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Mitigating Negative Behaviors in Student Project Teams: An Information Technology Solution

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ABSTRACT

The evolution of the information systems (IS) profession as well as the IS educational environment has resulted in student project teams becoming an increasingly important component of IS education. Negative behaviors within these project teams result in less than optimal project outcomes and confound attempts to fairly evaluate individual efforts within the team. These negative behaviors can also result in unfavorable perceptions of the educational experience for many students. An information technology-based application consisting of an online interactive activity log and an online peer review system was developed to mitigate the common negative behaviors of social loafing and free riding and provide more accurate and useful information for evaluation. Its successful implementation in a specific classroom environment is discussed and evidence of its efficacy is supplied in the form of subjective assessment by the instructors and the results of a survey measuring student perceptions of the system.

Keywords: Student Teams, Negative Group Behaviors, Social Loafing, Free Riding, Peer Review, Information Technology

1. INTRODUCTION

Most information system (IS) educators have been periodically required to manage student team projects. In recent years several forces have increased the need for a greater number of team projects being incorporated into the pedagogy of IS curricula. Tightening budgets have often led to larger class sizes making individualized projects difficult or impossible due to the prohibitive management and evaluation load imposed on the instructor and teaching staff. Additionally, as the IS profession has matured it has become increasingly important to make use of large-scope projects that more accurately depict real-world development efforts. These types of projects require more development time than a single student could provide. Finally, potential employers of the graduates of IS programs place a great deal of weight on interpersonal skills, especially those relating to how well the applicant works in team environments.

This perceived increase of the number and average complexity of student team projects in the IS area inevitably has lead to increased concern over the management of these projects. Some of these concerns have been formally researched for nearly a century and social science research has devoted a great deal of effort towards these subjects during the last several decades. The "Ringelmann Effect" (Ringelmann, 1913) or "social loafing" (Latané, Williams, & Harkins, 1979) suggests that there is an inverse relationship between the size of a team and the effort expended by individuals in the team. "Free riding" (Mulvey & Klein, 1998) describes the attempt to benefit from the other team members' efforts while making little contribution oneself. These well known negative team behaviors can dramatically affect the project team's results and make it not very realistic to assume all involved students participated equally. In fact, it is likely that making this assumption enables or exacerbates these negative behaviors.

The efforts of the authors to mitigate these behaviors in their courses began by first developing and implementing a technology-based system designed to both motivate students who may otherwise become social loafers and free riders and to aid in the assessment of individual contributions to a team project.

The developed system took the form of an online interactive activity log and peer evaluation system. Although the concepts of using activity logs and peer evaluations in general are not extremely innovative, the online and interactive characteristics of this system overcome many problems associated with paper-based systems and enable several capabilities that would be difficult or impossible using more traditional systems.

This effort incorporates several, but not all, of the principles underlying the concept of continuous auditing (Nelson,

2004; Searcy & Woodroof, 2003). First and foremost it is an attempt to gather information concerning a process while the process activities are occurring or shortly thereafter. This has obvious advantages relative to the accuracy, reliability, and timeliness of the gathered data. However, the concept of continuous auditing often automates the gathering of data using information technologies (Searcy & Woodroof, 2003) while this proposed system simply uses technology to facilitate the manual recording of data and then automates and enhances the reporting mechanism. This is an important distinction since automated data gathering might also increase concerns related to privacy and ethical considerations. These considerations are discussed in more depth in a later section.

It is important to distinguish between mitigation and elimination and between social behaviors and larger social problems. First, the proposed system is only hypothesized to have an affect on the prevalence of these negative behaviors and is not suggested as a cure-all for these issues. Logically, the positive effect would only be realized if the system is used as an additional supplement to the instructor's normal policies and procedures for managing team projects. Instructors must remain just as involved and vigilant as they would normally be with their students. Second, it is widely believed that technological solutions to social problems do not work (Weinberg, 1967; Weinstein & Neumann, 2000). The social problems involved in this discussion relate to student work ethics, dishonesty, and other "large" issues. The proposed system is not suggested to be a solution to these larger social problems but rather is suggested to have a positive effect on certain negative behaviors associated with those problems. In this context, many examples of technology being implemented to affect negative behaviors can be cited. Ignition switch breathalyzers are used to deter repeat drunk drivers, surveillance cameras are used to deter red light runners, and biometrics are used to deter information thieves. None of these systems are suggested to completely eliminate the negative behaviors they are used to deter and none address the larger social problems that lead to those behaviors. The proposed system should be viewed as similar in concept to these types of efforts.

2. RESEARCH ON TEAMS AND TEAM BEHAVIOR

Best practices as well as usage and relative advantages of utilizing teams in industry settings has been extensively researched (Holland et al., 2000; Kirkman et al., 2000; Lurey & Raisinghani, 2001). Social interaction and other team behaviors have been addressed within industry and educational settings as well. Although teams within the educational environment have much in common with teams in industry, the educational environment does have special characteristics that make the management of these teams unique. The balance of this section reviews previous research on teams in education and on negative team behaviors. Next, work on the mitigation of these behaviors, including research on peer review issues, is summarized. Finally, the motivations for and proposed benefits of the developed system are discussed.

2.1 Team Research in Education

Institutes of higher learning have responded to the requests of potential employers by providing their students with necessary team-building skills such as the ability to work well in team environments, to take leadership positions, and to be effective team players (Gueldenzoph & May, 2002; Niehoff & Mesch, 1991; Williams, Beard & Rymer, 1991). A case study of the development of student teams within an industry setting indicated successful implementation of student teams required institutional changes from both the students and instructors in terms of curriculum, pedagogy and student assessment (Dunne & Rawlins, 2000). Michaelsen (1994) suggested that incorporation of small team-based instruction methods into college courses was impeded by faculty members' lack of formal education in using teams and perceptions of the effectiveness of the lecture format for delivering content. Concerns pertaining to introducing team-work into the curriculum were addressed by the appearance of case studies and methodologies in the education literature (Adams, 2003; Siciliano, 1999; Vik, 2001).

Extensive research focuses on factors that affect team performance in educational environments. They fall into three categories: 1) group dynamic characteristics such as cohesion and commitment, 2) team member characteristics such as aggressiveness and cooperation, and 3) project characteristics such as relevance and importance (Bacon, 2005; Bento, 1997; Mulvey & Klein, 1998; Wagner, 1995; Werner & Lester, 2001).

Strategies for evaluating team effectiveness and assessing individual member contributions has garnered extensive interest. Some form of evaluation was necessary to ensure team member accountability (Bacon, Stewart & Silver, 1999; Beatty, Haas & Sciglimpaglia, 1996; Gueldenzoph & May, 2002). Bacon et al. (1999) found empirical support for the hypothesis that peer evaluations can be counterproductive and led them to recommend against using traditional peer evaluations.

Bacon (2005) found that students learned more project-related content when they worked alone rather than when they worked as a member of a team. This was attributed to social loafing, specialization of labor among team members and loss of time through the inability to coordinate efforts.

