Teaching Assistants' Experiences of Lab Sessions in Introductory Computer Science Courses

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***Abstract* — This Research Work in Progress paper presents a study on how teaching assistants (TAs) in introductory computer science courses experience their roles and responsibilities in programming lab sessions. Eight semi-structured interviews were performed with TAs who worked in different introductory computer science courses at a technical university in Sweden. The interviews were recorded, transcribed and analyzed using thematic analysis. Four main themes were identified: uncertainty with assessing, lack of training and instructions, communication and students in focus. The most important finding is that TAs, even those with long experience of teaching, experienced uncertainties with the assessment of the assignments. Typically, the guidelines given to the TAs only included the functionalities of the program, but the TAs express that they also assessed whether the students understood the concepts and how their code worked. Noteworthily, the TAs had been offered none or little formal training and instead relied on informal mentorships and own experiences. Furthermore, the course structure and communication channels were also described as areas that could be improved. The TAs did, however, try to assist all their students, and tutor and support them from the best of their abilities.**

Keywords—Teaching assistant, TA, TAs' experiences, Assessment, Lab sessions

I. Introduction

Teaching assistants (TAs) have long been used in computer science (CS) courses in higher education and are often described as a necessity to make it possible to offer CS courses to a larger number of students [1, 2]. TAs are typically undergraduate or graduate students, who assist the faculty throughout the courses by, for instance, tutoring, grading assignments and giving workshops. Using undergraduate students as TAs have proved to engage students and make the learning environment more friendly and comfortable [3]. The students comfort levels have also proven to be an important factor for student success in an introductory CS course [4].

Despite the fact that the TAs plays an important role when assessing and tutoring students, little is known about how the TAs experience their roles and their responsibilities. The aim of this study is to map out the TAs' own experiences of their roles and work tasks in order to find areas which could be improved to further strengthen the TAs in their work. The research question addressed in this study is: How do TAs in introductory CS experience their role, their responsibilities and their interactions with students, other TAs, and faculty, during or in relation to lab sessions?

II. Related Research

Previous research on TAs in science, technology, engineering and mathematics (STEM) have shown that TAs are important for student success, but that the TAs could be poorly prepared for their role as instructors [5]. In CS, research on TAs has mainly been focused on recruitment [6, 7] and training [8] of TAs. Programs for employing and using undergraduate students as TAs have been reported as successful at multiple institutions [9, 10, 11]. Marbouti et al. [12] conducted an interview study on which factors help or hinder the TAs, in the context of a first-year engineering course and also conclude that training was perceived as an import factor by the TAs themselves. TAs' development with a special focus on team teaching (in pairs) has also been studied and the results highlight the importance of staff meetings and suggest formal mentorships as training [13].

Even if the previous research of TAs' experience is limited, there has been a substantial amount of research conducted on one of the TAs' work task, namely on assessment. Assessing students' work can be quite complex and can be seen as a way to measure the students' knowledge, but assessment can also be seen as judging achievements [14]. Joughin [15] acknowledged that assessment could be experienced as a stressful situation for both the students and the teachers. Joughin also acknowledges that the context in which the assessment takes place might skew our definition and understanding of assessment [15]. Sadler describes that assessment can be done in two ways, either through what is called an analytic approach or through a holistic approach [16]. The analytic approach (or criteria-based approach) is described as focused, on often isolated skills, and usually conducted together with a grading rubric. The holistic approach is less focused on details and described to rather see the assessment as a judgment of the students' work as a whole, and described as more intuitive. The holistic approach is described as useful for open-ended problems without a right answer. However, a holistic approach demands the grader to be skilled in making a qualitative judgment of students' work, based on multiple criteria [16].

In higher education, analytic approaches with grading rubrics are quite commonly used [16]. A literature review on the use of grading rubrics in higher education [17], showed that some instructors are skeptical towards using grading rubrics, but that the students, in general, appreciate them as they help direct their learning. One of the main benefits of using grading rubrics from the instructors' perspective is that the grading can be done more objective, by the same framework [17].

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III. Research Setting

This study is focused on undergraduate and graduate students working as TAs during lab sessions in introductory CS courses at a technical university in Sweden. All courses have a course coordinator, a member of the faculty responsible for the course. The course coordinator is typically also the lecturer, in charge of the course material, as well as responsible for the TAs.

