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Approaching the Relative Estimation Concept with Planning Poker
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We aimed to answer the research question: *What is the perception of the students regarding the usefulness of Planning poker for understanding relative estimation concept?* To answer this question we conducted a practical exercise where the students were required to estimate given user stories twice: a) using only the theoretical concepts presented at the lecture, b) using the Agile Planning Poker technique. After each exercise, a survey was conducted.

The paper is structured as follows: Section 2 provides an outline of the related work. Section 3 describes the practical exercise, the setup in the classroom and the data collection and analyzes. Section 4 presents and discusses the preliminary results of the study. Finally, in Section 5 conclusions and future work are provided.

2 RELATED WORK

The different interactive approaches to learning, e.g., game, simulation, and gamification are applied to address different learning challenges [6].

Simulations simulate reality, in a controlled risk environment where the students can practice and apply what they have learned where on the same time encounter the results of their actions. The students take individual decisions which can impact one or more factors to conclude into measurable outcomes [6]. Thus, simulation can give us meaningful insights regarding the social aspects of software engineering and in particular for the agile development.

SE is tightly linked to the industry, and it is natural to use approaches that try to reproduce a real context for the students. Simulating these real environments where students apply concepts, and acquired knowledge is a growing tendency in SE [11].

Kropp and Meier [8] used simulation to teach ASD in an SE course. The authors applied planning poker to simulate a real context where SCRUM framework is applied. They perceived notable commitment from the students on the planning phase of the software, where estimation is involved. When the students were asked about their experience of applying the management practices, the majority of them answered positively.

Mahnič and Hovelja [10] analyzed the perception of students regarding the most important practices for successful SCRUM-based software projects. They simulated a context of a real project and applied the Agile Planning Poker technique to estimate effort and velocity. Students considered estimation as less significant when comparing to the other factors, e.g., team-work and communication among team members. The authors believe that the students underestimate how vital the estimations are.

In a different study the same authors [9] focused on the accuracy of planning poker estimation. In one instance, the 13 students had three sprints to plan the implementation of the given user stories. In the other, a group of experts estimated the same set of user stories. In both instances, Planning Poker technique was applied. The results revealed that the students' estimations improved by using the planning poker technique, where the experts' estimation was very close to the actual effort spent on each given user story.

In another study, Steghofer et al. [14] noted that students struggle to understand and apply the concept of relative estimation to measure the tasks' effort.

In the present paper, we aimed to investigate relative estimation since it is a relevant concept in SE. The SE students should

understand relative estimation well due to its broad adoption in the industry context. However, the students usually struggle or underestimate the aforementioned concept. For that purpose, we choose an Interactive Learning Event (ILE), i.e., simulation, to teach students the concept of relative estimation. Moreover, since the use of Planning Poker is part of the planning of teaching overall fundamentals of project management in ASD, it was our first choice.

Therefore, the contribution of the paper is to understand and reason if simulating elements of an industry environment in the classroom, by using Planning Poker technique [3], helps students grasp the relative estimation concept for estimating user stories in ASD projects. The results of the present study are preliminary and derive only from one run of the exercise. In the near future, we plan to run the same exercise to a different group of students with different backgrounds and compare the findings.

3 PRACTICAL EXERCISE

The simulation exercise for teaching the challenges of agile estimation and planning was applied in the Software Engineering course at Blekinge Institute of Technology, in Karlskrona, Sweden, in the winter of 2018. The objective of the course is to provide knowledge and competence in the fundamental principles of software engineering to students in the integrated five years program (300 ECTS) in Industrial Economy¹ pursuing the specialization on Software Engineering and Information Technology. Although the students are Swedish native speakers, the teaching and the exercise were carried out in English.

3.1 Planning poker technique

The procedure is simple. Each estimator receives a deck of cards with an estimate written on it. For each story, the product owner begins by reading the story to the team and by explaining the requirements. Next, the team discusses and if needed, poses questions to the product owner. When the team discusses the story, each estimator privately estimates the required effort by selecting a card from the deck. Figure 1 depicts an example of the Planning Poker table; the team reveals the cards simultaneously and put on the table, to be visible to all the team members. In that way, the independence between the views of the group members is assured. At the next step, the estimates that differ, especially the outliers, should be discussed. After discussion the team re-estimates using the same procedure. The process is repeated until a consensus is achieved [3] [12].