Despite these issues, team projects are used to provide students with real-world experience, translate conceptual material into practice, and work with peers (Beatty, Haas, & Sciglimpaglia, 1996). Once the skills have been introduced, instructors often promote assimilation of these concepts by assigning semester-long student team projects. These student team projects make use of the five basic elements of cooperative learning: positive interdependence (ability to work well on an assigned task and share their work with other team members), individual and team accountability, face-to-face interaction, team-work skills, and team processing (Gueldenzoph & May, 2002).

The majority of team or group research has focused on contrived experiments performed in a laboratory. In a meta-analysis of 78 studies dealing with social loafing, Karau and Williams (1993) noted 85% were conducted in the lab and 15% were in the field. Werner and Lester (2001) support the assumption that college project teams equate to workplace teams. They concluded that, even though case teams were not in a work setting, the students were involved in a project that had real meaning and significant consequences to team members. These student teams resembled self-directed work teams since there were no assigned leaders and their task was similar to those undertaken by parallel team structures in the workplace.

2.2 Negative Team Behaviors

College students often demonstrate resistance to working in teams. The two major complaints voiced by students regarding unsatisfactory team-work experiences are team members not pulling their weight and uncooperative team members (Strong & Anderson, 1990; Williams, Beard, & Rymer, 1991). Perceptions that team members are not accountable for their responsibilities and that there is an inequity in individual team member's effort, knowledge, and quality of work are common in team projects (Strong & Anderson, 1990). These assertions are supported by Kirkman et al.'s study identifying specific areas of resistance to working in teams in the workplace: fairness, equity, accountability, trust, organizational direction and individual ability and confidence to complete the task at hand (Kirkman et al., 2000).

The NASA Research Program identified several negative behaviors associated with team failure including team members being withdrawn and passive, engaging in competitive behavior and deceit, and instigating conflict through negative feedback, criticism, and public embarrassment or humiliation of others (NASA, 2005). Jalajas and Sutton (1984) identified five types of students that are associated with conflict in student teams: whiners (complain about everything), martyr (willingly accept more tasks than others but complain about it), bully (intimidates other team members), deadbeat (doesn't contribute), and saboteur (makes changes without other team members' approval). They observed that conflict tends to be more common in teams that don't manage these personalities well.

Phenomena such as social loafing, free riding, and perceived social loafing describe behavior that is perceived as negative by other members of the team. Social loafing is the tendency for individuals to expend less effort when working collectively than when working individually (Karau & Williams, 1993; Latané, Williams, & Harkins, 1979; Williams & Karau, 1991). Free riding is the attempt to benefit from team membership without bearing a proportional share of the costs. These individuals believe their efforts won't be identified or are dispensable (Mulvey & Klein, 1998). Perceived social loafing is the perception that one or more other team members are contributing less that they could to the team (Mulvey & Klein, 1998). A subsequent behavior, labeled the "the sucker effect" occurs when team members scale back their efforts to match those of the free riders (Jackson & Harkings, 1985; Kerr, 1983; Wagner, 1995). These negative behaviors are sources of conflict that often lead to reduced team performance (Liden et al., 2004; Wagner, 1995; Williams, Beard, & Rymer, 1991).

Team members are more likely to engage in social loafing when their individual outputs cannot be evaluated from the final team project, when working on projects that that are perceived as having little influence on their grade, when they have very little personal involvement with the project, when their teams are not compared to other teams, when working with strangers, when they expect their team members to perform well, and when their inputs to the team project are redundant with those of other team members (Harkins & Szymanski, 1989; Jalajas & Sutton, 1984; Karau & Williams, 1993). Additionally, many individual personal factors are likely to influence the prevalence of social loafing such as aptitude for the task and the number and perceived priority of other activities competing for the students' time.

Liden et al. (2004) investigated social loafing in organizational settings with intact work teams. Their findings confirmed the work of others in the field. The more employees see their job's and team's mission as significant and meaningful, the less likely they will be to engage in social loafing and the more likely they will be to compensate for perceived substandard contributions of coworkers. Perceived coworker loafing was associated with less social loafing. The form of retaliation from other workers was to intentionally work slower or withhold effort.

Team process research indicates social loafing can be reduced or eliminated when the team members can be identified or when the individual members' contributions can be evaluated (Karau & Williams, 1993; Wagner, 1995; Williams et al. 1981; Williams & Karau, 1991). Williams and Karau (1991) investigated the relationship between social loafing and social compensation (the expectations that other team members are performing insufficiently, people may work harder in a collective setting than in a coactive setting to compensate for the others in their team). Social compensation was more likely to occur if the evaluation of the team product is important to the individual (e.g. makes up a large portion of grade). The individual will be motivated to avoid a poor team performance by compensating for the poorly performing coworkers. They found when participants expected their coworkers to be unreliable, unwilling, or unable they exhibited social compensation.

2.3 Evaluation of Student Team Projects

Evaluating student projects pose an additional problem. Although instructors often measure the final product without the input from the individual team members, the instructor can evaluate only the product, not the process that was used to create that product. Because of the importance of being an effective and contributing team member, students should be evaluated on their ability to interact, work, and collaborate with others. Assigning appropriate points for each team member is often difficult because of the potential for uneven

performances within teams (Williams, Beard, & Rymer, 1991).

Team member information such as attendance at team meetings, dependability, availability, quality of ideas and work, facilitating goal achievement, completing a fair share of the work and being easy to work with as well as an overall evaluation can be obtained from other members or peers of the team (Beatty, Haas & Siglimpaglia, 1996). These peer evaluations are defined by Pond and Ul-Haq (1997) as an assessment methodology that allows students to provide input into the assessment procedure through evaluating each others' performance in out-of-class learning activities, with control of the final grade remaining with the instructor. The results of these contributions mitigate the concerns about fairness and accountability. Research suggests that individuals are less likely to loaf when the students are aware their contributions are being monitored and evaluated (Karau & Williams, 1993; Williams, Beard, & Rymer, 1991). A comprehensive evaluation, according to Crews and North (2000), should include a combination of product evaluation by the instructor, peer evaluation by the team members and self-evaluation by each student (Gueldenzoph & May, 2002).

Peer evaluation data, however, is only useful if students willingly provide quality input. Chen and Lou (2004) found that students are more motivated to deliver quality peer evaluations if they perceive the evaluations have some value. Determining peers' grades and reducing conflict, uneven workload or both were the most attractive outcomes for peer evaluations (Chen and Lou, 2004; Jalajas and Sutton, 1984; Steers & Porter, 1991).

