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Author(s): Hämmäläinen, Ville; Isomöttönen, Ville

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What Did CS Students Recognize as Study Difficulties?

Ville Hämäläinen and Ville Isomöttönen

Faculty of Information Technology

University of Jyväskylä, Finland

ville.o.hamalainen@jyu.fi, ville.isomottonen@jyu.fi

Abstract—Computing education research shows substantive interest in novice programming challenges. The present study was rather interested in any phenomena that students would recognize as difficulties during their university studies. The research question was what computing students recognized as their study difficulties after the first year of study. An inductive thematic analysis was applied to the students' personal writing of the difficulties experienced. The main result categories were independence in new environment, academic requirements, lack of prospects, learning to work, and social integration, which were illustrated by multiple lower level themes. The results inform educators of the wide range of aspects that can underlie complicated studying and help in designing intervention methodology.

Index Terms—study difficulties

I. INTRODUCTION

A wide range of studies have focused on university dropout. The research suggests that the critical time is the first year of university studies, which seems to be a universal issue (e.g., [1] [2]). Even though the dropout rates from higher education have been declining for the past few decades in the present national context, graduation times are, more often than not, delayed tremendously [3]. School dropouts and delayed studies are an issue for the society, universities, and individuals [2].

Regardless that dropout rates have been declining, lots of variation exists among disciplines [3]. OECD reported that the largest dropout rates concerned natural sciences and technology (see, e.g., [4]). In computer science, the critical first-year course is an introductory programming course (CS1), where an international study found that typical pass rate was around 67% [5]. Reasons for dropping out from an introductory programming course are multiple, which makes the issue difficult to resolve [6].

This study investigates what computer science (CS) students recognized as their study difficulties after a minimum of one calendar year of university studies. Student difficulties were studied generally, without prompting for particular CS content. A thematic analysis was applied to students' writings in which they elaborated on the difficulties they had encountered. The contribution of the study is argued to be in this general setting that can complement the studies carried out in connection to a particular course, such as CS1.

II. ASPECTS RELEVANT TO STUDY DIFFICULTIES

Research explaining higher education students' study difficulties is extensive while scattered because various aspects

and established lines of research are necessarily included.

The prominent aspects in Tinto's [7] extensively cited theorization on higher education dropout were social integration, academic integration, institutional commitment, and goal commitment. The theory also acknowledged personal attributes such as sex, ability, and ethnicity, and external attributes such as job market fluctuations. In proposing various mechanisms that integrate these attributes, Tinto noted that the student with degree completion commitment may stay despite low social integration or as long as staying becomes truly impossible due to an academic failure. Another staying mechanism was hanging on due to institutional commitment. The cost and benefit theory integrated into the Tinto's theorization in turn assumed evaluation of costs and benefits between staying and leaving in many possible situations, e.g., hanging on regardless of academic difficulties, or staying or withdrawing in light of job markets.

Tinto later emphasized students' perceptions of a curriculum, including teaching methods, institutional quality, and perceived value of the studies [8]. He acknowledged obvious individual differences in students' perceptions, while noting that teaching methodology and the attitude of the institutions on how courses are structured should receive attention. He argued that the first-year introductory courses too often fail to make sure that students understand connections between the courses and real-world situations. Another argument was that, while introductory course materials need to be challenging for a meaningful study, they need to be comprehensible for students, e.g., through academic support.

Studies reflecting Tinto's work are abundant. Wray et al. [9] pondered a 'choosing to stay' question through a 'pull' and 'push' conceptualization. The pull factors discovered were family, peers, academic support, and determination toward a profession (becoming a nurse), and the push factors were financial difficulties, personal pressures, poor placement experience, and academic difficulties. Rickinson and Rutherford [10] reported similar challenges: feelings of both emotional and academic unpreparedness, and welfare problems. For CS area, we would stress here the importance of balance between support structures and academic challenge, as the latter of these is known to exist in introductory programming.