However, variations are possible and expected to be present. Any member may be asked to justify his or her estimation, not necessarily the outliers, i.e., the highest and lowest. Moreover, if no consensus arrives, more or less number of rounds may be used. In real situations, after many rounds and discussions for a user story, this particular user story can be left pending while the team can move on to the next and revisit in due time. The continuous dialog between the members results in more accurate estimations. Studies have shown that averaging estimations and group discussion lead to better results [4], [5]. Since group discussion is the basis of Planning Poker, those discussions may lead to an averaging of sorts of the

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Figure 1: Example of Planning Poker

individual estimates [12]. According to Grenning [3], the best way for agile teams to estimate is by playing Planning Poker.

3.2 Setup

One week before the exercise, the third author introduced the students to the concepts of Agile Software Development. The objective of the lecture was to help the students to understand the different frameworks for agile project planning, management, and estimation, i.e., SCRUM, as well as problems associated with long-term estimation. Finally, non-absolute estimation approaches were presented and explained how they could integrate the management and planning of Agile Software Processes. At the end of the lecture, the exercise of the estimation was advertised to the students as a practical exercise without disclosing more details. It was a recommended part of the course, but not a mandatory one and took place four days after the introductory lecture. The attendance of the students was high (89 %, 50 out of 56 students enrolled in the course).

Figure 2: Overview of the practical exercise.

The arrangements for the exercise took place in a suitable room for performing the activities, i.e., 11 round tables with five chairs each. The students were asked to select their teammates, up to 5-6 persons. Finally, we had ten groups of students with five to six members each. To assure that the process was anonymous, the first two authors prepared a box with random numbers from 1 to 100. The students were asked to choose one and use it as their ID when they asked to fill the surveys individually.

At the next step, the first two authors summarized the main concepts of agile planning and estimation, already discussed in the course and emphasized the units of estimation and in particular, the difference between absolute and relative estimation of the size of a user story. In sequence, the students were asked to estimate a set of user stories related to the library room renovation (See Table 1). The relative estimation was a requirement, and they were recommended to select a base story, i.e., the smallest or medium in size, and assign story points to them. Then, the students had 20 minutes and nine user stories to estimate, based on comparison to the medium or smallest, without using any particular technique. When the time expired, they were asked to complete a survey².

Table 1: User stories used in the first exercise

As a User, I want to:
1. Remove old electrical installation from this room
2. Remove old wallpapers and take them out
3. Put masking tape around the windows
4. Move the furniture out of the room
5. Paint around the windows with especial brushes
6. Paint the walls with two different colors, half blue and half gray
7. Cover the floor to avoid damaging it
8. Purchase supplies for all the work to be done
9. Clean the room after renovation

Next, Planning Poker was introduced to the students. When all the steps of the technique were described, each group of students assigned their product owner and received an envelope. The envelope contained five decks, one pen and one piece of paper. Subsequently, the students were asked to estimate a new set of user stories (See Table 2) by using the Planning Poker technique. The stories were related with the effort the students allocate for different study activities within their course. The estimation values used on the decks were: 0, 1/2, 1, 2, 3, 5, 8, 13, 20, 40, 100, ?, ∞ and the story points estimation was still a requirement. Similarly, they had 20 minutes to complete the task, and at the end, they completed once again a survey³.

3.3 Data collection and analysis

We evaluated the effectiveness of the exercise to help students understanding the agile estimation and planning through two surveys. Figure 2 depicts the activity flow of the exercises.

The surveys aimed to gather feedback from the students and their learning experiences. The students completed each survey after each estimation, a) using only the theoretical concepts presented in the lecture, b) using the Planning Poker technique.

The first survey consists of two parts: 1) demographical questions and 2) Likert scale questions related to their experience and how confident they feel to estimate relatively user stories, without using any technique. The second survey consisted only of questions related to their experience and the students' confidence to estimate relatively user stories using the Planning Poker. In both surveys,

²<https://goo.gl/hY3wJX>

³<https://goo.gl/PHLYoo>

Table 2: User stories used in the Planning Poker exercise

As a User, I want to:
1. Create a 60-minute presentation about the waterfall and the agile software development for your classmates
2. Write the product backlog for all assignments in this course
3. Write an 8 page summary of the software engineering course as the examination for this course
4. Read a 150-page book on agile software development
5. Recruit, interview, and hire a new member for your team
6. Paint the walls with two different colors, half blue and half gray
7. Write exams for the course: Software Engineering
8. Read and explain a densely written 5-page philosophy paper
9. Read a high-level, 10-page overview of agile software development in People magazine

the students could give their feedback also through free text. We used the anonymous ID number of the students due to traceability reasons (i.e., to be able to identify the two surveys filled by each student).

Furthermore, to ensure our data quality, we removed one ID duplicated, and three incomplete Surveys. Therefore, the resulting cases included in the analysis were 46.

To analyze the survey responses, we used the nonparametric Wilcoxon signed-rank test (equivalent to the paired-samples t-test). The test determines whether there is a median difference between the paired observations since the participants are the same individuals tested on two different occasions.