Peer evaluation research performed by Lejk and Wyvill (2001a) suggests that students are more discriminating in their peer assessment when it is performed secretly than when it is performed in open agreement within the team. In a comparison of holistic (each student awards only one grade to each of the other team members based on the team member's perceived contribution) and category-based (students assess each other on a number of categories that are totaled and converted into a percentage contribution for each member) peer evaluation methods, Lejk and Wyvill (2001b) found that holistic peer assessment results in closer agreement between peers than category-based assessments and were more effective at dealing with outstandingly good and outstandingly weak contributions to the team. The category-based assessment is a less effective methodology for measuring the overall contribution since many of the categories (e.g. motivation, adaptability, creativity, communication skills and general team skills) do not impact the contribution value directly. However, category-based peer assessment is useful for formative feedback (Lejk & Wyvill, 2001b).

In their study of student opinions about free riding, Strong and Anderson (1990) found that students believed that peer evaluations do reduce free riding but rated other factors such as team cohesiveness, small team size, the option to get rid of a team member, or the option to leave a team as having a stronger effect on reducing free riding. The use of peer evaluations was found to be negatively associated with good team experiences in a study by Bacon et al. (1999) comparing best and worst team experiences encountered by first and second year MBA students. A negative effect was found for the tendency of team members to have equal influence on team decisions, the team's ability to agree on goals, and team members' accountability for team success. When the peer evaluations were taken at the end of the quarter, team members were more likely to tolerate poor team dynamics and mark down the team members involved than to confront the issues and resolve the problems. Offering teams the option to fire uncooperative or unproductive team members was suggested as being more effective in motivating team members than peer evaluations (Bacon et al., 1999; Strong & Anderson, 1990).

2.4 Motivations For and Proposed Benefits of the System

The main contribution of this research is to describe the use of an online interactive activity log and peer review system and the authors' experiences with this system that they perceive as being highly efficacious in motivating individual team members and in improving the quality of individual evaluation within team projects. The motivations for the original decision to develop this system as well as the benefits the authors assumed would result from its application will first be addressed.

As discussed in the previous sections, the negative team behaviors of social loafing and free riding have been shown to be mitigated by several factors. An example that is commonly cited in previous research is individual accountability for the work done by the team in producing the end-product. Peer evaluations have often been the primary method of trying to produce this individual accountability but are often hindered by problems such as student resistance. For many students it is difficult for them to provide information that may damage a fellow student's grade. Additionally, if students are allowed to form their own teams then many teams will likely be composed of friends and acquaintances. Where membership is assigned by some other means, students are likely to have many friends and acquaintances within their cohort, making it likely those teams will contain members with these relationships. Even where such relationships are not present it is often part of the student culture to resist giving poor evaluations to other students even where deserved. In the experiences of the authors within their own classes the exclusive use of peer evaluation for mitigating these behaviors and for assessing individual contributions was, at best, minimally effective.

In an effort to address these problems, methods to retrieve more objective information on individual effort within teams were considered. Having students keep a log of the activities they performed on the project seemed to be an appropriate method. The problem anticipated with a simple form of this method was that some students would likely exaggerate their activities to achieve a higher evaluation. It was decided that an interactive form of an activity log where students could enter their activities through online forms and then view and confidentially comment on the activities entered by their team members would be a much improved method of

gathering this activity information and promoting honesty in what was entered. Since another student exaggerating their activities would lower the proportion of the total project activities that an honest student would receive credit for, they should be more likely to report a fellow student's exaggerations. In addition, the almost universal fear of being "caught in a lie" should lead to fewer exaggerations in the first place. Finally, this fear of being caught was intentionally amplified by the instructors emphasizing that entering dishonest activity entries was a form of academic dishonesty that could result in disciplinary action being taken against the student.

The interactive online activity log was not meant as a replacement for peer evaluations but rather as an augmentation. Peer evaluations do provide important information. In an effort to motivate students to differentiate between relative contributions of their team members they were asked to both rate (on a numerical scale) and rank their peers in each category. In previous experience with paper-based peer evaluations it was observed that some students refused to rank their peers differently even when clearly instructed to do so. By making the peer review system an online form-based system it was possible to achieve 100% compliance by designing the system to detect invalid entries and disallow final submission of the evaluation until all invalid entries are corrected.

2.5 Ethical and Privacy Considerations

The system being proposed represents a form of electronic monitoring. Although the concerns here are lessoned by the lack of automated data gathering incorporated into this system, other forms of electronic monitoring have often raised ethical and privacy concerns and debates (Alder, 1998; George, 1996; Hawk, 1994; Hodson, et al., 1999). Alder (1998) presents an extensive examination of the arguments for and against the ethics of implementing electronic performance monitoring in the workplace. A discussion of this depth is beyond the scope of this research; however, some relevant considerations will be briefly discussed.

In the workplace, most ethical dilemmas concerning electronic monitoring pertain to the automated collection of data with or without the employee's knowledge. In these cases it is difficult to argue that employees, even when notified of the monitoring, can be completely aware of all the data that is being captured by the system and how it may be used. In our system, every piece of data that enters the system is manually entered by the student and they are aware through verbal notification and system prompts of who will have access to the entered information and how it is used in their evaluation. Such notification has widely been held to lesson the ethical concerns of such systems (Alder, 1998; Hodson, et al., 1999). The described system also utilizes two aspects of peer review. One is a formal evaluation of team member performance and the other is a peer review of entered activities. The usage of paper-based peer review systems in these types of projects is widely accepted as ethical and has been discussed previously. The described system implements these peer reviews electronically but does not change their content; this, from an ethics standpoint, is no different from a paper-based system.

The concept of pr ivacy concerning information technology usage is currently ill-defined and contains several dimensions (Bakke, et al., 2005). Of greatest concern in the proposed system is the storage of individual activities on a team project and the dissemination of this information to other members of the team. The only personal information captured or stored by the system is the individual's name. All of the system's data including activity entries, comments on team members' activities, and individual names are password protected so that only the authorized individuals should have access to it. Since it would be difficult to accomplish any team project without communicating with team members what activities are being accomplished by whom, it is asserted that this system simply formalizes an informal information flow that already exists (or should exist) between the team members with the added component of making this information flow available to the instructor. The creation of an appropriate team output and the utilization of an appropriate process to achieve that output are both educational objectives in most settings that utilize team projects. In this environment it is reasonable to argue that students do not have an expectation of privacy concerning their role in that process.

In the end, it is the decision of the educator, in accordance with any institutional policies or guidelines that they operate within, to determine whether the positive aspects of the implementation of such a system outweigh any negative aspects they identify (using teleological and utilitarian arguments). This research presents the method and some empirical evidence of its efficacy but cannot make this philosophical decision for the individual. The fact that the authors did implement the described system themselves reflects their personal decision that the system was ethical and did not unduly violate the students' privacy.

The remainder of this paper is organized as follows. First, a detailed description of the system as well as how it was implemented in the classroom environment is discussed. Next, hypotheses are developed to test the perceptions of students concerning certain goals of the system. These hypotheses are tested empirically using a questionnaire and the results are presented and discussed. Finally, directions for future research and limitations of this research are discussed.

3. SYSTEM AND CLASSROOM ENVIRONMENT DESCRIPTION

The activities involved in this effort began with the development and implementation of a web-based system for interactively recording student project activities and peer evaluations in a specific classroom environment. The following sections describe the classroom environment and the system in detail and provide the instructors' assessment of the system's efficacy.