Lowe and Cook [11] studied student preparedness for university, and found inaccurate perceptions about studying at a university level to be the major challenge. This was assumed

to exist due to minor communication between university and pre-university education regarding student preparedness. One challenge identified was the students' experiences of staff not being sympathetic, which was suggested to be remedied by increasing staff-student interaction. The first semester was deemed critical to counteract problematic perceptions and their consequences. Lowe and Cook concluded that proper advice should be commenced before students develop feelings of failure. Leese [12] reported that some students entering the university were surprised by the level of independence (independent study, higher work load, and higher expectations). Acknowledging widening HE participation, she emphasized a well-planned and supported transition for students—in place of marveling at the characteristics of a “new student.” Furthermore, Wingate [13] emphasized “learning to learn” perspective in the students' transitions to university, specifically arguing that epistemic access to and development of students competences in constructing disciplinary knowledge is important. Generally, the transition to university is known to belong to a vulnerable phase in the early adulthood, in which persons of age 18–25 might not identify themselves with an adolescent or an adult [14]. The findings of Dyson and Renk [14] emphasized vulnerability to stress and depressive symptomatology in relation to the use of avoidant coping strategies.

Need for self-regulative learning (SRL) has been emphasized in multiple studies. Boekaerts and Corno [15] reviewed different genres of SR, differentiating, for instance, between top-down and bottom-up SR. The former referred to personal aspirations that can guide the development of SR and the latter referred to environmental cues that can guide it. They concluded that classroom education can lead to the students' adaptive use of top-down and bottom-up strategies. This was seen possible because “teachers and others in the extended social milieu provide models, serve as coaches, and establish environments conducive to SR” (p. 226). Interventions for self-regulated learning have been found beneficial [16], [17].

Again reflecting Tinto, Elliott [18] found that both academic and social self efficacy influenced retention. The review by Dinther et al. [19] in turn suggested that self-efficacy affects motivation and learning. Their conclusions emphasized providing master experiences with authentic exercises. In a sense, this complies with the usefulness of “bootstrapping” activities (such as CS0) as a preparation for CS study [20]. Self-efficacy, referring to “what people think they can do under given circumstances” [21], can be altogether seen as a relevant aspect in coping with CS studies. We find this to be indicated by the “comfort” attribute reported as an influential success predictor for CS1. This attribute signifies that students are comfortable (cf. anxiety) with the material [22], [23] and that they perceive the learning surrounding as comfortable, concerning, for instance, asking and answering questions in a class [22]. These dimensions seem to resemble academic and social self-efficacy.

The short review illustrates the multi-faceted nature of the topic of “study difficulties,” which is an umbrella term we use

to refer to multiple influential aspects.

III. THE STUDY

In IT faculty at University of Jyväskylä, a second-year course titled “Sparring for Academic Study” (1 ECTS credit) continues to prepare students for academic study through group study counseling. The course is mandatory and arranged bi-annually.

The course has a pre-assignment asking the student to prepare one-page writing about challenges and success factors experienced in studying. The present study investigates what students recognized as study difficulties, as reported in these pre-course writings. The research permission was received from 20 out of 24 students who were invited to participate. The students have been studying one academic calendar year in the minimum. Due to curriculum changes and personal study plans following these changes, few of the participants take the course later (e.g. during the third year). This does not change the present research setting where the interest generally was to inductively come to know of what students had experienced as challenges *after studying some time*. Demographics or course scheduling are not detailed to preserve anonymity.

The pre-course writing assignment was the following:

Reflect on your studying. Pay attention to challenges and successes you have experienced. Attempt to identify and name the reasons underlying the challenges as honestly as possible. Prepare a one page writing out of this reflection.

The data analysis procedure followed “conventional” (data-driven) content analysis [24]. Iterative inspection of the data yielded low level themes, which were subsequently grouped into higher level themes.

