
Does the Perception of Team Collaboration Changes with Time? Study with Computer Science Students

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framework for discussing the variables mediating learning-team effectiveness. An exploratory study with Pre- and Post-test was conducted with a sample of 49 students of Computer Science. Team collaboration was measured

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Abstract

In this paper, we discuss the need for teamwork skills in the workplace and the training of Computer Science Bachelor students to perform in teams. Researchers claim that collaborative learning can positively influence teamwork competencies. We argue that time can change participants' perception of the effectiveness of the team collaboration. The group development model TEAM (Team Evolution and Maturation) offers a

using the Team Collaborator Evaluator (TCE). Results indicate that the perception of team collaboration changes pending on the moment of the evaluation. The outcomes of this study could potentially be used to build more effective teams and might be extended to interdisciplinary teams.

Author Keywords

Collaborative learning; TEAM; Team collaboration; Team effectiveness; Teamwork skills.

ACM Classification Keywords

H.5.3 Group and Organization Interfaces: Computer-supported cooperative work

Introduction

The goal of this study is to explore the differences, if any, on the perception of team effectiveness in teams of STEAM (Science, Technology, Engineering, the Arts, and Mathematics) students, considering the moment when that evaluation is made. Teams are becoming critical in the way work is organized [1] and, consequently, teamwork skills have become essential in staff [2]. Teams were found to be more flexible and responsive to shifting events than the traditional departmental configuration, as teams have the capability to rapidly assemble, deploy, refocus, and disband [3].

Nevertheless, massive problems can still be found in individuals working in teams [4].

A team includes two or more individuals, with certain roles, who perform co-dependent tasks, are flexible, and share a common goal [5]. To function as a collective, a team needs to have some key attributes like common perception, shared aims, interdependence, social organization, interaction, cohesiveness, and membership [1, 6]. Businesses, especially those related to technology, increasingly rely on teams to enhance productivity. Therefore, they expect colleges to prepare graduates to effectively operate in teams [7, 8, 9]. Higher Education Institutions (HEI) and employers both agree that academia plays a major role in improving the personal proficiency competence cluster [9]. There are reports on the lack of support from the HEI in preparing their students to build effective teamwork skills throughout their studies [2, 9]. Students agree that teamwork is a highly desirable skill [7, 8, 9]. Personal proficiency competence cluster includes teamwork, not only concerning its extensive features, but also leadership, time management, and the ability to work effectively with others [9].

According to Fransen [10], the Team Evolution and Maturation (TEAM) model is appropriate for application in the educational context, as it acknowledges that ad-hoc learning-teams have to develop by proceeding through stages. Moreover, it also recognizes the effect of deadlines on learning team development, the emergence of a transition phase (i.e. the re-norming stage), and the influence of past experiences with teamwork on the pattern of team development [11]. The TEAM model offers a framework for discussing the variables mediating learning-team effectiveness. It

assumes that the impact of these variables may differ according to the stage of development in the learning team and may have a specific influence on learning team evolution and maturation [11]. Accordingly, this paradigm is the theoretical guide of this study.

Learning collaboratively is considered a critical pedagogical approach [12] that arises in so-called communities of inquiry that facilitate the construction of personally meaningful and socially valid knowledge [12]. This is based on the constructivist paradigm that students must be involved in the process of knowledge construction through discussion, debate or argument if they are to establish deep learning and understanding [13]. Although, some authors report a reluctance in students to work in teams' due to negative experiences in past collaborative team experiences [1, 14]. Team effectiveness includes the quality of the team's performance and the perceived satisfaction of individual team members' needs [10].

Shimazoe and Aldrich [15] have found several benefits of teamwork such as advancement of deep learning, earning higher grades, campaign of social skills/civic values, increasing level of thinking skills, encouraging personal growth, and positive attitudes toward independent learning. Furthermore, it facilitates active exchange of thoughts, rises motivation among participants, and develops a better understanding of plain cultural backgrounds [6]. This might be remarkably important in economic sectors that are highly competitive and diverse, like the technology, for instance. Despite the significant number of benefits, Davies [1] has also shown that some problems that may arise with teamwork, such as motivational issues, the ethnic mixes, the complexity of the task, the recognition

of individual effort, the group size, encouragements, and penalties, or even the free-rider effect.