A. Introductory CS courses

In this study, introductory courses that are given to non-CS majors are investigated. The courses all have a similar course design and are taught using the programing language Python. Each week, the students have lectures, a workshop/seminar (given by TAs) and a two-hour long lab session. During the lab sessions in the first part of the course, the students are given small coding assignments to work with, in pairs or individually. Each course has five to six of these assignments and the students are given one to two weeks to complete each of them. The assignments allow the students to practice and get feedback but are also individually graded pass/fail. If the students complete the assignments before certain predefined deadlines, they are awarded bonus points that count either on the written exam or towards the final grade. The second part of the course consists of a larger individual programming assignment, usually graded by a TA. The larger assignment is graded on a scale A–F, where E is the lowest passing grade, A the highest and F is a failing grade.

B. Lab sessions

All lab sessions take place in computer labs. Each computer lab has 12–20 computers and to fit all the students, multiple computer labs are booked for each session. During the lab sessions, the TAs' work tasks are both to help the students and assess the students' work. How students are assigned to TAs differs between the courses, however, the students can rarely choose which TA to assist them. In some courses each TA is appointed to a certain group of students, in others, the TAs assist whichever student is first in line. Most courses use a digital queueing system to keep track of which students waited the longest and which computer the students are using. One of the courses does not use the queueing system, but during the lab sessions, the students are assigned to a TA and specific computers.

IV. Methodology

Eight semi-structured interviews were performed with TAs who worked in different introductory CS courses. Many of the interviewed TAs had also taught more advanced courses, however, these were not in focus. Interviews were chosen as the data collection method because the aim of this study is to investigate the TAs' experiences, therefore a qualitative approach is suitable [18]. The participating TAs were chosen to get a wide range of experiences as possible (3 months to 6 years) and an equal gender distribution. The interviews lasted between 30 to 65 minutes and were conducted in Swedish by the author. Prior to the interview, all participants were informed of the study's purpose and confidentiality. It was completely voluntary for the TAs to participate and all interviewees gave their consent to be part of the study. The interview questions were designed to make the TAs reflect on their experience and practice. The questions focused on 1) assessment and tutoring 2) interactions with the students, TAs and faculty and 3) training and instructions.

The interviews were recorded, transcribed and analyzed using thematic analysis [19, 20]. A thematic analysis is an inductive approach that can be used to interpret data and identify themes [19, 20]. In this study, thematic analysis has been conducted according to six steps described by Braun and Clarke [20]: getting familiarized with the data, initial coding, searching for themes, reviewing themes, defining the themes and producing the report

V. Results

From the thematic analysis, four themes, divided into fourteen subthemes were identified. Each theme and subtheme is explained and some are highlighted with example quotes.

A. Uncertainty with assessing

All interviewed TAs had experienced uncertainty when assessing the students' work. The theme was divided into three subthemes, which are summarized below.

1) What to assess and whether or not to pass the students

The TAs all described the assessment of students' presentations to consist of two parts. The first part is to assess that the program work as intended, the second part is to assess if the students had understood their program. This second part was described as the vital point, however, not trivial. Depending on the assignment and the guidelines given to the TAs, they stated it was not always easy to decide which concepts the students need to understand and how to check that. Sometimes, TAs just relied on their gut feeling when they did not have a grading rubric, which was usually the case for smaller lab assignments. The assessments were instead solely based on the students' instruction, described as often not being detailed enough and only being focused on the functionalities of the program. The TAs claimed that this could also cause TAs to assess the assignments differently.

"It is more this feeling. What I do, I would say, is listen and then I try to... go on my intuition" – Charlotte, 4.5 years experience as a TA

2) Checking for plagiarism

TAs emphasize that the students need to be able to explain how their code works in order to pass the assignments. One reason for this was to try to make sure that the students had not copied the code. This could, however, be hard to distinguish, since students could be able to explain code written by someone else.

3) Easier to pass than to fail

The TAs agreed that failing a student's presentation is never easy. The students could get upset and the TA could feel bad for the students and a bit mean. If really uncertain, the TAs could seek a second opinion by another TA or the course coordinator, however, they are usually busy.