4 RESULTS AND DISCUSSION

We included forty-six observations in our analysis. The results showed the majority of the students is below 25 years old (90 %), where the 83% of them are reported to be native Swedish speakers. Finally, most of the students stated that they have zero or small experience with software development (83%).

The results from the descriptive statistics are available in Figure 3. The figure summarizes the answers of the students on how easy the activity of estimating the user story points was on a scale 1 to 7 by a) using only the theoretical concepts present in the lecture and b) by using the Planning Poker technique. The results revealed that the students give slightly higher values on the use of the Planning Poker technique, however without a clear indication.

Of the 46 students that took part in the study, the Planning Poker technique elicited higher confidence in relative estimation in 18 students (39%) compared to the relative estimation without using any technique. However, 18 students (39%) reported no difference and 10 students (22%) said that without using any particular estimation technique, they feel more confident in estimating the user stories relatively. A Wilcoxon signed-rank test, however, determined that there was not a statistically significant between the views of the students ($p > 0.05$). The results are available in Figure 4.

In particular, Figure 4 shows that from the 18 students that had "positive differences", meaning that they feel more confident in using the Agile Planning Poker technique, 13 students (28 %)

Figure 3: To what extent the activity of estimation was easy to perform?

estimated positively by 1 more point (from a likert scale 1 to 7) the Planning Poker technique versus not using any specific technique, 3 students (7%) by 2 more points and 2 students (4%) by 3 more points. From the 10 students that had a "negative difference", 4 students (9%) have estimated negatively by 1 point Planning Poker technique versus not using any specific technique, 3 students (7%) by 2 points and 3 students (7%) by 3. Furthermore, as already mentioned, there were 18 students (39%) where the exercise had no effect on their confidence to estimate relatively the user stories.

Figure 4: Differences between the two perspectives of the exercise

Even though the preliminary results of the first run of the exercise were not statistically significant, the feedback from the students' comments was valuable and indicates that the students were more likely to estimate the user stories by using the Planning Poker technique. Indeed, in a next workshop of the same course, one of the teachers of the course reported that the same students tend to use the Planning Poker technique on given tasks even though they were supposed to use traditional estimation techniques.

Regarding the validity threats, to avoid comparison, the students completed the first survey with the concepts presented in the lecture. They received Planning Poker instructions only after the first exercise. Therefore, they evaluated the two perspectives separately. Moreover, due to lack of previous industry experience, the user

stories used in the exercise were closer to the students' context and understanding instead of realistic user stories in SCRUM agile methodology. However, this decision did not affect the understanding about the concept, since it is a concept that does not depend of software engineering domain knowledge.

5 CONCLUSION AND FUTURE WORK

The primary objective of this study was to investigate the students' perception about the usefulness of Planning Poker technique to improve their understanding of the relative estimation concept in an Interactive Learning Event (ILE), i.e., Simulation. Moreover, through this process the students, as future software developers and managers, realized the impact on human factor in software engineering and they were able to explore the differences and similarities in their classmates' views that ultimately determine the quality of a product.

We conducted the study under two different approaches. The students in the first instance applied only their knowledge from the course to estimate the user stories, while in the second case, we simulated an industry environment for them to estimate the user stories.

The initial results showed no statistical significance between the two different approaches. However, the students have shown more interest and involvement during the Planning Poker activity, and also externalized their satisfaction in further lectures to another teacher of the same course. They also wanted to apply the same technique to estimate the effort in a different approach to software development.

Even though we did not find statistical significance in the results, the students were more engaged with the Planning Poker, which encourages us to conduct more investigation regarding this subject matter. We consider that it is possible that the stimulus the students have to discuss within the group, motivated by one of the steps of the technique, might lead to a preference for the technique. Thus, as future work, we aim to investigate further the relative estimation with the use of the Planning Poker technique with a different group of students with a different educational and cultural background.

To gather more data and expand our findings, we intend to replicate this study in the near future, i.e., next academic semester. Although this study is not classified as an experiment, we categorize the future application of this exercise as a *close replication* [1], in which we intend to perform minor changes on the data collection instrument for further comparison.

However, after the comparison, we are planning to take a further step and integrate the quantitative data that we receive from the questionnaires with qualitative data from individual interviews of the students. Moreover, we are planning to recruit a number of teaching assistants i.e. one for each group. They will be distributed one for each students' group to observe silently and without affecting the process.

The repetition of the exercise will enlighten us more regarding the flaws of the simulation application and how it could be improved, but also, we aim that the qualitative data from both the interviews and the observations will aid us and in order to help the students comprehend the relative estimation concept better.

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