A. Limitations

A potential bias is recognized in teacher-student relationship, which was counteracted by having the first author, who did not participate in the teaching of the course, to perform the first rounds of iterative analysis. To improve the validity of interpretations, the two authors then reviewed the resultant thematization in multiple sessions. To increase credibility, we included lots of quotations that enable the reader to evaluate how the categories were interpreted. To increase transferability of the results, we have described the course context above. Although not all the students granted a research permission and the targeted population was small, we assume that the results are not undermined by self-selection bias; the received data was collected as an ordinary course assignment and the research permission was requested afterwards. We acknowledge that more data could reveal more categories but believe that the current categories would remain relevant. We also acknowledge that this study outlines categories whose relative importance can be judged in follow-up quantitative studies.

IV. RESULTS

This section presents higher and lower level themes found in the data, both of which are indicated by section titles.

A. Independence in new environment

This section illustrates the difficulties students encountered entering the university related to *Managing basic responsibilities and planning your curriculum*.

1) Managing basic responsibilities:

Remembering the basic things was found difficult:

S11: I have noticed that I don't always remember all the important things, like attending exams. Some courses are so much on my own responsibility, and for that reason I have not been able to start working on them.

One student worded that the high school was insufficient preparation for new ways of studying at the university:

S11: The biggest challenge has been adjusting to academic way of studying. I came to the university straight from a high school, and for that reason, I do not think there is a scenario through which I could have been prepared for how my university studies would begin.

The below demonstrates that some students also had issues getting enough sleep and taking care of themselves:

S19: Getting enough sleep can be an issue, especially when the state of mind is getting worse, after having an ineffective day. At nights I usually feel good so I stay up late.

Another student stated that he lacked the ability to stick to routines during earlier studies:

S5: Most of my challenges have been caused by bad routines. Doing things regularly, going to sleep early, eating properly. All these things have a huge effect on study motivation. And I have to admit that I managed to get proper routines only during the last year.

The above quotations regarding sleeping and managing your daily activities are a root problem to many other self-regulation related issues illustrated in the later sections.

2) *Planning your curriculum*: Planning the curriculum was found difficult:

S8: The most challenging aspect of the studies was the uncertainty about selecting a proper amount of courses and knowing when certain courses "should" be done during each period and year.

Another student also felt that there was insufficient initial guidance regarding the course selection:

S13: The fact that no-one was telling what courses should be taken and when was new and weird.

Assessing the importance and the workload of different courses was also a challenging part of curriculum planning:

S8: I got the impression that both CS1 and CS2 are really important courses that would be a foundation for many upcoming courses. For this reason, I focused on these courses, even though they were worth six and eight academic credits, so [the challenge was that] I needed other courses also.

On the other hand, managing other courses affected the effort put on programming courses:

S11: I'm doing minimum work required as I have other courses I need to take care of also.

Finding the right courses were found to be an issue:

S8: Our course planner's search didn't always work correctly; it found old courses, no courses, or the course's code and name were changed. I heard it's getting replaced, so we'll see if it gets easier.

B. Academic requirements

This section illustrates the difficulties caused by increased requirements from the perspectives of *adjusting to faster pace and workload, academic level of study and knowledge, learning environments and material, and issues in mathematics*.

1) *Adjusting to faster pace and workload*: Workload increased quite a bit from high school:

S14: Getting used to the pace of the courses needed some adjustment, as one lecture could contain amount of material comparable to a week of lectures in the high school.

S17: I am sure I did more work during my 1st university year than during the whole high school.

S13: Everything was new and for sure there is a lot to learn going forward. Workload from the high school increased quite a bit.

Workload was surprisingly heavy on mandatory programming courses:

S13: CS1 and CS2 courses were really laborious (weekly demos, project work, exam), which came a bit as a surprise.

University studies were even more laborious than expected, and realizing the requirements took some time:

S14: I have managed to pass my prior studies by attending classes and skimming through the notes night before the exam, and even though I knew university would require a lot of more work, it took me over six months to understand the work required.