3.1 The Classroom Environment

This research effort began as a response to the difficulties that arose in managing team application development projects in a junior/senior level information systems course. The course is an advanced elective second course in systems analysis and design. The vast majority of students are IS majors with the remainder being in another technical major. All students have completed a first course in systems analysis and design and have taken basic programming courses along with other background courses. The main student deliverable is a team application development project where they employ a generic systems development life cycle (SDLC) approach. Specific deliverables include formal written reports on each phase of the process (investigation, analysis, design, implementation, maintenance and review), documented code, user manuals, a final presentation and demonstration, and the final working application. The applications were web-based, database-driven, and business-oriented in nature. The team size ranged between three and eight due to variable class sizes and instructor preferences as well as attrition contributing occasionally to smaller than designed team sizes.

The previous evaluation scheme of the class did not lend itself to making individual distinctions on effort within a project team. The majority of a student's score was based on the end project and every member of the team received the same score. A small portion of the grade was based on an end-of-term peer evaluation and individual evaluation by the instructor. The main concern with these methods were that instructors had very little information about the internal activities of the team to base their individual evaluation on and students often resisted portions of the paper-based peer review process.

Prior to the development of the application discussed here there was no effort being made to document the individual activities of team members. The instructor only learned about lack of effort problems on an exception basis when a student volunteered this information.

The following sections describe the two components of the system that were developed as a response to the course's challenges. The interactive online activity log module provided entirely new capabilities and the online peer review module strived to solve the problem of student resistance to ranking their peers.

3.2 Description of the Interactive Activity Log Module

The activity log module of the system was designed to collect information on the actual activities of each individual student within the project team. The system was designed to force correct entry of information and to limit the opportunity for dishonest or exaggerated reporting of activities by the student. Figure 1 shows a flowchart of the main components of the activity log module.

The application requires each student to log into the system and then select from four menu choices: (1) input activity log entries, (2) review and approve the team's log entries, (3) display the individual's log entries, and (4) display the team's log entries. After each module element is completed the student is channeled back to the menu and can select additional elements.

When the student chooses to input activity log entries they are first asked to select the appropriate date the log entry applies to. In order to encourage timely entry of log information the list was limited to ten days prior to the current date (this could easily be modified). The student is then taken to the log entry page as shown in Figure 2a. Here the student selects from categories of activities appropriate for the given project and provides a detailed description of the activity. The student also must select an approximate time duration for the activity. Multiple entries are allowed on the page and when all the activities for that day are entered the student submits the entries for automatic review and validation. The submissions are validated to ensure that certain characteristics of the information entered are present. In our implementation the system automatically checked for entries in each of the required areas: type of activity, activity duration, and description of activity. It would be a simple matter to add additional validation checks such as a minimum number of characters in the description. In this scenario, the instructors also viewed the student entries periodically to identify any entry problems and communicate them to the student so additional automated validation was not considered necessary. If valid, the student can choose to edit their entries or submit them to the system. If the entries are not valid the student is given an appropriate error message and only offered the choice of editing the entries. When the entries are completed for that day the student receives a confirmation message that includes some statistics for the student's self-evaluation. It is emphasized that the time expended on project activities is not the only measure of success but some reporting of these measures was considered useful feedback. The system provides the student with the total amount of time that has been reported to have been spent on the project by the individual and the team as a whole. It also reports the average individual and team times for the entire course as well as the individual's and team's relative ranking on this measure in the course. Next the student is automatically taken to a page displaying any other team member's log entries that have been entered and not yet reviewed by that student.

Whether or not the student arrives at the page that displays their fellow team members' log entries through the process discussed above or selects the menu item that takes them directly to that page, the function is identical. They are presented with a list of their entire team's entries besides their own that they have not yet reviewed (see Figure 2b). The student can simply click a checkbox stating they have viewed and approved the particular log entry or they can write optional comments about the log entry (positive or negative in nature). These comments are confidential and only the instructor has the ability to view them after submission.

The final two menu choices are similar in nature and help document the entire process. The student can select to view either the team's log entries or their own individual log entries for the entire project. These reports are read-only and do not require or allow any data entry or modification.

