

Teaching Teamwork in Information Systems Courses

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Abstract

Teams are becoming an increasingly important organizational form (11). The popularity of teams extends to the information systems development field. IS educators should recognize this trend towards teamwork and prepare their students to work effectively in team environments (14). This paper discusses the knowledge, skills, and abilities (KSA's) needed for effective team membership and presents a method for teaching these in the context of IS courses. The paper also discusses the results of a field experiment designed to assess the effectiveness of the method. The results indicate that specific instruction in teamwork does impact students' perceptions of the success of their teams but does not impact their attitudes towards teamwork.

Keywords: Information systems; teamwork; project teams; information systems education

Introduction

Teams are becoming an increasingly important organizational form (11). Employers seek workers who possess the skills necessary to perform effectively in a team environment. The interest in teams extends to the information systems (IS) development field, where teams have become a popular organizational form (12; 13). IS educators should recognize this trend

towards teamwork and prepare their students to work effectively in team environments (14).

This paper argues the importance of teamwork to organizations, to IS development and to individuals. In addition, the paper delineates the knowledge, skills and abilities (KSA's) required for effective teamwork. Further, the paper describes a method for integrating teamwork instruction

into IS courses and reports on a field experiment conducted to assess the method's effectiveness.

Importance of Teams and Teamwork

As organizations prepare for the new century, they are re-evaluating how they perform their core functions. One outcome of this re-evaluation is the emergence of the self-managed team as a replacement for some of the former hierarchical management structures (19). In this section, we discuss the importance of teams to three areas: the organization as a whole, IS development, and the individual.

Developments such as the globalization of competition increase the complexity of tasks that organizations must perform. These more complex tasks impose demands, both physical and mental, that are simply too large for a single individual to perform alone. Teams address this complexity by providing the means to bring together individuals with the abilities necessary to complete complex projects. Teams provide a function similar to that provided by the organization itself--they allow individuals to accomplish more than they can by themselves (2). As a result, it may be that the team is the natural organizational form for information systems development (8).

Performing as part of a team may have positive impacts on individual worker's attitudes and beliefs. Work groups that have at least some degree of autonomy, such as self-managed teams, may increase both productivity and job satisfaction (5; 16). Team membership may have other positive impacts on the individual employee. Research indicates that team membership may increase workers' dignity, self-worth, commitment, and sense of purpose, and may also lead to reduced alienation (5; 16).

The importance of teams to the organization results in a need for employees who possess the skills necessary to be effective team members. Teamwork-related skills were among the more important reported in a recent study of employers of new IS graduates (18). In addition, a recent issue of *ComputerWorld's Careers* edition included an article specifically discussing the importance of interpersonal skills (20). IS educators are tasked with preparing their students for the increasing popularity of teamwork. As a result, many feel that teamwork has a place in the IS curriculum (1; 9; 10).

While the importance of providing IS students with the knowledge and skills necessary to function effectively in teams is well established, little research has been conducted as to how to accomplish this. Fellers (10) provides an exception, giving advice on how to implement teams as part of a cooperative learning environment. However, Fellers does not include the explicit teaching of teamwork knowledge, skills, and abilities among his recommendations. In a later section, this paper provides a specific method for teaching teamwork KSA's and for integrating this teaching into IS courses.

A necessary step in understanding how to provide instruction into effective teamwork is to understand what knowledge, skills and abilities must be gained by the students if they are to be effective team members. This issue is addressed in the following section.

Teamwork Knowledge, Skills, and Abilities

Teamwork KSA's can be divided into two broad categories, interpersonal and self-management KSA's. Interpersonal KSA's include a) conflict resolution, b) collaborative problem solving, and c)

communications; while self-management KSA's include a) goal setting and performance management and b) planning and task coordination (17). The discussion which follows is drawn from Stevens & Campion (17), except where noted otherwise.