The same student continued:

S14: I thought that I was working hard, even though in reality I was only working for few hours per week, which felt like a lot of independent work compared to the high school. Learning that starting the bigger course assignments on the last week wasn't enough, even though earlier it was sufficient preparation.

Postponing work was an insufficient strategy in university studies:

S7: "Why do something today when you can do it tomorrow" mentality has kind of stayed with me from the high school where this method seemed to work. Now the things we need to study are so broad that this way of working is not enough.

Studying courses more thoroughly felt difficult due to the pressure of graduating:

S16: I think everyone has similar issues, that sometimes it's hard to handle the pressure because of a hurry to graduate in three years, but there's no other way than just to try. It would be nice to study things more thoroughly with time but this is not always reality.

2) *Academic level of study and knowledge:*

S11: In my opinion, there are too many hard or puzzling exercises in the programming courses.

The same student elaborated on the effect on having too many difficult exercises at the same time:

S11: Reasons for my challenges have clearly been my own laziness, and I feel that the exercises are too hard for me and there's also too many of them. I can't find motivation if exercises stack up and get more difficult. I also enrolled for too many courses, and couldn't keep up with the pace.

Difficulty of the studies in general was echoed by another student:

S17: Many courses in computer science are quite laborious, and also the difficulty has increased after advancing further.

One student felt that all the new knowledge was hard to apply to the real world:

S12: After the 1st year I feel that I have studied plenty of small bits of knowledge, however, it's hard to comprehend larger concepts. I didn't have prior programming experience, so the amount of new knowledge has been immense. The sheer amount of knowledge has got me longing for deeper understandings and more expertise on certain topics.

Another student emphasized the requirement to be able to apply skills studied:

S1: Studying CS in university is different because you need to apply everything taught and really understand it.

Having no prior domain knowledge caused challenges:

S13: Everything on courses was new to me, so I could not use anything I had learned earlier.

3) *Learning environments and material:* The scattered nature of new learning environments and searching for information was frustrating:

S15: On some of the courses the learning material, or the availability of it causes issues. The scattered nature of the learning environments doesn't help at all, and even less helpful are those individual teachers who have built a supposedly great environment on top of the existing ones (many of these are bad) [list of learning environments], and "god help me" if I need to bounce between more than three during one period.

Comprehending the study material was found problematic:

S18: At university one of the challenges is the academic way of presenting. Texts are not practical

or easy to read. I have to think and push my self really hard to understand what I am reading.

The same student continued on the difficulty of grasping the course material:

S18: I would hope that courses would proceed more explicitly; simple materials, lectures and exercises, which would help with grasping the concepts quickly before moving to harder issues. It would be nice to have material which explained all the most essential points. Sometimes it is hard to understand the essential points of the courses.

Varying course material and searching for your own material was difficult for a beginner:

S8: the reading materials of the courses vary a lot; some give everything in one handout, on some courses the material is almost nonexistent, and you need to search for information by yourself. Searching for your own material online causes issues, as you kind of have to enter the topic somewhere, in the middle of it, and the material can be almost incomprehensible for a beginner. In this regard, the material given by the courses comes with clarity and is user friendly.

With new topics, new vocabulary was introduced, and most of it was in English, which required some time to adjust to:

S18: Also the English language and new vocabulary of the field causes studying difficulties. At the same time, you should know all the new purposes, meanings and words in English, to be able to find help online. Some courses have also [part of] materials in English.

Understanding difficult materials required a lot of more time than before:

S1: Depending on the difficulty of the material, watching and making notes on a single online lecture can take a whole day at my own pace.

Studying methods needed were found challenging compared to earlier education:

S14: Another challenge was the difference of school work as on earlier courses [in high school] studying consisted mostly of attending lectures, writing notes and reading books.