Most researchers agree that teams must cultivate shared mental models to set team goals, define strategies, allocate subtasks to team members, monitor team processes and effectively communicate [10, 16]. Furthermore, to be called teamwork, individuals should possess specific knowledge, skills, and attitudes, such as the ability to monitor each other's performance and a positive approach toward teamwork [10, 16]. This suggests that the team develops over time, and this might influence team dynamics and the interaction among all members. Some scientists argue that teamwork is influenced by the social skills of its members [17]. Still, there is little consensus about its effects [17]. Teams, especially ad-hoc learning teams, are often initially ineffective because team members lack necessary information about each other's competencies and do not exhibit mutual trust, having not experienced each other's behavior in a team situation [18].

We hypothesize that there is no difference in the perception of the team effectiveness considering the moment when the evaluation takes place.

Method

In this exploratory study, with a Pre- (deployed in week 4) and Post-test (deployed in week 9), a convenience sample was chosen, comprised of a class of the third year of the Computer Science bachelor program (CS), from a University in Southern Europe. The experiment was done as part of a team project in class, to keep the subjects as close as possible to the natural context of team collaboration. Students had ten weeks to work

with the same team and complete a team project, where they had to design, program, and build a robot that would perform a specific task.

The Team Collaboration Evaluator (TCE; [10]) was selected to weigh team collaboration. It allows to collect data about the perceived quality of team collaboration at various stages and has the potential to be a team tester to predict the emergence of learning team effectiveness during early collaboration stages [10]. Scores in the factors Shared Mental Models, Mutual Trust, Mutual Performance Monitoring, and Perceived Team Effectiveness (each one with three items) were rated using a 1 to 10 scale (1=Low/Almost Never True to 10=High/Almost Always True). All the elements consisted of statements covering aspects of team collaboration. Internal consistency of this instrument was high (Cronbach α = .90).

This study involved a total of 59 students enrolled in the Computer Science program (CS). However, just 49 students replied to the questionnaire, as the remaining students ($n=10$) dropped out of the course for reasons not connected to the experiment. Students were informed previously about the goals of this experiment and agreed to take part. Of the 49 respondents, 7 were female students (14.3%) and 42 males (85.7%).

Findings and Discussion

A paired-samples t -test was conducted to explore the difference in the students' perception of their team collaboration according to the moment it was assessed (Pre- or Post-test). The subscale shared mental models showed significant differences [Pre-test: $M=7.81$, $SD=1.16$, Post-test: $M=8.54$, $SD=1.05$, $t(34)=-3.89$, $p=.00$, $\eta^2=.31$]. Previous studies show that shared

mental models facilitate the processes of setting goals, establishing strategies, monitoring team processes, and communicating effectively [1, 16], leading to stronger team collaboration scores [1, 10, 16]. This goes in line with the fact that the perceived shared mental models have grown over the semester. The results in this subscale confirm that these teams can assemble and deploy in less than eight weeks, confirming previous findings [3]. CS teams present no significant differences to research done in other areas.

Findings also show that students changed their perception over the mutual performance monitoring [Pre-test: $M=7.67$, $SD=1.44$, Post-test: $M=8.27$, $SD=1.32$, $t(38)=-3.35$, $p=.00$, $\eta^2=.23$] and the perceived team effectiveness [Pre-test: $M=8.13$, $SD=1.41$, Post-test: $M=8.68$, $SD=1.06$, $t(38)=-2.73$, $p=.01$, $\eta^2=.16$]. As participants tend to consider their teams more effective at the end of the semester, it might indicate that the students were involved in the process of knowledge construction [13], not confirming the studies that report a reluctance in students to work in teams' due to negative past experiences [6]. This study illustrates that CS students recognize on themselves the ability to monitor each other's performance, confirming previous work in other areas [10, 16]. Considering the results of this study, the framework of the TEAM model seems to be appropriate for application also in the teams of CS students, as it deems the variables mediating learning-team effectiveness. However, this model still needs further research, namely its application to interdisciplinary groups.

The small size of the sample presents a limitation of the study. Student academic records may also be

considered in future research, so correlations between past performances and teamwork result can be conducted. Our research is only a first step towards understanding team collaboration mechanisms in groups of CS students. Additional research is necessary to increase our understanding of the mechanisms through which teams collaborate, and more specifically the reciprocal causation of team collaboration with team performance in teams of STEAM students and interdisciplinary teams.

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