Interpersonal Knowledge, Skills and Abilities

Conflict resolution: A certain amount of conflict is desirable in teamwork--disagreement leads to a variety of decision solutions being identified and considered (4). To be effective, team members must possess the KSA's necessary to recognize desirable and undesirable conflict and to encourage the desirable and discourage the undesirable. Also, the team must be able to identify the source and type of conflict. The team must also possess the KSA's to execute an appropriate resolution strategy and to effectively use a win-win negotiation strategy.

Collaborative problem solving: The team must gain the KSA's to be able to identify situations that are appropriate for group problem solving. In addition, the KSA's to recognize barriers to collaborative problem solving and to take the proper actions to overcome those barriers are necessary.

Communication: Several communication KSA's are required for effective teamwork. These include the KSA's to: 1) understand communication networks, 2) communicate in an open and supportive manner, 3) listen actively and nonevaluatively, 4) maximize the agreement between verbal and nonverbal messages, 5) interpret other's nonverbal messages, and 5) recognize the importance of and engage in small talk and ritual greetings.

Self-Management KSA's

Goal setting and performance management: Teams must possess the KSA's to enable establishing specific, challenging, and acceptable team goals. They must also gain the KSA's to engage in effective performance monitoring, evaluation, and feedback--both in terms of individual members and of the team as a whole.

Planning and task coordination: Teams must also be able to coordinate activities and information. In addition, they must recognize task interdependencies. Teams must also have the KSA's to properly balance the members' workloads and to set role and task expectations.

A Method for Teaching Teamwork

Although many courses in the IS and business curriculum may use team projects as an integral part of their makeup, it seems that there is little time allotted to teaching the necessary skills. In informal conversations with other IS educators at a number of institutions, the authors came to believe that most instructors, while agreeing with the importance of teamwork skills, have not yet integrated explicit teaching of these skills into their courses.

Where then, can students learn how to be effective members of a team? Courses may employ team-based projects, giving students exposure to teamwork. For example, in many cases team projects are an integral part of courses such as Systems Analysis and Design. These projects certainly give experience in teamwork that is both valuable and necessary. However, training in teamwork skills may serve to make these experiences richer. Perhaps training in teamwork can teach students how to deal with teamwork in a positive, rewarding fashion, thus alleviating some of the frustration that both students and

instructors experience as a result of team projects.

Using the previously discussed teamwork KSA's as a guide, a method for teaching teamwork skills within the IS curriculum was developed. The method includes five components: 1) class lecture and discussion sessions, 2) a teamwork handout, 3) in-class collaborative exercises, 4) a team-based project, and 5) monitoring of the teams by the instructor. These components are designed to be interrelated, working together to help students acquire the required KSA's.

Lecture and Discussion Sessions

The lecture and discussion session on teamwork should take place early in the term. The goal of this session is to: 1) make the students aware of the importance of team-related skills, 2) get the students thinking in terms of teams and teamwork, and 3) introduce the critical KSA's necessary for successful teamwork. The basic structure of the session follows the teamwork handout (described below), which is given to the students at this time. Throughout the session, discussion is encouraged by asking the students to relate the various topics to their own experiences. The session begins by stressing the importance of team-related skills. This is followed by a discussion of the nature of teams and team-based activities. Finally, team and project organization is discussed using the context of the team project. Although only one class session is devoted to teamwork, periodically throughout the term, teamwork issues are revisited and discussed in the context of other class activities.

Teamwork Handout

The teamwork handout, which was developed using the teamwork KSA's as a

guide, is designed to reinforce the concepts discussed in the lecture and discussion session. It also provides the students with a document that they can refer to throughout the course. Sections cover all of the KSA areas--conflict resolution, collaboration, communication, goal setting and performance management, and planning and task coordination. The handout is available from the authors.

In-class Collaborative Exercises

At various points throughout the term, the project teams work together on in-class exercises. These exercises serve multiple purposes. First, they give the team members additional time to get to know one another. They also provide additional experience in collaborative problem solving. In addition, the exercises present an opportunity for the instructor to observe the teams at work and to offer input on various teamwork issues. Finally, there is the side benefit of allowing reinforcement of subject area topics through problem-solving exercises that may be too large in scale for the students to complete on an individual basis.