4) *Issues in mathematics:* The gap between academic and high school maths was observed:

S1: I passed the introductory maths course with the grade 5 but barely passed the first calculus course with the grade 1. In the high school, I had to change from advanced maths to intermediate maths.

The same student found maths in the university to be frustratingly difficult compared to CS studies:

S1: Some of the topics have been naturally interesting, and I've been able to immerse my self into these topics for hours. For example, programming, making games and 3D-modeling have been interesting. So

when things are not too easy or frustratingly hard (calculus) I can find a flow state. (emphasis ours)

C. Lack of prospects

This section illustrates the issues related to lacking prospects from the perspectives of *general lack of vision, lack of vision in CS studies, self-belief, and positive feedback.*

1) *General lack of vision:* Lacking a clear vision caused one student to search for “something meaningful” instead of studying, illustrating the anxiety caused by not knowing one’s place:

S19: When I get the blues, it’s really hard to start studying on my own time. I feel anxious of the fact that there is not going to be anything meaningful during the day, and I postpone studying while trying to find something meaningful. In the end, if I get started there’s not much time left.

One student felt that prior experiences with school being “a necessary evil” were a hold back:

S7: Perhaps I associate studying with boring and numbing exercises, and my negative emotions are holding back my studies. I should learn to enjoy studying.

The same student continued by stating a lack of interest in working for only oneself:

S7: I don’t feel like searching information for my own sake is meaningful.

2) *Lack of vision in CS studies:* One student failed to see the benefit of doing extra work for a better grade:

S3: Perhaps I have not really found the courses to be interesting enough, so that I would bother doing the extra work for a one grade improvement.

Another student who found programming really interesting and started working on his own projects had a different kind of issue:

S17: On my 1st year I was notably more motivated, while now I seem to question the usefulness of every course.

The same student continued:

S17: Lack of motivation makes me ponder if I should use my time better, for example, applying for a job or learning interesting things on my own, instead of “wasting” time on courses that take a lot of time but feel like they don’t benefit me at all.

Focusing only on courses which seemed to match the personal perception of the field caused some issues:

S4: I focused mainly on most interesting courses, which seemed to produce concrete results that would fit my image of the field. For this reason I would find some of the courses interesting only after their ending, which would result in lower grades or dropping out of them.

The same students reflected on his flawed perceptions of the courses and stated the consequences on his goals and future:

S4: I feel like I’m missing out the deeper levels of the discipline and understandings about computer science application areas, and for this reason, I feel like I am just hanging on without really caring about the topic or if I get employed.

Choosing a field without plans caused difficulties:

S4: I applied to computer science mainly because of easy access and personal liking for computers, for that reason I have sometimes had issues feeling like belonging to the field, or planning my minor studies.

On the other hand, the same student continued:

S4: Although it might seem like I am really unsure of my study success, my grades have been mainly positive and I have experienced my studies as interesting. The challenges are perhaps exaggerated by my melodramatic mind.

One student had strong bias towards certain mandatory courses, and thus failed to pass the courses:

S2: Earlier I did not value the content of the courses in computer science since I didn’t feel that they were preparing for a real programming work. This is partly because the 1st courses in computer science are mostly “trick courses”.

The same student explained how the early perceptions were subsequently displaced:

S2: I also noticed that after putting some effort into the courses, they were more interesting than before.

Above quotations illustrate a contradiction where a student starts the university with a strong personal preconception of the field, while, at the same time, not understanding the depth.

3) *Self-belief:* Believing in one’s own ability to succeed was difficult:

S12: On the other hand, I would like more practicality in my studies. However, I feel that my skills are at so low level that for example getting an internship feels impossible. The practical work in the programming courses have mainly made me uncertain of being able to build programs that actually work.

Fear of failure in programming courses caused a lot of stress:

S13: I wanted to do well, so I worked hard on the exercises. I’m not sure if it was smart to work at evenings and feeling like crying, because I didn’t know how to do the exercises. However, the exercises have to be done if you want to pass the courses and also try to learn something.

