

The Dynamics of Motivational and Emotional Challenges and Regulation Strategies in Customer-Driven Project-based Learning

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Abstract—Project-based learning has been introduced in many university courses as a dynamic classroom approach that motivates active exploration of real-world problems. It is also proven as one of the most effective ways for students to acquire practical skills and deeper knowledge. However, while learning with technologies in project-based blended environments, students are expected to know how to cope with real-world complex issues. Hence, students from two universities participated in an exploratory study with a focus in motivational and emotional challenges as part of collaborative learning. In particular, the study explored what regulation strategies students practiced as an answer to the challenges they encountered in customer-driven project-based learning activities. Nonetheless, the broad idea is to understand in what ways collaborative learning can be beneficial or debilitating for students' progress, and how technology can support or influence positive outcomes.

Keywords—blended learning, socio-emotional challenges, survey study, focus group

I. INTRODUCTION

Majority of the higher education (HE) institutions are practicing technology-enhanced, student-centered learning environments to accommodate the industry's evolving expectations for an agile, adaptable, and inventive workforce [1]. The focus is on active learning through cultivation of the 21st century skills [2]. Moreover, a survey performed by the Association of American Colleges and Universities, reported that majority of the surveyed companies believe that learners should immerse in experiences with strong emphasis on applied learning and teamwork, skills that recent graduates lack [3]. Therefore, many HE institutions are developing curricula that nurture these skills and provide learners with more hands-on, real-world experiences [4].

Project-based learning (PBL) is one of the methods that facilitate active and self-regulated learning (SRL) with instructors as guides that model inquisitive behavior [5]. This pedagogical model engages individuals in authentic collaborative learning experiences, where knowledge and skills are realistically embedded [1]. Although PBL promises to overcome some of the drawbacks in the traditional teacher-centered degree programs, its success is highly dependent on the learner's ability to direct their own learning utilizing metacognitive strategies [6]. Moreover, studying SRL in individuals is noting new and has been extensive [5], [7]. However,

there is a limited research investigating SRL in collaborative settings, especially the interplay between individual and social regulatory processes [8].

The socio-cognitive models of SRL hold the view that regulation is an individual process; however new streams have evolved over time that recognize the significance of context and social interaction [9], [10]. In addition, Zimmerman explains that SRL is not socially isolated learning [11]. Consequently, SRL is not an aptitude; it is an adaptive process that depends highly on the context and the conditions [12]. Furthermore, in collaborative learning, behaviors and cognition grow interdependent, and as such, affect individual's goals, decisions, motivation, and regulation, leading to coordinated and shared mental and motivational efforts [13]. These aspects can facilitate or obstruct the learning, by either strengthening the interdependence or evoking negative socio-emotional challenges (e.g., conflict).

This study aims to explore and identify the socio-emotional challenges students experience in collaborative learning, in particular, customer-driven PBL, and to understand how successful students take advantage of technology to learn and collaborate. The customer-driven PBL is a local variation of the generic PBL model [14] in which learners work on a real problem with the help of the technology, while being mentored by company's employees. This pedagogical model is developed in collaboration with the Nordic tech-companies, as a learning with technology method, where technology promotes access to resources and tools that facilitate collaboration and knowledge construction. The instrument used in this study is the "Adaptive Instrument for Regulation of Emotions" (AIRE), designed to identify the social challenges [8]. Hence, the research questions that this study tries to address are the following:

- 1) "What kinds of motivational and emotional challenges students experience in customer-driven PBL?"
- 2) "What kinds of regulation strategies students practiced in customer-driven PBL?"
- 3) "How are the individual and shared regulation processes in customer-driven PBL interrelated?"

II. BACKGROUND

A growing body of research shows that socio-emotional aspects contribute to enhanced interaction, communication,

and engagement in shared learning activities through effective self-regulation and co-regulation [8], [10], [15]. However, an assumption that group members who collaborate together can also regulate the learning together (not just co-regulate), is yet to receive the deserved attention [8]. When such processes are considered, important contextual findings might emerge, and new psychological models for motivation and learning might be developed that could have practical applications towards the educational improvement efforts.