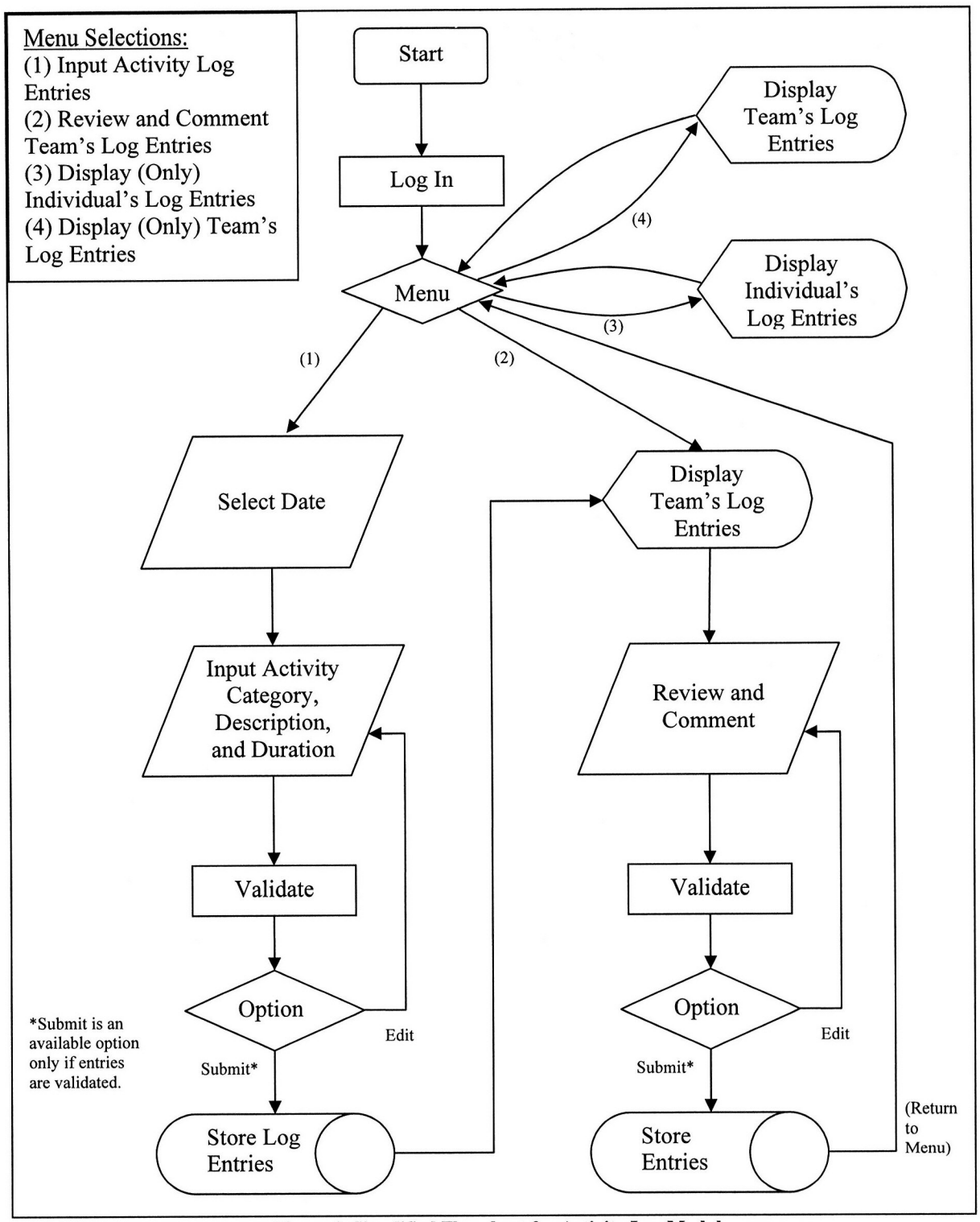
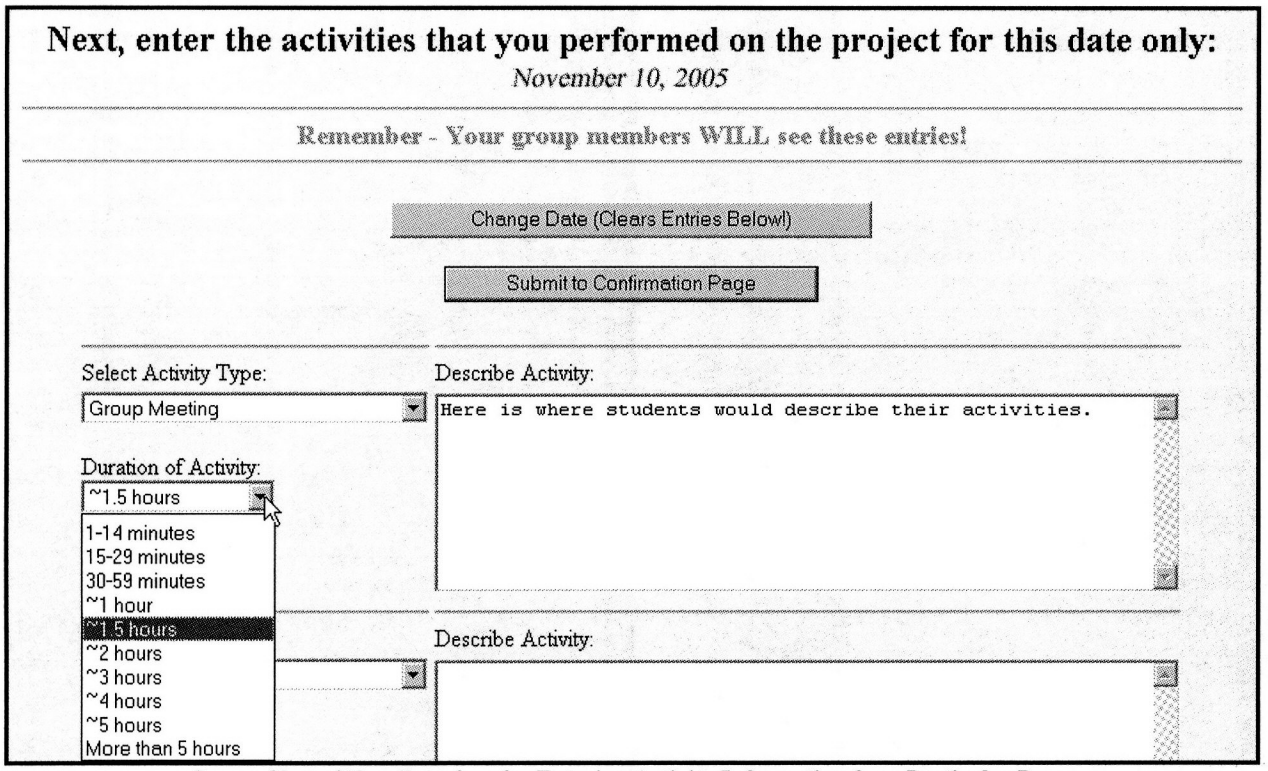
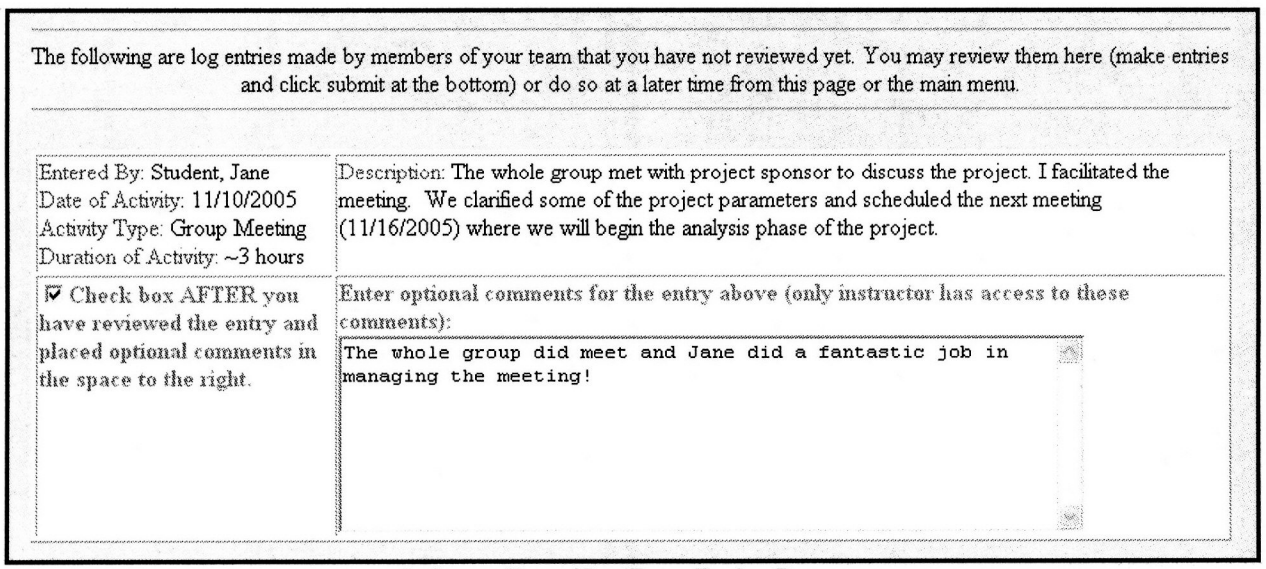


Figure 1. Simplified Flowchart for Activity Log Module



a. Screen Shot of User Interface for Entering Activity Information for a Particular Day



b. Screen Shot of Log Entry Review Page

Figure 2. Screen Shots of Activity Entry User Interface

3.3 Description of the Online Peer Review Module

The online peer review module's primary advantage over paper-based systems is verified compliance with the directions. The system could be easily modified to support other peer evaluation schemes.