"*In that situation <when a student solution was not complete>, I felt that, the student would like me to just disregard this. Because it was a pity, sort of. [..] Everyone would get so much more happy if I just passed him."* – David, 6 years experience as a TA

B. Lack of training and instructions

The TAs all expressed a lack of training and instructions. This theme is divided into four subthemes, were the first two describes the problems and the second two how the TAs tried to overcome them.

1) Little formal training

Not all of the TAs had been offered any training. Some of the experienced TAs saw no need for training at this point, and when offered to attend a TA training workshop, declined to participate. The experienced TAs who had attended a training workshop, viewed it as a good initiative but had not experienced it as fruitful for themselves. For the novice TAs, one of them had not been invited to attend a workshop and the other one thought it had been given too late. Apart from a workshop, some TAs had been given the opportunity to observe how an experienced TA or the course coordinator handled a presentation. All of the TAs stated that when starting, some kind of introduction should be offered.

"*I had the opportunity to come along when the course coordinator had a student present his work […]. But that was only on the first assignment*." – Anna, 3 months experience as a TA

2) Lack of practical info and pedagogical guidelines

The TAs said they lacked instructions and guidelines for how to do their work tasks. This has previously been presented in the theme "uncertainty about assessing", but the TAs also described a lack of instructions in other areas, both for practical things and how to handle interactions with students. Practical things include how to report work hours and if the lab session has an "academic quarter" (start quarter past) or not. The TAs also expressed a lack of pedagogical guidelines, on how to help the students in the best way possible, which was also described as lacking from the training.

"The focus was on what we do as TAs, but actually, not on how to approach students in order to make them learn as much as possible, that part was missing." – Adam, 4 months experience as a TA

3) Informal mentorships

The TAs stated that if they had a question or felt uncertain, they usually turned to other TAs with more experience. They formed informal mentorships and relied on them if they needed help. To be a mentor, was not a formal work task for experienced TAs, but described as a necessity for the new TAs.

" *I had a friend who just started to teach and then she asked me "Cecilia, how does the report system work?" Because no one had shown her that.* – Cecilia, 3.5 years experience as a TA

4) Previous experience as students

The TAs had all been enrolled in the same or similar courses as the one(s) they were teaching. The TAs expressed that remembering their own lab experience could help them in their work. The TAs could also use and try to copy techniques that TAs used on them as students. TAs whom they liked were viewed as role models and TAs they disliked as bad examples.

"*Well, they <other TAs> are simply not helpful. But I sat and helped this student and explained things and such, and I believe that person got a lot out of it."* – Bill, 2 years experience as a TA

C. Communication

Communication, or rather the lack thereof, was found to be a theme. This theme consists of five subthemes, were the first two describe the problems arisen, and the last three how some course coordinators try to solve them.

1) Not knowing when the deadlines are

One of the things that the TAs described as causing confusion and stress, was not knowing the deadlines for receiving bonus points. Keeping these deadlines in mind could be tricky, both because the TAs usually teach more than one course and because the deadlines could change. Not being able to answer questions could make the TAs feel a bit ashamed since the students expect the TAs to know the answer.

2) TAs' performance

The TAs expressed that they rarely been given any feedback, neither from students nor from the course coordinator on how they are doing as TAs. The TAs who had received feedback viewed it as very valuable. However, they could see the difficulty for a course coordinator to give negative feedback to a TA since that might hurt their feelings.

"*I've never got an evaluation. I would very much like to get one.*" – Belinda, 2 years experience as a TA

3) Chatting tool for urgent questions

The TAs described that it could be hard to reach other TAs and the course coordinator if they had an urgent question. For example, should the TA pass a student assignment when it had been solved in a way that was not intended? Using a chatting tool for this kind of communication was brought up as a possible solution, and used in some courses.

4) Present course coordinator at the lab sessions

The presence of the course coordinator was highly appreciated when the queue of students was building up, or when a student's solution was on the borderline of passing. In addition, the course coordinator could also help with difficult questions from the students. However, the TAs described that the presence of course coordinator varied, and they could be left on their own.

5) Staff meetings

The TAs all described that meetings with other TAs together with the course coordinator were useful for discussing,

solving problems and planning ahead. However, TAs that assist only during lab sessions (not conducting workshops) are typically not invited to the meetings. The TAs stated that different course coordinators had meetings at different intervals, some each week and some only once at the beginning of the semester. Overall, the TAs appreciated the meetings and viewed courses with regular meetings as structured.

