

The system was tested with volunteer teams of students within the Information Systems degree programmes at the University of Salford. The system was made available to all of the project teams, by providing each team leader with a login user name. The team leader was able to add their team members to the system themselves, and provide a login user name for each member. The team leader was at liberty to choose whether to use the system or not, and on each cycle of using the system, between a quarter and half of the team leaders in that year opted to use it.

About six weeks after the team projects had started the teams were asked for feedback on their use of the system, in the form of a questionnaire given to all team members, a focus group, to which all participants were invited, and interviews with team leaders. The questionnaire results from three years of trials are given in Table 1. A summary of these findings is followed by some of the findings from the interviews and focus groups.

Table 1: Summary of survey data from team members

Questions	Java version 2003 Total Count (22)		PHP version 2004 Total Count (12)		PHP version 2005 Total Count (35)		Avg. over 3 years Total Count (69)	
	Number answered Yes	% of total	Number answered Yes	% of total	Number answered Yes	% of total	Number answered Yes	% of total
Was the system useful?	13	59	8	67	12	34	36	52
Was the interface easy to use?	18	82	5	42	30	86	53	77
Was the interface self explanatory?	14	64	7	58	28	80	49	71
Do you think it would be useful online?	14	64	5	42	25	71	44	64
Do you think it would be useful on campus?	10	45	5	42	18	51	33	48

Would you like this sort of support online?	9	41	3	25	21	60	33	48
Would you like this sort of support on campus?	8	36	2	17	13	37	23	33
Would you personally like such a support system?	7	32	4	33	17	49	28	40

Although the number of team members responding to the questionnaire was low, there was agreement that the system was useful (52%), but from the interviews with team leaders it became apparent that it was the team leaders who were the main users of the output, and realised the potential of the system. The team members did, however, agree that the system would be more useful for online team working (64%) than co-located teams (48%), and not all of these team members felt that they would personally like to use such a system (40%). This may be explained by the low usage of the outputs by team members in these trials, even though the output was available to them all, not many actively referred to the summarised output. The interface was changed from one prototype to the next, and in the end the interface did not seem to prevent the system from being used satisfactorily, the interface was regarded as easy to use (77%), and self-explanatory (71%).

In contrast to the responses from team members, team leaders thought the support system provided valuable information on team members' skills and preferences, both in the form of a database of individual preferences, and as suggested allocations, which was good for forming the structure of the team, dividing technical from administrative functions in the team. "...helped me to know who to put into which part of the team ..." (TL, quote from a team leader), "yes, showed clearly the technical and other types of people." (TL). As Berge suggests, students do not always know other students' capabilities, and tutors may not have the time or knowledge to allocate members to teams according to their previous learning (Berge, 1998), so this system can provide this functionality: "Yes a good idea with people you have not seen before." (TL).

As part of the assessment for the team projects, teams need to quickly determine the type of project they have been assigned, identify the main tasks involved and produce a plan and specification for the project. The output from the system was also said to be useful to: "...build a knowledge base of the skills existing and required and matched to the specification of the project" (TL).

But some thought the functionality was limited, and would have liked to have more direction to distinguish between the different elements of a project: "Nothing to distinguish between theoretical work and practical work". Because of the specific arrangements for team projects in this case, the respondents were comparing the potential for the system with practices they had used, or seen in use, previously: "Hard to get away from method used previously" (TL), "Let's do what we normally do" (TL), there was a reluctance to try something different, knowing that there were time and assessment constraints. Many of the practices are propagated from year to year: "Get set as you arrive in 1st year", said one student.

Team leaders thought that the task allocation function changed their attitude to the project: "It made them think about the skills, choosing them" (TL). Though another team leader remarked: "everyone ticked all the boxes so they did not really think about it" (TL). Team members, in this study, sounded a note of caution because it was remarked that individuals' perceptions of their skill levels might be misleading: "Rating/grading but may be subjective – all say they are good at word processing but what is 'good'". Some individuals may inadvertently exaggerate their skill levels, or be over or under confident. The team leader must feel he is able to trust the output from a system, and must be able to trust the team members' input to the system, as a precursor to assigning roles on the basis of the system output. A study with global teams by Paul et al, highlighted the need to maintain trust in a team, and the need for training to use technology in order to use the tools effectively (Paul, Seetharaman, Amarah, & Mykytyn, 2004).

Team leaders used the output in different ways, for example one used the grading to pair off members with higher ability with members of lower ability: "See all grading for everyone. So if low mark can put with more confident person" (TL). So team leaders also felt able to use the system for identifying training

needs, either individuals who liked something but felt they were not very good at it, or, by returning no allocations for a skill area, indicating a shortfall in skills for the project.

Respondents in the focus group did realise the importance of developing different skills through participating in a team project: “team project work is an opportunity to learn re new things, not just about what you can do and what you think you can do”. The work involved in team projects does enable students to put theory into practice and to learn from other team members: “Limiting yourself as a person. Good to learn something new, try, more skills”.

Summary and conclusions

By combining quantitative and qualitative results from the three cycles of the trials, it was possible to build up a picture of the overall acceptance levels of co-located students for the concept of the team project support system. It was also possible to find out how using the system impacted upon the team project, from team leaders’ and team members’ perspectives.

The system provided two main outputs: a suggested allocation of the tasks for the project and a database of each team member’s abilities and preferences. The suggested task allocations were very useful for team leaders to divide the work between the team members, and were mainly used as a starting point for discussion and negotiation, particularly when the team leaders did not know their team members from working together previously. But team members did not on the whole consult the database of abilities and preferences after the task allocations had been agreed, they tended to rely on their leader for guidance. As co-located students, constant reassurance on tasks to be completed was provided at face to face meetings, something that may not be available if students work online.

Several team leaders said that the output from the system compared favourably with outputs from manual methods used previously. Although the system did help the team leaders to allocate tasks equitably, taking into consideration individual team members' preferences, there was some conflict concerning too many students capable of doing certain tasks, and no one able to do other tasks. Also a note of caution was sounded that the team needed to be able to trust the system, and that meant trusting individuals to input their abilities and preferences honestly.

Team leaders found the output of suggested training needs, and the grading of individual ability levels useful to identify skill shortages, and to arrange pairings of different ability levels, as they structured their teams. Although many students thought it was easier to work in similar ways to those used in previous team projects, the knowledge base resulting from the system was useful to highlight skill shortages, requiring some training, and to mitigate risk, team leaders were able to ensure the most appropriate member was responsible for critical tasks. In this way students felt more confident that other team members could successfully achieve the desired outputs, indicating some degree of trust emanating from the system outputs. There was reluctance by the students in this study to try something different, but they acknowledged the importance of the team project in providing an opportunity to try out and learn different skills.

This study was limited in its scope, but showed that automating parts of the processes involved in the maintenance roles of team project working, can be beneficial to students in helping them to agree equitable task allocations and so promote trust between the members of a team. Technology can be designed to provide support for maintaining connections between individual learners within a team in certain circumstances. The design, usability and affordance will determine whether students will use the system to its full potential. Feedback from the students in this study provided several suggestions for improvements to the system, ranging from using the system to identify skill shortages to linking the system to project planning tools. This study also highlighted a need for more instruction to guide students in using the system, giving more information on what is involved in the different tasks of projects, and how students should prepare for the specific assessment of these team projects. Further developments of the system will be aimed at providing a more reactive system, to better guide students through team project work, help them to acquire the transferable skills needed for co-located team working and to give them the opportunity to use the tools they will encounter for global team working.

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