FIRST YEAR COMPUTER SCIENCE EDUCATION IN NORWAY

A mapping study of computer science study programs in Norway focusing on the first year

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The need for ICT knowledge in Norway is increasing and the demand for candidates is currently higher than the number of students graduating. It has been identified that the first-year experience is crucial to student motivation and throughput of study programs, therefore it is interesting to look at the state of the art of computer science study programs in Norway. In this paper we present a survey and study of the number of undergraduate computer science programs in Norway and map their characteristics in order to gather an up to date overview of the selection of programs. Through a systematic review of all Norwegian undergraduate programs using data from national databases we have found that there are 12 institutions offering 56 different programs in Norway in 2018. The study showed that the characteristics of these programs vary, that is, the amount of computer science courses during the first year, the number of students, admission requirements, student satisfaction and time commitment. This article presents these findings along with an analysis of what characteristics impact the students' contentment and learning experience.

KEY WORDS: Education, computer science, first year experience

1 INTRODUCTION

Norway will in the near future face a shortage of computer and information science professionals is the conclusion of a report done for the Ministry of Local Government and Modernization in 2017. The need for advanced information and communication technology is increasing, and with the current student enrollment and graduation rates there will be a gap between supply and demand (Ministry of Local Government and Modernization, 2014). These predictions are in line with the situation in other parts of the world, for instance USA. The National Academies of Sciences published a report last year concluding that although the number of bachelor's degrees in computer and information science has increased substantially, there is indeed a gap to be filled as far as industry need (2017). In addition, this report stresses the fact that this massive growth will in the near future demand a number of computer science educators the sector will not be able to fill. Especially in higher education, the fact that "over half of new PhDs are drawn to opportunities in the industry, hiring and retaining CS faculty is currently an acute challenge that limits institutions' abilities to respond to the increasing CS enrollment" (National Academies of Sciences, 2017, p. 5).

When it comes to solving the problem of increasing demand, high computer science student enrollment and the possible shortage of computer science educators, both reports have several recommendations. Firstly, it is important to state that the high student enrollment problem of course can be solved by limiting the number of students in computer science study programs, however, the consequences of doing so should be considered comprehensively, and the benefits and costs weighed for the entire university community (National Academies of Sciences, 2017). Furthermore, the Norwegian report suggests nine concrete actions, where six of them directly concern higher education. Summarized, these actions are concerned with increasing the number of graduates by increasing throughput. In order to do so, the National Academies of Sciences recommends actions to support diversity and to facilitate an improved understanding of national undergraduate enrollment trends. Therefore, this study has aimed to provide an overview of what computer science programs exist in Norway today and how they are prepared to meet these demands. The research inquiry is as follows:

What characterizes the first year of computer science study programs in Norway?

- How are they designed?
- What impacts student contentment and learning experience?

2 DEFINITIONS AND BACKGROUND

2.1 Defining computer science education

In Norway the term information and communication technology, ICT, is used as an umbrella term for all things computing and computer technology. Regardless if the accurateness of this, or personal preference, it is in this case important to have a common understanding of the terms. For the purpose of this paper the term computer science is used consistently, with the understanding that the term includes what we in Norway call ICT: computing, informatics, information and computer technology.

When it comes to computer science education, the various universities and colleges have different ways to further define and divide their departments and study programs. In Norwegian higher education there are two major stakeholders who have an important role in computer science education; The Norwegian Universities and Colleges Admission Service (NUCAS) and the Norwegian Agency for Quality Assurance in Education (NOKUT) (NOKUT, 2018b; Samordna Opptak, 2018a). NUCAS handles all applications and admissions to public undergraduate education in Norway. All students wishing to study at any public university or college in Norway must go through their web portal, which means that NUCAS gathers data on grade point averages and student admission numbers. Furthermore, NOKUT is the organization who accredits the various study programs and is in charge of quality assurance across all higher education institutions in Norway, public as well as private. Part of the work with quality assurance is a national survey of all study programs called Studiebarometeret (NOKUT, 2018b). The survey asks for the students' perceptions of educational quality in their study programs and is sent out to 60 000 students each fall. In addition to the valuable data gathered by NUCAS and NOKUT, the way these organizations categorize the various study programs is important for the purpose of this paper. This will be described in detail in the methodology section.