Over the years, there is an increased integration of student-designed project-based learning environments [3]. However, relatively little focus has been placed on understanding how successful students take advantage of these environments and how computer technology assists individuals in learning [16]. Furthermore, the effectiveness of technology enhanced learning environments can only be achieved if learners can employ regulatory processes, since these environments create complex interactions among cognitive, motivational, and social processes [16]. In addition, there is a limited research investigating regulation in shared learning, specially the interplay between individual and social regulatory processes within collaborative learning activities [8].

When it comes to studying emotion and motivation regulation, research has taken a slow pace [17]. Emotion regulation is learner's ability to monitor, evaluate, and change a particular emotional experience [18]. An effective emotion regulation can lead to motivation required to complete a task [17]. Hence, focus must be given to strategies students can employ to cope with the challenges (e.g., from personal goals and expectations to perceived incompatibility) and regulate any emerging problems that impose emotional pressures on students. Self-regulation refers to metacognitive strategies students use to take charge of its own learning and performance [7]. Finally, socially shared regulation focuses on the group as a unit of analysis, referring to all group members that regulate their collective activity in a genuinely shared way [19].

As documented in the educational literature, challenges in collaborative learning are mostly related to the social dynamics, rather than the technology [8]. Thus, considering the self-regulated learning scenarios, Wolters [18] introduced five motivational strategies. These strategies focus on individual motivation regulation, and since collaborative learning is not unidirectional and isolated learning process, the authors in [20] modified the framework to adapt it to socially shared learning. In sum, meaningful emotion and motivation regulation are essential to the development of successful collaboration in PBL activities, academic achievement, and life-long learning strategies [21]. Nonetheless, this study aims to observe the dynamics of collaborative learning in technology enhanced environments so that researchers can integrate motivation into the learning design and implement technology in education, utilizing pedagogy and content informed by research [20].

III. METHODOLOGY

A. The instrument

The methodological approach used to answer the research questions was based on AIRE, an instrument to measure the adaptive and social nature of the regulation process in socially shared learning with focus on students subjective experiences

[8]. The instrument has been previously published, and verified for its reliability and validity [8], [22]. AIRE consists of four sections, each sensitive to the responses in the earlier sections. The four sections focus on different key concepts: *personal priorities, socio-emotional challenges (e.g., personal, work and communication, teamwork, collaboration, and external constraints), forms of regulation (e.g., self-, co- and socially shared forms), and reflections on personal goal attainment* [8]. The assumptions behind the key concepts are based on the following:

- 1) In general, students generate personal goals (sometimes unconsciously) that they strive to achieve, alongside the learning goals set by their teachers [8];
- 2) After establishing the goal commitment, students move towards performance, or in other words deciding how to achieve their goals [7];
- 3) In order to avoid failure or breakdown in the team, students try to regulate emotions and motivation as individuals or together with the rest of the team (i.e., self-, co-, or shared regulation) [8];
- 4) At the end, students have the option to reflect on the whole learning experience.

B. Participants and research context

The selected participants were third year computer science (CS) students and information technology (IT) students coming from two different universities - Norwegian University of Science and Technology - NTNU and University of South-Eastern Norway - USN. A total of 54 students participated in the study (35 from NTNU and 19 from USN). The students' PBL activity was set in a computer-based learning environment with high degree of learner control. The students were divided in groups of 5-7 persons with the aim to gain practical experience by executing all phases of a large development project, such as requirements specification, design, implementation, and evaluation of a software solution. The expected learning outcome was solving complex software development problems, using the skills students have gained in their previous years of studies. These are the similarities between the two universities. Regarding the differences, at NTNU, the groups of students are supported by teaching assistants (TAs) that meet with the groups every week. The students from USN have no support from TAs; the only person they can contact for help is their professor. Moreover, the students at NTNU in their program have more technical courses, compared to the students from USN, which have management and business oriented studies. Both groups will be treated as separate cases, with the aim to observe any similarities and differences between the groups.

C. Procedure

The first step in the study included administration of the survey [8] to students undertaking mandatory customer-driven project course. The survey asked students to rate on a four-point Likert scale in all four sections. In addition, in section one students were asked to write down their major goal for the project. The survey was administered during the last week of the course and the following two weeks after the end of the course (November-December 2018). The second step included a focus group organized with the project leaders from NTNU in the last week of the course. In total, there were 14 groups

and 14 project leaders, of which only 6 were present at the focus group session (43%). The aim of the focus group was to encourage discussion among the group leaders regarding types of regulation strategy they used and skills they should hold to be able to regulate any evoked challenges during customer-driven PBL.