Team-based Project

The team-based project represents a major opportunity for the students to put into practice what they have learned about teamwork. Completion of the project requires significant effort on the part of all team members as well as coordination of those efforts. The project experience provides students with considerable insight into all of the teamwork KSA's. In order for the project to be successful, the students must learn to resolve conflicts, collaboratively solve problems, communicate with each other, set goals and manage performance, and plan and coordinate tasks. However, the teamwork

involved in this project is not the sink-or-swim proposition many actual business efforts represent. Students are aware of teamwork issues and have received training on effective teamwork. With the project, the issues become very real and important to the team members. Readers who seek more information on the value of collaborative learning, including team projects, are referred to Fellers (10).

The project typically deals with simulated "real-life" business situations that require a system of some sort to be built. For example, the team-based project might require students to perform an analysis and design of a system for a small business, such as a pizza parlor or a plant nursery. The teams could be required to interview clients to determine requirements, develop entity relationship and data flow diagrams and structure charts, and possibly prototype the system. At the university where this research occurred, projects typically had intermediate milestones with associated deliverables. This allows instructors the opportunity to monitor the teams' progress and to provide guidance where appropriate.

Instructor Monitoring

The instructor should continually monitor activities on the team project. For example, teams are required to turn in a project schedule. This deliverable is checked to verify that the team members understand and have reached consensus on goals and that they have engaged in planning and task coordination activities. In addition, teams that are having problems in other areas such

as conflict resolution or communication will find it difficult to complete the schedule. This gives the instructor the opportunity to counsel with the team and guide them toward proper teamwork, further clarifying and reinforcing team KSA's.

In addition, it is important for instructors to monitor all teams, not just those who seek out guidance. There can be a tendency to monitor the "squeaky wheels" more than other teams. However, even the less vocal teams may benefit from the instructor guidance that can result from monitoring.

It is of the utmost importance for the instructor to remain an active part of the teamwork experience. Without the instructor monitoring both the progress of the project and the students' learning of teamwork KSA's, the method described here stands little chance of success.

Testing the Effectiveness of the Method

In order to test the effectiveness of the method described in the last section, a field experiment was conducted. The purpose of the experiment was to address the research question:

Does specific instruction in teamwork KSA's impact students' a) perceptions of the team's success, and b) attitudes towards teamwork?

It is expected that specific teamwork training has a positive impact on students' perceptions of team success and on their attitudes towards working in teams. This is illustrated in Figure 1.

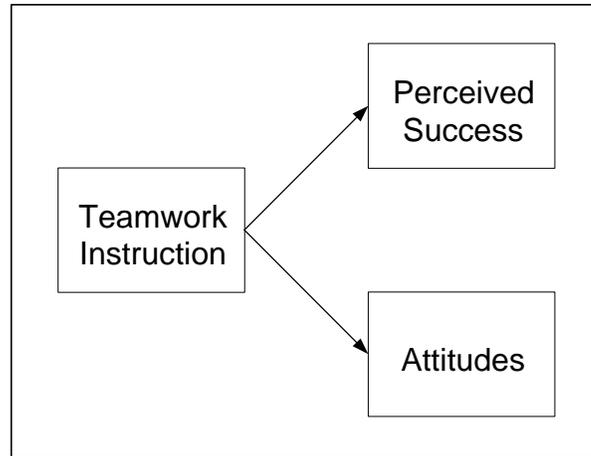


Figure 1 – Research Model

Methodology

A field quasi-experiment was conducted to gather data in order to test hypotheses related to the propositions. A two-group, post-test only design was used. The control group did not receive specific teamwork instruction, while the treatment group did receive teamwork training following the method described earlier. Subjects were students in two IS courses, one in Systems Analysis and Design and the other in Database Administration. In one semester, both courses were conducted without teamwork instruction. In the following semester, both courses included a component that specifically addressed teamwork KSA's. Due to pragmatic considerations, subjects could not be randomly assigned. As a result, this study must be considered a quasi-experiment as described by Cook and Campbell (6).