D. Students in focus

The TAs described that students' experience and learning were central in how they conducted their work tasks and what they viewed as most important. This theme is divided into two subthemes described below.

1) Tutor and support the students

Deciding on the appropriate amount of help was described as a constant struggle, even by the most experienced TAs. If the TAs did not have their own group of students, they felt uncertain about how much help the students have received from other TAs and what the students know. Reviewing code and debugging as well as reviewing previous material such as lecture notes, were also described as approaches to help students move forward. The TAs expressed that they feel responsible for their students' experiences and that it can be challenging to handle students that are unsatisfied with a course since students often turn to them first.

"*I'm always struggling with how much I can help them, so it doesn't become too much help. Then you can't be too vague because then they don't get help at all. One has to balance it and I've done lots of mistakes on both sides, definitely.* – Daniel, 6 years experience as a TA

2) Time management to assist all students

Assisting all the students was described as impossible at some lab sessions, especially on deadline days. If the queue was long the TAs felt rushed to help or assess fast. If time allowed, the TAs described that they could explain by draw data structures and explain concepts thoroughly. If the queue was long, the TAs could just refer to concepts students have to read up on. The TAs also stated that they tried to be fair and spend an equal amount of time with each student, not favoring any student or student group. However, that TAs could be helping female students more than male students, was described as something the TAs have experienced, reflected about and tried to avoid in their own practice.

VI. Discussion

A. Results related to previous studies

The study highlighted several areas that could be improved. The results show clear evidence that the interviewed TAs experienced an uncertainty regarding assessment. An important finding is that even TAs who had been working for many years experienced an uncertainty. That assessment could be experienced as stressful [15] and a reluctance towards failing students [21], align with previous research. The TAs refer to doing a holistic assessment of the students' understanding, often solely based on the students' instructions for the assignments. That in combination with little training in how to assess might make a holistic approach, which requires the grader to make a qualitative judgment of the assignment [16], unsuitable for the TAs. The TAs also expressed that it could be difficult to know where to draw the line for passing a student and that different TAs might assess differently. Providing grading rubrics may improve the objectiveness of the assessment [17].

The TAs said to rely on their previous knowledge and informal mentorships for how to conduct their work tasks. This indicates that there is a need for more training and support. Junior TAs should be allowed to grow into their role. Estrada and Tafliovich [8], have argued that TA training can help bridge the gap between desired and actual qualifications. TA meetings and formal mentorships could be part of assisting the TAs in their development [13].

The result that communication was experienced as crucial to the TAs, is not a surprising finding. In this context, the course coordinators are the leaders for the pedagogical work and their presence, opinions and practice are valued by the TAs. The academic leadership has, in higher education, shown to influence teachers in their practice [22]. A supportive and collaborative academic leadership is associated with teamwork and student-focused approaches [22].

B. Trustworthiness

In this study, one researcher did the interviews and the analysis. The reason for the author to not include anyone else in this process was to protect the identity of the interviewed TAs. The results have, however, been discussed with several colleagues. This study is a small-scale study and the number of participants limited. The data collection did, however, ceased when no new themes were found by a new interview. Generalization of the results is not the goal of the study. This study should be seen as a starting point in understanding how TAs experience their roles and work tasks.

C. Further research

Implementation of training sessions, where the identified problem areas are addressed, is planned to be conducted and systematically evaluated. All TAs, in the introductory courses, will also be invited to participate in a survey, to investigate if the findings are generalizable within this university. The course coordinators for the introductory courses will be interviewed, in order to get a deeper understanding of their expectations of the TAs. The course coordinators will also be invited to participate in a workshop about how to develop grading rubrics.

VII. Conclusions

The results show that the TAs, even those with long teaching experience, had experienced uncertainties in the assessing of students' assignments. The TAs used a holistic approach for assessing, but without training and assessment criteria, the approach could be subjective. The communication, both between the TAs and the responsible faculty, were also described as an area with room for improvements. The TAs had been offered little formal training and relied on informal mentorships and own experiences. The TAs did, however, try to assist all their students from the best of their abilities.

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