The initial fear of not learning programming was shared by another student:

S17: At first, I was scared if I would learn programming at all but it went pretty smooth with good courses.

The most extreme reactions to failure caused a drop out:

S2: I had never gotten a bad grade in maths, and when I failed a [calculus course], I stopped going to the exams.

Lacking self-efficacy in maths caused issues on selecting a minor:

S4: I believe that my studies would benefit greatly from math, but as I have never seen myself as mathematical thinker, minoring in maths doesn't seem very tempting.

Encountering difficulties early on, and getting feedback that undermined the student's self-belief was not helpful going forward:

S11: *It was stated at the 1st course that the earlier courses would be easier and something one should do well, but if I had issues on those courses I feel like the upcoming courses continue to provide challenges.* (emphasis ours)

Self-confidence was seen as a key to succeeding and demanding more from yourself:

S5: Success grows self-confidence, and with more self-confidence you can demand more from yourself and try harder. When you learn to expand the way you see success, you can get a lot more out of your experiences.

4) *Positive feedback*: The following quotations give an insight to students' experiences during studies, and how getting a positive result can boost self-belief, and intrinsic motivation:

S12: There has been success also but sometimes it feels like success is overshadowed by challenges.

One student, on the contrary, described an empowering experience:

S15: The biggest "wow-experience" came from [game research] course after I got a 5 from my project work, and even a suggestion of publishing the work on a [journal]. I haven't really explored on this opportunity yet, however an acknowledgment like this was huge boost to my motivation. It's a shame that the semester was almost over at that point.

Getting good grades after working hard reinstated the purpose of studying:

S10: The best thing in studying is the feeling of succeeding. The feeling after you have practiced a lot, getting a good grade and can apply the things you've learned. When I get this feeling, I realize again why I need to study, and how much benefit studying has on my future. This feeling makes me study.

D. Learning to work

This section illustrates the difficulty of putting in the effort from the perspectives of *planning the work*, *getting started*, *getting distracted*, *last minute working*, and *falling behind*.

1) *Planning the work*: One student had difficulties on doing the mandatory exercises on time allocated to them, emphasizing the necessity of time management:

S3: I spent 25 hours on exercises that were supposed to take 6 hours of working, and that was the amount I sat on the computer and worked on the exercises. *Perhaps, if I divided my time a bit more reasonably, the course would not have been so horrible, but I was also attending [a confidential post], which took a lot of time.* (emphasis ours)

Managing a night time job and studying was difficult:

S12: I have a part time job, where I mostly work at nights. For this reason, I am often tired, which has made studying unnecessarily difficult.

2) *Getting started*: Getting started in a new style of working and unfamiliar topics were found to be difficult:

S6: Getting started especially on creative thinking can be hard at times depending on the topic, and also my prior knowledge of the subject.

Knowing that the work at hand would be difficult caused issues on getting started:

S11: Working on hard exercises has been difficult. After you postpone the work once, it gets even harder to get started.

One student illustrated how hard it can be to start working:

S7: Big difficulty that hinders my studies is the difficulty of starting. I postpone working until I have no time left, and for that reason I need to work in a hurry. While working at home even cleaning seems more interesting than studying.

Understanding that the exercises ahead would take a lot of time caused issues on getting started:

S20: Sometimes I just can't muster enough vigor or interest to start working, and I just browse the Internet, and think of how much time it would take to finish something.

Working on exercises that seemed uninteresting and boring was found difficult:

S3: I still haven't learned to study courses that require studying a book, and then writing an essay of it. I just can't force myself to read something I find really boring.

Another student reflected on failing to start working, avoidant behavior, and rewards. By reward, the student means doing activities that give pleasure or just help the student to forget what should be done:

S1: Time management was fragmented, which made it difficult to keep up with the "eight hours per day" model. This inefficiency leads to dissatisfaction and anxiety, which feeds the need to reward yourself.

