Poster: Analyzing the transactive memory in teaching Software Engineering

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ABSTRACT

Software Engineering education requires offering to students practical experience via collaboration with the industry and working in teams. At the same time, students require different skills and knowledge at different levels of their studies, i.e. undergraduate versus postgraduate. In this context, Transactive Memory, referring to the shared store of knowledge, affects the dynamics in groups influencing the teaching outcome. In this paper, we present the process that we have employed in University of Cyprus, for teaching Software Engineering courses to bachelor and master students. We describe the process of team building, the different roles, and how the group dynamics can affect Transactive Memory.

CCS CONCEPTS

• **Software and its engineering → Reusability**; **Open source model**; **Programming teams**; *Software development process management*; Software development methods;

KEYWORDS

Software Engineering education, transactive memory system, project manager

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1 INTRODUCTION

Bridging this gap between education and the industry is not an easy task [6]. Succeeding in this process requires bringing students together in teams asking them to collaborate toward a common goal: the completion of a Software Engineering project. Project management plays an important role in Software Engineering education and in software system development, as it may largely affect the success of the project or may be the reason of software project failure. The current form of software development may make the role of project management even more vital, as software development is performed in interdisciplinary teams and their members are expected to collaborate, exploit their capabilities and know-how toward a common goal.

In this endeavor, Transactive Memory System (TMS) represents the collective awareness of the group's specialization, coordination, and credibility; three aspects that are considered vital for a successful and productive collaborative team in Software Engineering projects [8]. The notion of Transactive Memory (TM) and the development of a TMS have proven to be very promising for the functioning of couples, teams and groups in several contexts. Transactive ÎIJemory is memory that is influenced by knowledge about the memory system of another person [8]. A Transactive Memory System represents the collective awareness of the group's *Knowledge Specialization*, *Task Credibility* and *Task Coordination*.

Different approaches in SE education can be found in the literature including works that have studied the effect of Software Engineering projects on students, such as self-efficiency [1]. In this work, we focus on the team level and interactions. The use of TMS is not new to Software Engineering research. In [7], the authors studied, among other social theories, the development of TMS within software development teams and concluded that having TMS in the team is rather helpful, especially in understanding the skills and expertise available within the team subjects and in managing a successful software development project. This previous study acted as an initial inspiration to our research for exploring the development of TMS in the Software Engineering courses at our University. Furthermore, a previous work that investigates knowledge sharing in open source software teams and information systems development teams reveals that parameters related to TMS have positive impact on how the team is sharing knowledge, on the quality of communication of information within the team, on the way the team coordinates tasks among its members and finally, on how the team performs overall [2–4].

The study described in this paper is an initial attempt taking place at the Department of Computer Science in University of Cyprus, to exploit the results of Software Engineering research and explore an alternative approach to Software Engineering and Software Engineering Project Management education, by bringing together postgraduate (masters) and undergraduate (bachelor) students in the same team. Projects of different size and domains are undertaken by undergraduate student teams consisting of four to six students. Projects are defined by an industrial partner or by a Department or Service within the University. The software project may thus, refer to any kind of application needed in the organization (e.g. web system, mobile application, customer management system). The students work on: 1) Requirement and specification, 2) System design, and 3) System prototype implementation, following the first phases of the prototype development model. A

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project manager (postgraduate student) is assigned to each team of undergraduate students. As part of their role, the postgraduate students are responsible for 1) organizing meetings, 2) supervising the procedure followed by their team and 3) completing all project management documentation based on specific templates, including Project Management Plan, Work Breakdown Structure, Risk Management and Quality Management.

2 USER STUDY

In the framework of this work, we are studying the effect of TMS on the SE student teams considering also the different roles of the members (regular team members versus project manager). The Transactive Memory System Scale Items, divided into *specialization*, *credibility* and *coordination*, have been employed. Each subscale or dimension has five items (using a 5-likert scale) [5].

The study participants, 43 in total, are students at undergraduate and postgraduate level who attended the aforementioned SE courses during the academic year 2016/2017. 18 were female (41.9%) and 25 male (58.1%). The teams followed the set-up discussed above and at the end of the semester they were all asked, but not forced, to answer the TMS scale. Members from eight teams replied to the questionnaire. The analysis of the results was done following the work in [5]. Overall analysis was performed to gain a holistic picture, and to examine whether there were any differences between teams.

Results The overall TMS for all teams was above average[1] (Mean: 10.71, Std. Dev: 1.23) providing evidence of understanding the overall complementary knowledge among team members. Individual parameters were also extracted: specialization (Mean: 3.49, Std. Dev: 0.94), credibility (Mean: 4.08, Std. Dev: 0.65) and coordination (Mean: 3.12, Std. Dev: 0.27) indicating results above average, but calling for further analysis in order to draw more detailed conclusions.

One way ANOVA test was used to explore possible significant statistical differences in the development of TMS and its parameters between teams. The development of TMS was the same across teams and no significant differences were revealed indicating also that TMS is not affected by the application domain. Pearson correlation was employed to examine whether a relationship exists between TMS development and other parameters (gender, previous working together). The results revealed no correlation between gender and TMS development, nor with previous working relationships. The above results called for further investigation of the students' responses; thus, we looked deeper in the TMS scale items (each question individually).

Although results in previous analysis did not reveal any significant statistical correlations, significant correlation was observed in the third item of credibility parameter in relation to gender ($r = 0.374$, $p = 0.013$). According to these results, male participants appear to be more confident relying on information brought in the team by other members than female participants were. In addition, the majority of participants acknowledged the knowledge diversity existed among the group members (41.9%) and they appreciated holding unique knowledge that no other member had (37.3%). On the other hand, in the coordination items, participants seemed to have struggled to accomplish activities smoothly and efficiently in their teams with 62.8% selecting the most negative option in the scale. In the credibility items the participant appear positive in all questions demonstrating trust in each other.

A one way ANOVA was conducted to compare the responses of students acting as project managers to those who were conducting the project as team members. An analysis of variances showed that for the question "*I was comfortable accepting procedural suggestions from other team members*", there was a significant statistical difference $F(1.41) = 19.16$, $p=0.000$, with students acting as managers being more reluctant in accepting procedural suggestions by other members of the team. Similarly, for the second question "*I trusted the other members' knowledge about the project was credible*", students acting as managers appear to be significantly more reluctant to reply positively with significant statistical differences between the two groups $F(1.41) = 8.21$, $p = 0.017$.

3 DISCUSSION

Students were generally positive about their collaboration, as they were able to utilize better the dynamics of the team with more space for task organization and coordination. Furthermore, students acknowledged the diversity of expertise that existed in the teams and utilized this in approaching the project with undergraduate students appreciating the experience and expertise of postgraduate students ranking the credibility items above average in all five questions. On the other hand, inexperience of undergraduate students picked from the postgraduates who acted as project managers and ranked two of the credibility items below average with significant difference compared to undergraduates. An interesting finding that needs further investigation is that female participants were overall more reluctant to accept and trust information brought in by other members of the team.

Our study has limitations mainly found in the small sample of students employed. Immediate future work will clarify the above findings in a larger scale ecologically valid study and in a more systematic approach, in order to be able to compare and generalize these initial findings.

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[1] For TMS the average is 5 and for each dimension the average is 2.5.