Students log on to the system and enter in their team members' names. They are then presented with a form that asks them to rate each student on three different facets of the project: quality of work, level of effort and participation at team meetings. In this implementation the student doing the rating is excluded; however, it could be easily modified to include the rating student. The student rates their peers by selecting a score from one to fifteen (could also be easily modified) from mutually-exclusive radio buttons. The student is also required to rank the members of the team on these three items. Each student must receive a different ranking. This is the portion that students most commonly

resist. It is carefully and clearly explained that even ranking a member last in the team will not necessarily translate into a poor score. It could be that all members produced valuable contributions. This is the reason that both ratings and rankings are done. A student with a very high rating on a facet of the evaluation but is ranked last in the team on that facet will not be considered to have done poorly. Obviously, if someone earns both a low ranking and rating from a majority of their peers then this would lead to a poor evaluation score.

In addition to the ratings and rankings, the student may submit optional comments on each member and overall comments on the team. When the form is completed the student submits it for validation and they receive a confirmation page showing their entries. The system validates the entries to confirm that a rating and ranking has been entered for each student in each category and that each student has been assigned a different ranking than their colleagues on each category. If validated, the student can choose to submit the entries or edit them; otherwise, the student will receive appropriate error messages and will only have the option to edit their entries.

It would be up to the discretion of the instructor whether the students evaluate each other weekly, monthly, twice a term, or at the end of the term. It would also be discretionary as to whether they were instructed to evaluate them for only the period since the last evaluation or cumulatively. Finally, these ratings and rankings could be used to calculate a score directly to be utilized in the grading scheme or, as was the case in our scenario, the evaluations could be used subjectively by the instructor in assigning grades.

3.4 Subjective Assessment of the System

After several semesters of utilizing the system it was the consensus of the instructors that the system was quite successful in meeting the original goals of mitigating negative group behaviors and assessing individual contributions. In contrast with the previous evaluation scheme, it was no longer felt that these individual assessments were done on purely subjective criteria (i.e. which students "appeared" to be putting in the most effort). Subjective evaluation remained part of the equation but confidence in these evaluations was greatly increased by the addition of the objective information provided by the system. Critically, individual assessments also had a much greater appearance of legitimacy since the peer evaluations and the log entries were very consistent (students with higher quantity and quality of activity log entries received higher peer evaluations). The time requirement for the student to enter information into the system appeared minimal and no student complaints were observed over the three years the system was in place. It is estimated that the total time per week required of the student would be around fifteen minutes and most individual entries should take less than a minute to complete. In addition, invalid peer evaluations were completely eliminated since the system required compliance with the directions.

The overall effect of the system on social loafing and free riding is more difficult to assess primarily due to the fact that there was no method of objectively measuring individual contributions in the prior evaluation scheme. The instructors did see an apparent reduction in the number of complaints related to these behaviors during the term and on written course evaluations. It is the instructors' combined opinion that these behaviors definitely were reduced overall and where they occurred they were more likely to be identified during individual evaluations due to the ability of the system to capture the self-reported activities of each student as well as whether their team members agreed with those reported activities.

4. DEVELOPMENT OF HYPOTHESES

After the initial deployment of the system for a semester the instructors had a very positive perception of the system and developed conceptually logical hypotheses (prior to the initiation of this research) from their perceptions of the system and classroom dynamics. Measuring the negative behaviors that are suggested to be mitigated by this system directly would have required intrusive experimental manipulation and measurement and, in addition to being impractical, would likely add significant validity problems. Therefore, student perceptions of the efficacy of the system in its ability to manage, document, and increase the accuracy of individual activity reports were thought to be an acceptable proxy for the efficacy of the system. This suggests that if students perceive that the system is efficacious in these aspects then students would also be less likely to engage in these activities. Since the system is supposed to provide superior information to an authority (the instructor), the analogy of a system that does something similar is worthwhile. Surveillance cameras are believed to mitigate (not eliminate) certain negative behaviors in society and to increase the ability of society in holding those individuals who do choose to engage in those negative behaviors responsible for their actions (Anonymous, 2001; Norris, et al., 2004; Simon, 2002). Empirical evidence of this effect on behavior remains to be studied or is inconclusive in some applications but this technology has been demonstrated as effective in modifying behavior in specific applications including in parking areas (Norris, et al., 2004) and in red light enforcement (Anonymous, 2001). The mitigation component logically only works if the potential perpetrators are aware of their existence; this is the obvious purpose behind "surveillance cameras in use" signs in locations such as parking structures. With the activity log, the students are obviously aware that the system is present and are told that its purpose is to track individual activities (that intent is also self-apparent). Therefore it is believed that by providing evidence that the students perceive that the system works is a reasonable proxy for the system actually working since, on the mitigation side, it is logical that the perception of efficacy is more important than the actual function of the system itself (a surveillance camera would still logically mitigate negative behavior even if it was not functioning as long as people perceived that it was functioning). If the system was to be considered efficacious it would need to be considered to be useful in: managing projects, evaluating individual and team performance, improving communication and information flow between team members, reducing

inaccurate reporting of effort, and/or communicating other aspects of the level of effort required to the instructor. These arguments led to the development of the following hypothesis (in alternative form):

H1: *Students will have a positive perception of the activity log application in its ability to aid the management and documentation of individual activities on a team project.*

In addition to these efficacy measures, it was deemed important to distinguish between the students who are highly motivated and put forth superior effort from those that are not and do not. The logic behind this is that if the system "works" the highly motivated student is likely to have a more positive perception of the system than the student with lower motivation (free riders or social loafers). The direction of this hypothesized effect follows from the belief that the system would highlight and therefore give credit to the students who put in the most effort while not allowing students who would normally be inclined to put forth a minimal effort to do so without consequence. The following hypothesis was developed to address this issue:

H2: *Students who put in greater effort will perceive the application more positively in its ability to aid the management and documentation of individual activities on a team project than do students who put forth average or low effort.*

Finally, students' perceptions about team projects in general were considered. Here we are interested in discovering how students' perceive working on team projects. Specifically, whether they enjoy the activity and whether they perceive these activities to be important to their education. As to whether students who put forth greater effort are more likely to like or dislike team projects and to recognize the importance of these activities is difficult to anticipate logically. One argument would suggest that students may put in more effort because they enjoy team projects; however, an alternative argument is that they may feel they have to put forth more effort to make up for less motivated students and would therefore enjoy team projects less as a result. This discussion yielded the following hypotheses:

H3: *Students will not be indifferent in their overall perception of team projects.*

H4: *Students who put forth greater effort will perceive team projects differently than do students who put forth average or lesser effort.*

5. METHODOLOGY

5.1 Population, Sample and Instrument Administration

The theoretical population being studied is all undergraduate students who engage in team projects in a classroom environment. Two sub-populations were also defined to answer specific hypotheses. These are students in the overall population who put forth greater effort than average on team projects and those who put forth average or lesser effort on team projects. The sample employed was, by necessity, a convenience sample of students who enrolled in a particular course at a large public university. The questionnaire was administered to ten sections of the course over a three year period during the final week of the session. All questionnaires were administered to students who utilized the activity log and peer review system in the classroom setting described in previous sections. The questionnaire was paper-based and administered during class time. Filling out the questionnaire was optional and anonymous and a high return rate was observed (>95%). This yielded a final usable sample of 144 observations. The sub-population sample sizes were 38 for the "greater effort" population and 103 for the "average or lesser effort" population.