Subjects

Students from Systems Analysis and Design and Database Administration sections in a major urban university were the subjects of this study. Students were assigned to teams based upon a variety of criteria, including proximity to campus and times available for meetings. A total of 166 usable responses were obtained, with 84 responses obtained from the control group and 82 from the treatment group.

Analysis of variance (ANOVA) indicates that there are no significant differences between the treatment and control groups in terms of the subjects' age, work experience, or team experience. Characteristics of the sample are shown in Table 1. Age and work experience were measured in years. Team experience was measured on a 5-point Likert-type scale with 0 indicating no prior team experience and 5 indicating extensive team experience.

| Characteristic | Treatment Mean | Control Mean | Sample Mean |
|-----------------|----------------|--------------|-------------|
| Age | 28.17 | 28.22 | 28.19 |
| Work experience | 7.04 | 7.43 | 7.24 |
| Team experience | 3.57 | 3.57 | 3.57 |

Table 1 - Sample Characteristics

Instrument

An instrument adapted from Fellers (10) was used to assess the students' perceptions of their experience with teams during the semester. The validity of the instrument was assessed by performing a factor analysis and computing Cronbach's coefficient alpha (7) as a measure of reliability.

In order to assess the construct validity of the instrument, a factor analysis was performed using maximum likelihood method for the initial extraction and the oblique promax rotation method. Examination of both the χ^2 statistic and a scree plot indicates two factors exist, as expected. Factor loadings indicate that five questionnaire items associated with perceived success load on a single factor, which we call the teamwork success scale. The other four items, all of which are concerned with attitudes towards teamwork, load on the second factor, which is termed the teamwork attitude scale.

Cronbach's coefficient alpha was computed to determine the reliability of the perceived success and attitude scales. This coefficient is a representation of the reliability of the inter-item correlations of the overall instrument (15). The perceived success scale has a reliability of 0.849, while the attitude scale has an alpha of 0.893. Both of these exceed the 0.80 cutoff recommended by Nunnally and Bernstein (15).

Hypotheses

Two hypotheses can be derived from the research model discussed earlier.

H1: Specific instruction in teamwork KSA's will increase the students' scores on the teamwork success scale.

H2: Specific instruction in teamwork KSA's will increase the students' scores on the teamwork attitude scale.

Analysis and Results

Due to correlation between perceived team success and teamwork attitude (0.493), multivariate analysis of covariance (MANCOVA) was used to test the hypotheses stated earlier. In addition, data were analyzed to ensure that the assumptions underlying MANCOVA (3) are met.

Measurement was made at the individual level of analysis. The decision to work at the individual rather than the team level of analysis was made primarily because we are interested in the impact of the treatment on individual students. Aggregating results by team would not allow examination of the impact on individual students. Once the effectiveness of the method is established at the individual level, further research may investigate differences at the team level. Such research holds the potential to extend the findings of this research. These findings are discussed below.

Results

As a preliminary step, a MANCOVA was performed with treatment as the independent variable, success and attitude as dependent variables, and instructor, age, work experience, and team experience as covariates. This analysis was done to determine which, if any, of the covariates are significant and should therefore be included in the final analysis. None of the variables emerged as significant covariates, so none were included in subsequent analyses.

Omnibus tests were employed to test whether the treatment and control groups

had the same population mean on both perceived team success and teamwork attitude. The omnibus tests indicate that the null hypothesis of equal mean vectors can be rejected at a significance level of 0.001 ($F = 7.115$, $df = 162/2$). This can be interpreted to mean that the treatment, teamwork

instruction, does have an impact on subjects' perceptions of teamwork.

Follow-up analysis (ANOVA) was performed to test the specific hypotheses related to perceptions of the teams' success and attitudes towards teamwork. The results of the follow-up analyses are shown in Table 2.

| Hypothesis | Construct | F Statistic | Deg. Freedom | Significance |
|------------|-------------------|-------------|--------------|--------------|
| H1 | Perceived success | 12.826 | 1/163 | < 0.001 |
| H2 | Attitude | 0.473 | 1/163 | 0.485 |

Table 2 – Hypothesis Test Results

As can be seen from Table 2, there is a significant difference in the treatment and control groups for perceived success but not for attitude. In other words, H1 is supported, while H2 is not.