D. Data collection and analysis

The data was collected from two different data sources, an administered validated survey instrument (i.e., AIRE), and a focus group. The data from the survey included students' ratings on a four-point Likert scale, one major goal for the project work they had expressed in writing, and selection of the most and least experienced socio-emotional challenges. Regarding the data analysis, a descriptive statistics has been performed to describe the data from the survey. The Cronbachs alpha, computed for the overall scale was $\alpha=.858$, while for NTNU and USN was $\alpha=.845$.

During the focus group, the facilitators practiced a deductive approach based on already formulated and theoretically driven individual regulation strategies proposed by [18] and the adapted motivation regulation framework for a socially shared learning activities [20]. In general, the researches looked for the challenges and regulation strategies leaders practiced from two different perspectives, as a leader of a group and as a member of a group. An affinity diagram technique [23] was applied to systematize and group the brainstormed experiences leaders had taking into account the two different perspectives.

IV. RESULTS

The total number of surveys sent was 138; while the student response rate was approximately 40% (35 and 19 students respectively). Male participation (63% NTNU and 73.7% USN) was higher compared to female participation (37% NTNU and 26.3% USN). The participation was voluntary and all students consented to participate in the study. No surveys were removed from the sample, because there were no missing responses. In addition, most of the respondents (i.e., 80% from NTNU and 68.4% from USN) were between 20 and 23 years old.

Figure 1 shows the major goals students have written in the survey, classified by the authors in several categories. On the other hand, Figure 2 shows the most frequent answers for other important things in a project. A very interesting finding was that *not working more than others* and *avoid being stress* is something the students care the least in shared learning.

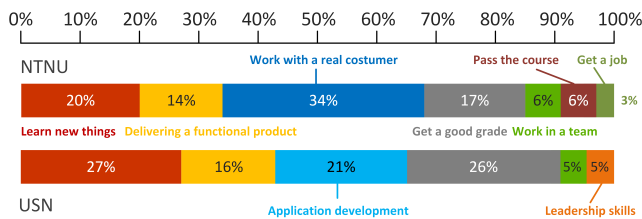


Fig. 1. Students' major goals

Teamwork was the most frequently reported challenge at both universities. Figure 3 shows the percentage of the five broad categories of challenges students experienced during

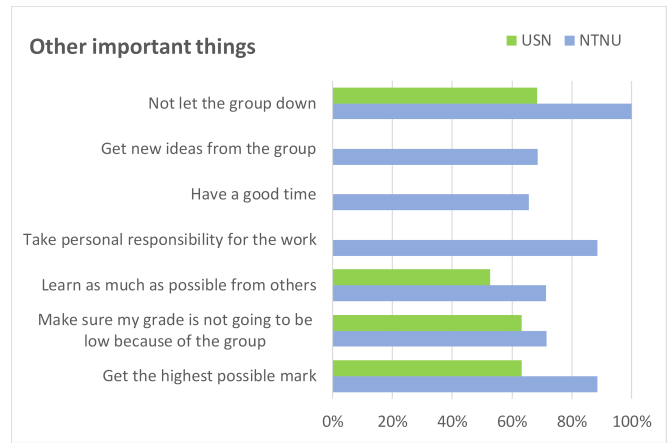


Fig. 2. Other important things in project work

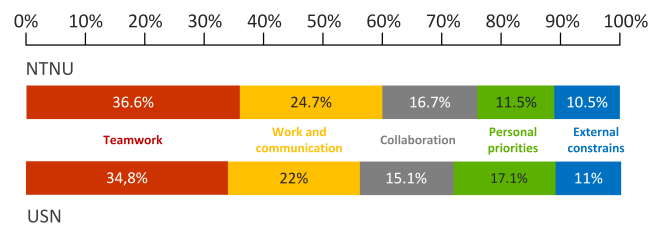


Fig. 3. Categories of reported challenges

the project. This distribution of challenges did not occur by chance, as confirmed by the chi-squared test ($\chi^2_4 = 67.68, p < .001$) for NTNU and ($\chi^2_4 = 27.4, p < .001$) for USN. Moreover, when students were asked to choose what was the biggest challenge they faced in the project, students from both universities reported *people not fully committed to the project* (28.6% NTNU and 52.6% USN) from the work and communication category [20]. Challenges that majority of the students from NTNU did not experience fall in the category of personal priorities (28%), in particular, *different goals for the project* (54.3%) and *different priorities* (51.4%). However, majority of students from USN did experienced these challenges; *different goals for the project* (36.8%) and *different priorities* (31.6%). Figure 4 shows some of the small challenges that groups experienced during the project.