5.2 Instrument Development

The questionnaire was developed to address the hypotheses previously discussed. These explore the perception of students concerning the efficacy of the online interactive activity log and team projects in general. Five questions were designed as components of the "Activity Log Perception" (ALP) construct. These questions dealt specifically with the design goals of the application when it was developed. Two questions were designed to address the "Team Project Perception" (TPP) construct.

The instrument was designed by individuals with substantial experience in instrument construction and who were very familiar with the setting being studied. It was concurrently scrutinized by three experienced educators to insure a high degree of face validity. Confirmatory factor analysis was employed to demonstrate the resulting constructs are unidimensional and to demonstrate convergent and discriminant validity. Internal consistency (an aspect of reliability) was demonstrated with Cronbach's alpha. This will be discussed in more detail in following sections. The scale employed and questions included appear in Table 1.

5.3 Analysis of Constructs

Confirmatory factor analyses were conducted to demonstrate unidimensionality of the two proposed constructs. Principal component extraction with both orthogonal (varimax with Kaiser normalization) and oblique (oblimin with Kaiser normalization) rotations were performed. As consistent with the recommendations of Pedhazur and Schmelkin (1991) the oblique rotation was utilized to confirm a low inter-correlation of factors allowing the interpretation of the simpler orthogonal solution to be utilized. The inter-correlation of the two factors under oblique rotation was quite low at 0.240. This provides good evidence of the discriminant validity of the constructs and allows us to use the results of the orthogonal rotation in our analysis.

The orthogonal rotated component matrix is shown in Table 2. The quite high loadings of the items on their corresponding factors provide solid evidence of the convergent validity and unidimensionality of the constructs. Cronbach's alpha based on standardized items, a measure of the internal consistency dimension of reliability, was calculated as 0.88 for the ALP construct and 0.71 for the TPP construct. These calculations only include the items shown as loading on each factor (outlined in bold). Both of these

Very Strongly Disagree	Strongly Disagree	Disagree Somewhat	Indifferent	Agree Somewhat	Strongly Agree	Very Strongly Agree
1	2	3	4	5	6	7

Activity Log Perception (ALP) Construct	1. In comparison to other group activities I have been involved in, the activity log gave the instructor a better idea of the effort put into the project by individuals on my team.
	2. In comparison to other group activities I have been involved in, the activity log gave the instructor a better idea of the effort put into the project by the team as a whole.
	3. The activity log made me more aware of my own level of effort on the project than I would have been without it.
	4. Being able to review and comment on my teammates' activity entries made me more aware of their efforts.
	5. Being able to review and comment on my teammates' activity entries made the level of effort reported to the instructor more accurate.
Team Project Perception (TPP) Construct	6. I enjoy working on group projects.
	7. Whether or not I enjoy working on group projects, I think that the experience is valuable to my education.
Classifier	8. Which of the following categories would you place yourself concerning the project in this class only (check one only)? ____ I put more effort into this project than most of my teammates. ____ My teammates and I put equal amounts of effort into this project. ____ I put less effort into this project than most of my teammates.

Table 1. Questionnaire Items and Likert Scale (Used for Questions 1-7)

demonstrate acceptable reliability using the common social science cutoff point of 0.70 (Nunnally, 1978).

6. RESULTS AND DISCUSSION

6.1 Descriptive Statistics

A total of 144 questionnaires were obtained during the three-year data collection phase. A small number of these contained one or more missing responses and these were excluded on a test by test basis resulting in a slight variability (from 141 to 144) of sample size between different items and statistical tests. Table 3a shows descriptive statistics for each individual item for the entire population. A mean value of greater than the indifference point of 4.00 shows that the respondents had a positive perception of the trait being measured (see Table 1).

These results demonstrate that the students in this course did believe, on the average, that the online interactive activity log was useful in giving the instructor a better idea of the effort put into the project by individuals and the team as a whole (items 1 and 2). In addition, the ability to review and comment on their team members' activity log entries made them more aware of their own and their team members' efforts (items 3 and 4) and made the level of effort that was reported to the instructor more accurate (item 5). Students were indifferent as to whether they enjoy working on team

Item	Component 1	Component 2
1	.825	.182
2	.844	.106
3	.792	.091
4	.759	.048
5	.829	.091
6	.047	.887
7	.174	.864
Cronbach's alpha	.88	.71

Table 2. Principal Component Factor Analysis (Varimax Rotation)

projects (item 6) but were very positive on whether they perceive team projects as beneficial to their education (item 7). The constructs were obtained by a simple mean of the items they contain and can be interpreted in the same manner where 4.00 is indifferent and greater than 4.00 shows a positive perception of the construct (Table 3b). The overall perception of the efficacy of the activity log application (ALP construct) and the overall perception of team projects (TPP construct) show a positive perception for both by the overall population.

Item	N	Mean	95% Confidence Interval	
			Lower	Upper
1	144	4.91	4.67	5.16
2	144	4.75	4.51	4.99
3	144	4.31	4.05	4.59
4	142	4.33	4.09	4.57
5	143	4.48	4.26	4.70
6	143	4.01	3.73	4.30
7	143	5.38	5.17	5.60

Table 3a. Descriptive Statistics for Individual Items ("Indifferent" = 4.00)

Construct	N	Mean	95% Confidence Interval	
			Lower	Upper
ALP	141	4.57	4.37	4.76
TPP	142	4.70	4.48	4.92

Table 3b. Descriptive Statistics for Constructs ("Indifferent" = 4.00)

6.2 Hypothesis Testing

The hypotheses to be tested in this section were developed previously in section 4. The following is a review of these hypotheses (in alternative form):

H1: *Students will have a positive perception of the activity log application in its ability to aid the management and documentation of individual activities on a team project.*

H2: *Students who put in greater effort will perceive the application more positively in its ability to aid the management and documentation of individual activities on a team project than do students who put forth average or low effort.*

H3: *Students will not be indifferent in their overall perception of team projects.*

H4: *Students who put forth greater effort will perceive team projects differently than do students who put forth average or lesser effort.*

All hypotheses were tested with a level of significance of 0.05 and all had significant results and were therefore supported. Tables 4a and 4b show a summary of these results.