3) *Getting distracted*: Having to work on unpleasant topics on your own made it difficult not to get distracted:

S7: I lose focus easily if the topic is not something I enjoy. It is even harder because you are working

on a computer, and there are many websites where you can spend a lot of time.

S17: At times I lose motivation because I find it hard to focus on only one thing for a long time, especially if the subject is not super interesting.

Having a dedicated study area made focusing easier:

S19: At times focusing on your studies on your free time is hard, if there is a chance of doing something meaningful. Nowadays it's not that big of an issue, because I moved and have a specific place for studying until 23:00 every night.

:

S7: I'm able to focus on interesting topic for a long time until I face something too difficult. If I get stuck on same thing for too long I get frustrated, and instead of working on the exercises, I find entertainment somewhere else.

4) *Last minute working*: Trying to do too many courses, and failing to start early enough, put a lot of pressure on one student:

S16: At the end of the year, I was in a situation where I worked for few days non-stop because I had so much to do. This is something I need to improve on because I don't want to go through the same situation, where I have worked all night, and have to go to school. Once a month is fine but not once a week.

Trying to do too much at once was issue echoed by another student:

S15: I would like to do everything on one go, which seems impossible in university (only if I remembered this when time is of the essence).

Doing hard exercises and leaving the work too late was a major issue:

S1: Another issue is that I started working on maths exercises maximum of two days before the deadline, and doing few hours of work. On calculus course internalizing the subject took a lot of time, and applying it even longer.

5) *Falling behind*: Related to the working pace, falling behind was surprisingly easy:

S14: Related to this I was also surprised how easy it was to fall behind on the schedule even if you only missed few lectures.

The same student continued:

S14: At first I didn't know I was working less than I should, and I only realized how far behind I was when the first courses were ending.

Another student also felt the difficulty of going back to work after missing weekly maths exercises:

S5: After falling behind the biggest challenge is to get back on track. If I fall behind it's incrementally hard to get back on studying. For example, in maths

if I miss one week it's harder to start working on new exercises even if you attended the lectures.

Falling behind is a slippery slope. Many students reported taking too many courses during their first semester and failing to complete many of them. Falling behind on academic credits can push you taking even more courses in the future, and for that reason, the workload only increases. One student despite dropping out of many courses felt somewhat optimistic about his situation:

S10: This is my 3rd year of studying, and I am behind on academic credits. This year I am trying to complete both: this year's courses, and last year's courses I dropped out from. I took too many courses last fall, and because of the work load I failed almost all of them.

Another student seconded, that to catch up, one is tempted to take too many courses at once:

S2: I have tried doing my computer science courses many times, but I have always tried to do too much, or failed to combine my studies and work.

E. Social integration

Social integration difficulties were related to *not asking help, working alone, and group work*.

1) *Not asking help*: One student felt that the teachers would feel bothered by too many questions:

S11: I would probably get help to more difficult problems, but I don't feel like always bothering the teachers.

Another student felt that even though working alone was hard and tiring, asking for help was too difficult:

S4: I have done most of the work alone at home instead of going to demonstrations, which slows my working pace and hinders coping with the workload. Because I'm not used to asking help from others, it gets increasingly hard to ask for help, which also leads to issues outside of school work. I have also developed a mindset where asking for help is partly giving up.

Another student also had the habit of trying to solve every problem alone:

S6: When meeting challenges I should probably understand my limits and ask for a help, if I'm not sure I understood the issue correctly. Instead I try to overcome my issues with extra work.

Having to work alone was seen as a cause of bad maths grade:

S1: One part of the grade is that I want to do exercises alone, which leads to frustration and skipping some parts.

2) *Working alone*: Lacking social integration caused issues with getting into groups:

S8: I've done the courses by myself, that includes the demonstrations that were supposed to be done in groups because I couldn't get into any group.