Regarding the forms of regulation, the study showed that majority of the students practiced relatively often self-regulation strategies (35.6% NTNU and 38% USN), in particular, *trying to act more flexible* (68.5%) and *trying to accept the situation* (48.6%) from NTNU, and *trying to accept the situation* (51.4%) from USN. When engaged in co-regulation, they have chosen to *tell the others to accept that some people will work more than others* (21%); *tell the others to be more flexible in order to find a solution* (31.4%); and *try to convince others that we all are different and we can solve the situation* (28.5%). Moreover, there was a significant percent of students that engaged relatively often in shared regulation (34.2% NTNU and 33% USN), in particular, *work out the issues together in order to carry on with the project* (40% NTNU and 52.6% USN) and *acceptance that different group members have different goals and work is organized around that* (37.2% NTNU and 31.6% USN).

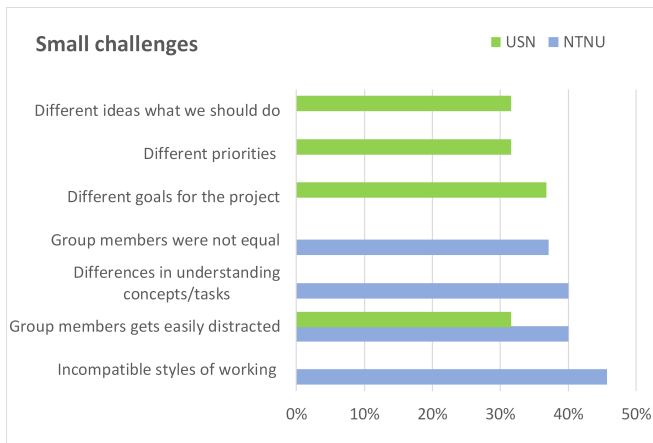


Fig. 4. Small challenges

When it comes to goal achievement, majority of the students reported that they were either fully (25.7% NTNU and 21.1% USN) or relatively (54.3% NTNU and 36.8% USN) satisfied with the achievement of their personal goals. In addition, majority of the students from NTNU reported that the group played a positive role in achieving their goals (45.7%), followed by a neutral (40%), and for a few students the group played a negative (5.7%) role. However, for the students from USN, majority agreed that the group played a neutral role (68.4%), followed by the same percentage for a positive (15.8%) and a negative role (15.8%). Finally, the overall satisfaction students had with this project work was as follow: somewhat satisfied (11.4% NTNU and 26.4% USN), partially satisfied (25.7% NTNU and 47.4% USN), and fully satisfied (51.4% NTNU and 21.1% USN).

Finally, using the affinity diagram technique, most of the generated ideas during the focus group corresponded to four categories: challenges, means, forms of regulation, and skills. Table I shows the structure of the affinity diagram in terms of categories linked to the two different perspectives, a leader and a group. The four categories are described as:

- 1) Challenges: evoked disagreements among the group members during project collaboration.
- 2) Means: methods used to find solutions and reach agreements.
- 3) Forms of regulation: strategies used to regulate or overcome challenges and keep up the motivation of the group and the individuals.
- 4) Skills: required competences to be able to regulate social challenges in projects.

V. DISCUSSION AND CONCLUSION

In this study, the authors wanted to study students' goals, challenges, and forms of regulation in customer driven PBL, from three perspectives: individual student, leader of a group, and a group of students. In addition, the authors were also interested to explore how individual and socially shared regulation are interrelated. For that reason, the authors used AIRE survey instrument to collect students' reflections from a customer-driven PBL course.