Hypothesis H1 is directional and tests the overall population to determine if their perception of the activity log is positive as anticipated. The test utilized a one-tailed t-test that the ALP construct was greater than the indifference point of 4.00. The testing for H3 was similar except for the test being two-tailed. It was not predictable whether the perception of team projects was positive or negative so this tested whether the mean was different than the indifference point of 4.00. The results showed that the perception of team projects was positive.

Hypotheses H2 and H4 test for differences between the subpopulations of those who report they put forth greater effort on projects and those who report they put forth average or lesser effort. In Table 4b, the values with a subscript of '1' correspond to the "greater effort" sub-population. As in the tests for the entire population, it was anticipated that one hypothesis (H2) was in a particular direction while the other (H4) was a situation where the direction of the effect could not be anticipated. The test for H2 was a one-tailed test that the sample mean for the ALP construct for the sub-population that put forth greater effort would be greater than the sample mean for the average or lesser effort sub-population (indicating the "greater effort" group perceived the activity log more positively). H4 was two-tailed and tested whether the sample mean for the TPP construct was different for the two sub-populations. The results indicate that the "greater effort" sub-population had a less positive perception of team projects in comparison with the sub-population that put forth average or lesser effort.

Hypothesis	n	Mean	t	P(T<=t)
H1	141	4.57	5.663	0.0000
H3	143	4.70	6.295	0.0000

Table 4a. Results for Hypotheses (H1 & H3) Testing Entire Population

	n_1	n_2	$Mean_1$	$Mean_2$	t	P(T<=t)
H2	37	102	4.88	4.45	1.87	0.0315
H4	38	103	4.04	4.93	-3.66	0.0000

Table 4b. Results for Hypotheses (H2 & H4) Testing Differences Between Sub-Populations

6.3 Discussion of Hypothesis Testing Results

Since all four of the hypotheses were supported the logic presented in the development of these hypotheses also is supported. From the previous discussion it was suggested that if the system did, in fact, work as anticipated then the students as a whole should have a positive perception of the system and the students who put forth greater effort should have a more positive view of the system than those who do not. The logic for this is that the "greater effort" group would feel that the system would highlight their efforts and would lesson the ability of potential loafers and free riders from being able to hide their lack of effort behind team results. Since the associated hypotheses (H1 and H2) were supported, there is good evidence that this is true.

During the development of the hypotheses concerning students' perceptions of team projects (H3 and H4) there were no clear conceptual arguments apparent to suggest whether students as a whole perceived them positively or negatively or whether there were differences in this perception between the two sub-populations. Concerning the potential difference in sub-populations, as previously

discussed, one argument would suggest that students may put in more effort because they enjoy team projects. However, an alternative argument is that they may feel they have to put forth more effort to make up for less motivated students and would therefore enjoy team projects less as a result. The results of these tests demonstrate that students do have an overall positive perception of team projects and that the students who put forth greater effort have a less positive perception of them. The first part of this is somewhat encouraging in that students do have a positive perception of these activities. Although student perceptions do not necessarily equate to educational value the fact that students agree with instructors that team projects do have value is certainly a positive result (it is assumed that instructors who utilize team projects believe they have educational value). The results demonstrating that students who put in the most effort view team projects less positively supports the conclusion that they may feel forced to put in greater effort and thus enjoy the activities less. This supports the premise that is the primary motivation for this research – that social loafing and free riding are problems and that these negative behaviors are harmful. They harm the students who engage in them by lowering the amount of learning they achieve (making the assumption that by doing fewer activities on the overall project they learn less than if they would have performed their share of activities). It also harms the students who do not engage in these negative behaviors by having their overall educational experience negatively affected. It should also be noted that these students may actually learn more by being forced to do more. However, it is likely that most educators would not consider an inequitable division of labor to be a preferred method of achieving some additional learning in a portion of the student team.

7. CONCLUSIONS

The primary contribution of this research is the description of the technology and efficacious application of that technology in a specific classroom environment. Qualitative and quantitative empirical evidence, in the form of a subjective assessment of classroom observations and an objective survey-based quantitative analysis, has been offered to support the claims of usefulness in the application of these technologies.

It is the perception of the classroom instructors involved that the online interactive activity log and online peer evaluation modules were very successful in meeting their objectives of reducing negative team behaviors and providing more useful information on individual performance. Although these technologies have only been applied in one classroom setting, the instructors are of the opinion that it could easily be applied to other settings involving student team projects likely achieving equally impressive results.

A survey method of exploring student perceptions of the system was also offered to corroborate the subjective assessment of the instructors. The analysis of these results showed that students generally had a positive perception of how well the system was able to provide the instructor and team members with useful and accurate information on the team's project activities. Key points here are that the students believe the system provided the instructor and the team members with superior information regarding individual activities and that this information was likely to be more accurate than it would be without the system. This included the ability to review and comment on the activities entered by other members of the team as increasing the accuracy of the entered information. This validates that this important goal of the initial undertaking was met.

Further results of the survey revealed that the students who put forth greater effort on projects view the system more positively compared to students who put forth average or lesser effort. This is an important result since it is apparent that the negative team behaviors of social loafing and free riding (that the system is designed to mitigate) harm the students who do not engage in these behaviors to a greater degree. In fact, habitual free riders were anticipated to have a very negative view of the system since it makes it difficult for them to engage in this behavior without consequence. These results further demonstrate the efficacy of the system in mitigating these behaviors.

The survey also explored the student's overall perceptions of team projects and their role in the student's education. It is interesting that students do perceive these projects as important to their education. The faculty in the setting of the described scenario have spent a great deal of effort in emphasizing the importance of being able to work in team environments including the involvement of local IS professionals who also emphasize this point.

Finally, one of the most intriguing results of this survey was that the students who put forth the most effort perceive team projects less positively. The fact that these results demonstrate that the more motivated students have a degree of dissatisfaction with these types of activities emphasizes the need for instructors in courses that employ them to do all they can reasonably and prudently do to mitigate these negative behaviors in student project teams.

8. LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Several aspects of validity and reliability have been discussed. Evidence of face, convergent, and discriminant validity along with internal consistency reliability was provided. However, this research does have as its primary limitation an unknown level of external validity. This is a common limitation in this type of research due to the fact that many instructor/researchers do not have access to the variety of classroom settings that would be required to demonstrate external validity. The setting that this research was conducted in was described to aid other educators who may be considering applying these methods in determining whether the results should be expected to be similar in the environment they are engaged in. Assuming these methods do become implemented in other settings a direction for future research would be to analyze the efficacy of the methods in those settings thereby demonstrating (or refuting) external validity. Finally, although external validity cannot

be objectively demonstrated in this case, there is no obvious reason to believe that settings that are at least similar to the research setting would not also find similar benefits.

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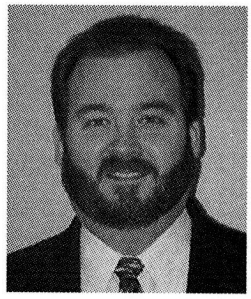

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