Discussion

According to the results of this research, it is clear that explicit instruction in teamwork KSA's following the method described in this paper can impact students' perceptions of the success of their teamwork. However, the instruction did not impact their attitudes towards working in teams. In short, the students who received teamwork instruction felt that their teams performed better, but they still did not like working in teams.

These results hold implications for those interested in information systems oriented teams, whether in an educational or organizational setting. The primary lesson learned is that specific training in teamwork *can* impact the team members' perceptions of teamwork, specifically of their perceptions of the success of the team.

For IS educators, the results may indicate that investing valuable class time on teamwork training can provide significant benefits. Student team members who receive teamwork training feel that their teams are more successful as a result. This perception may be a result of increasing teamwork skills, although future research is required to specifically address this issue. Organizations using IS teams may interpret these findings to indicate that investing time and money in teamwork training may be beneficial. Stated differently, organizations that use teams and do not provide teamwork training may be missing an opportunity.

Students may also benefit from the teamwork training. By participating in teamwork training, it is possible that students improve their teamwork KSA's. If so, it stands to reason that these students will make better team members in other classes and on the job. In addition, the KSA improvement may also lead to these students being more attractive to potential employers.

The second finding of this study indicates that teamwork training does *not* impact attitudes towards teamwork. While this finding does not negate the value of

teamwork training, understanding this finding may be of value.

One possible explanation for this finding may stem from the nature of some of the problems with team projects that may influence students' attitudes towards teamwork and are not addressed by the teamwork training. Student feedback indicates that most complaints about team projects fall into three areas: 1) scheduling problems, 2) problems with social loafing, and 3) interpersonal conflicts. These problem areas are only partially addressed by teamwork training.

Scheduling problems often arise when students work together in teams. This problem is particularly acute when dealing with commuter students and with students who work while attending school. The constraints imposed by commuting and work schedules make working out a mutually acceptable team meeting schedule difficult for some teams, which may result in some members feeling frustrated. Unfortunately, teamwork training does little to alleviate this problem. The problem of scheduling team meetings may be more severe when dealing with student teams than it is in organizations. Students must serve many masters--most take a number of classes each term, and many also work. The demands of these may often be in conflict. The students are left to set their own priorities among these demands, which can result in frustration for individual students and conflict among team members. Although similar conflicts may also occur in an organizational context, there is often an overriding authority who can be called upon to set priorities.

Many students complain of teammates who fail to "pull their load." Such social loafing may impact attitudes towards teamwork. The team members who are performing their tasks may resent the

members who are not performing, particularly when there is little reward differential between performers and loafers. Although instructors (and supervisors) can take some actions to guard against social loafing within teams, teamwork training does little to alleviate the situation.

Teamwork training's impact on interpersonal conflict is more complex. The training does include information on resolving interpersonal conflicts, so it is reasonable to expect that the training should have some impact on the effectiveness with which the team members deal with these conflicts. However, even with the training, the relatively short life of the class project team may prevent the team from coalescing. Team members may not have sufficient interaction with one another to allow for the team to come together to the point where the members become adept at dealing with interpersonal conflict. Further research is necessary to determine whether this explanation is accurate, or another explanation is more reasonable.

Conclusions

Employers of IS graduates desire employees who have teamwork (18). Many IS programs have responded by integrating team projects into their curriculum. However, it may not be enough to simply throw students together and expect them to function effectively as a team. Specific training in teamwork skills may be a necessary component for successfully enabling students to be effective team members.

This paper presented a method for teaching teamwork skills and reported the results of a field quasi-experiment that tested the method's impact on students' perceptions of their team's success and on their attitudes towards teamwork. Results indicate that the

teamwork training method does significantly impact perceptions of success but does not seem to change students' attitudes regarding teamwork. While further work is necessary to refine the method and to validate some of the explanations offered here, the method presented and studied represents the first step in the ongoing process of understanding the effectiveness of teamwork training.

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