Research has reported that in formal learning activities students are expected to pursue the learning goals set in the

TABLE I. AFINITY DIAGRAM COMPOSITION

| Category | Leader | Group |
|---------------------|--|--|
| Challenges | 1) Merge various solutions. | 1) Unequal contribution. |
| | 2) Balance different perspectives. | 2) Low attendance. |
| | 3) Compromise cannot be reached. | 3) Cultural differences. |
| Means | 1) Be flexible. | 4) The "free-rider" effect. |
| | 2) Be understanding. | 5) Lack of skills. |
| | 3) Make hard decisions. | 1) Make group contract. |
| | 4) Take responsibility for group progress. | 2) Stand-up shaming. |
| Forms of regulation | 1) Assigning tasks and responsibility. | 3) Alignment of expectations. |
| | 2) Teach skills. | 1) Task structuring. |
| | 3) Social reinforcing. | 2) Socially shared goal oriented talk. |
| Skills | 1) Leadership skills. | 3) Self-consequating |
| | 2) Getting things done. | 1) Research and methodology. |
| | 3) Negotiation skills. | 2) Programming skills. |
| | 4) Ability to convince. | 3) Ability to confront. |
| | 5) Knowing what to focus on. | 4) Teamwork. |
| | | 5) Stress relief. |

curriculum; however, students tend to partially follow these goals and adopt new goals which they find it more suitable for their personal advancement [24]. The answers shown in Figure 1 depict students' major goals that are aligned with the goals set in the curriculum; however during the project work students set and followed other goals (e.g., not let the group down, have a good time, take responsibility for the work) as shown in Figure 2, that were more suitable for their personal advancement. The major, but expected difference between the students from NTNU and USN was in their reported personal goals. Since, the students from NTNU are CS students, their major goal was to gain experience working with a real customer, while the students from USN who are IT students were mainly interested in learning more about application development.

The most experienced challenge that majority of the students from both universities individually reported was *not fully committed to the project*. Moreover, during the focus group, the leaders reported the same challenge from the perspective of a group member, but also the challenge of free riding that has not been mentioned in the AIRE instrument. This comes as no surprise in PBL and SRL activities, since students have the autonomy to choose whether they would like to take ownership of their learning and be actively involved in the project or not, and to what level [25]. However, not all students display personal initiative, perseverance, and adaptive skills [7]. These proactive qualities have origins in personal beliefs, motivation, and metacognitive strategies [7]. The other small challenges that students experienced emerged from the cognitive processes required in collaborative learning, such as differences in understanding each others thinking/concepts or having same goals and priorities. These might be challenges that question student's ability to develop ideas reciprocally or/and motivational reasons to engage or not in collaborative learning. Hence, if the teacher is aware of the goals, the beliefs, and the socio-emotional challenges students face, they could model inquisitive behavior and scaffold the learning process accordingly to help the students advance through the project phases with successful outcomes [5], [17].

Although self-regulation was the dominant regulation strategy, the study found that students also used co- and shared

regulation to maintain collaborative group work and avoid breakdowns. An interesting finding from the data from NTNU was that the students tend to use their practiced self-regulation strategies (e.g., *trying to act more flexible, trying to accept the situation*) to regulate the evoked challenges with the others from the group. In particular, during co-regulation they have chosen to *tell the others to accept that some people will work more than others; tell the others to be more flexible in order to find a solution; and try to convince others that we all are different but we can solve the situation*. However, this interrelation between individual and shared regulation was not observed from the USN data. Hence, when observing how individual and socially shared regulation are interrelated, one can notice that students tend to convey (project) their beliefs onto the others, from individual to co-regulation and finally to shared regulation. Furthermore, considering the adapted framework [20] from Wolter's framework for motivational regulation [18], the data from the focus group showed that students engaged in social regulation, in particular, social reinforcing and socially shared goal oriented talk, that can also be noticed in the data from the survey.

Finally, the results showed that students could relatively reach their personal goals, and in the same time avoid breakdown, stress, and task failures as a group. However, an assumption can be made that if students tend to engage more into shared regulation, and try to work on solutions together instead of accepting the situation without trying harder, the percentage of completely satisfied students might be higher than the percentage of students partially satisfied. However, there might be other reasons why students were not fully satisfied with achieving their personal goals, that is worth investigating in future through interviews and in-depth analysis. What the authors also plan to do in future is to progress the understanding how motivation is constructed in customer-driven project focusing on the customer-group interactions, and what pedagogical decisions and task structures give students more autonomy that positively influence motivation and engagement in collaborative learning. Nonetheless, the broad idea that authors have in mind is to understand in what ways successful shared learning can have beneficial or debilitating learning outcomes, and when and how teachers can assist students to maintain motivation and collaboration.

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