One student felt that studying was easier for others because they had friends:

S16: I don't think it's a problem for others, because they can discuss with their friends. In the end though, I feel like throwing us to deep end might be beneficial.

A student who did not socially integrate, and could not find help online found himself all alone with the difficulties:

S8: As some points there will usually be a problem that I can't figure out, and I can't find help online either. It would be nice to ask a friend for a help, but because I don't have any I need to manage things alone.

Added difficulty and having to learn alone was found difficult:

S18: Even though the topics during lectures seem clear and understandable on, I can't remember or understand them at home.

The difficulty of working alone was echoed by another student:

S18: Most of time spent at university consists of lectures, and the actual work is done at home on "free time" when it is hard to ask for help.

Another student with more experience had embraced the social aspect as one of the keys to succeeding:

S5: It's easier to get back on track with a peer pressure and someone "forcing" you to work. I have learned from this and tried to support my friends if I happen to be on same courses with them.

One student would have possibly liked to work with others, but was incapable of doing so, and in the end, preferred to work alone:

S17: As an introvert, I usually end up doing things alone instead of choosing working in groups. However, I realize that often working in groups might benefit me, and many things could be solved faster with peer support.

3) *Group work*: Collaborating in academic writing was found to be difficult:

S6: I've noticed that academic writing in groups can be very difficult, as it is hard to produce an essay with good enough quality of a structure and message. I have felt that this is especially difficult if the writing is done in a group and you have to mix the styles of all the participants.

Being a quiet person caused issues in group work:

S11: I'm a pretty quiet person and don't talk to people that much, and for that reason the group work hasn't gone as planned. Sometimes, I have trouble getting my chance to speak and share my ideas.

Having social anxiety caused one student to avoid appointments:

S20: Another challenge for me has been leaving my comfort zone, and doing social networking. As an

introvert, I have had issues with appointments. Pair and group work on some occasions have been "quite a job". I would predict that group work will also be a challenge in the future.

V. DISCUSSION

The current study with an initial sample that does not cover a yearly cohort does not warrant conclusion on the amount of students at risk or troubled already. In another context, the study by [11] suggested that there was a "substantial minority" (p. 71) who were at risk of failure. This research paper investigated study difficulties of CS students by applying inductive thematic analysis on one page pre-course writing. The research illustrated the study difficulties by highlighting the lower level themes as found in the data. Tinto's original work on transition [25] and the latest work [8] can still be found relevant, as the results illustrate difficulties on: getting used to being independent, adjusting academic requirements, lacking a clear vision, goals, and self-belief, learning to do the work, and social integration.

Our data also supports the findings of Dyson and Renk [14], which suggested that many young individuals are bound to struggle with stress, depression and avoidant coping strategies during their vulnerable transition phase. Our findings also emphasize the research conducted by Rautopuro and Korhonen [3], which suggested that for the majority of students in higher education the walk of life is still unclear. The digitalized era has increased challenges in forming stable identity for Finnish young adults, for example, the employment prospects are more unpredictable, while there seem to be an endless amount of opportunities [26]. Our research highlighted the lack of prospects, issues with identity, and self-belief in many ways, as the students illustrated their search for "something meaningful" instead of studying, and not being able to see themselves succeeding the future. The data suggested that many of the students were able to succeed and find interesting areas in the field after studying some time. However, encountering the laborious and difficult exercises and still having to adjust to the real world was overwhelming for many of the students.

Another interesting finding was that students had strong but unclear preconceptions of the field. They had difficulties in seeing the benefits of the courses, and failed or dropped out of them. This supports the findings of Lowe and Cook [11], which suggested that inaccurate perceptions are a major challenge to a large minority of students.

Taken together, we believe that the present qualitative exploration can inform educators in several different roles. For instance, teachers and study advisers can increase research-based awareness of students' difficulties, which can contribute to curriculum design in engineering/computing. The future research should investigate the educators' awareness of and intentions to address the issues reported here.

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