2.2 The importance of the first year

In order to meet future demands for computer science (hereby referred to as CS) it has been identified that increasing the number of CS graduates is essential. This means decreasing the drop-out rates and increasing throughput. Research by Vincent Tinto on student departure identifies the first-year experience as crucial for retention of students (Tinto, 1975). Tinto discusses student departure as several stages; separation (from a known home environment), transition (into a new social and physical structure) and incorporation (into a community and culture) and argues that the students' first year experience lays important groundwork, even though students may drop out later in their study (Tinto, 1988). An important part of this groundwork is related to what learning strategies and study skills the students develop during this time (Adams, Berzonsky, & Keating, 2006; Blickle Gerhard, 1996). Therefore, this study has chosen to focus on the first year for CS study programs, the admission process and students time commitment.

3 METHODS

The purpose of this study was to survey and categorize all undergraduate computer science study programs in Norway, focusing on the first year. In the following sections the data collection process, inclusion criteria and method of analysis will be described further.

3.1 Data collection

The first step in the data collection process was to make a list of all study programs within the aforementioned CS definition. For this, three approaches were taken. Firstly, a list of all the study programs within the NUCAS database was made. Secondly, this list was compared and reviewed according to the list of study programs from the NOKUT database. These two sources provided a list of 54 study programs. Additionally, a manual search was performed in both databases for the key words "informatics, computer science, computer technology and ICT". This provided two additional study programs to the list, making it a total of 56 study programs. A full list of these study programs along with selected variables can be found in Appendix A.

The next step of the data collection process was to combine the data from the two databases. This was done manually creating a spreadsheet with data on grade point averages (GPAs), admission requirements, student numbers, gender balance and survey data from Studiebarometeret.

The final step of data collection was to survey the first year of these study programs in order to categorize the various courses and their content. The researchers manually looked up each study program's web page and added the various courses to the spreadsheet. For each course the name and number of credits was documented, as well as a category indicating what kind of course it was. These categories are described in Table 1.

Label	Category	Explanation
P	Programming course	Courses about or involving a lot of programming.
D	Computer science course	Courses about topics in computer science not revolved around programming.
M	Mathematics course	Courses in mathematics.
F	Scientific philosophy	Courses in scientific philosophy and/or ethics.
A	Miscellaneous	Other courses. Including, but not limited to, economics, physics, finance and engineering.

Table 1: Overview and explanation of the different course categorizations.

The basis for this categorization was the name of the course and the learning goals listed on the web page. This was done independently by two researchers. The two researchers reached an agreement level of 81%. The researches then discussed the various differences and agreed on the final categorization. Most of the disagreements were related to a systematic difference of opinion. For instance, whether a web development course was to be considered a programming course or a computer science course (the researchers concluded the former). A small number of discrepancies were due to errors in the data gathering process, copy/paste errors, which were easily corrected in this process.

In addition to this general survey, all the programming courses were further investigated to categorize what programming language was used. This assessment was based on the course website information about content and learning coals, as well as any available syllabuses. This process also revealed some discrepancies, where a course which was given category P in reality was a D. However, some descriptions did not reveal what language was used, still it was clear that it was a programming course. These instances were given the value missing (.).

3.2 Inclusion criteria

Following the methodology of a general systematic review there is a need to identify some defined inclusion criteria (Booth, Sutton, & Papaioannou, 2016; Kitchenham, 2004). In order to exclude non-CS study programs, the researchers used the pre-defined categories "information technology and informatics" and "information and computer technology" in the NUCAS and NOKUT, respectively, to find study programs. In addition, all included study programs had to have 15 credits or more in programming or computer courses during the first year, with at least 7,5 credits per semester. Since the focus of this study was the first year, only bachelors programs and 5-year integrated masters programs were included. Additionally, study programs that were online, flexible or not full time were excluded because they are not comparable to on campus programs in this regard. Finally, in order to use data from Studiebarometeret, the study program had to have a sufficient amount of responses (defined by NOKUT). Although, six study programs did not have useable data in Studiebarometeret, they were still included in analysis which did not involve this data. In summary, the inclusion criteria and number of study programs was as follows:

- ICT study program (N= 86)
- Full time, Not online or flexible (N=58)
- Bachelor program or 5-year integrated master's program (N= 56)
- 15 credits or more in programming or computer courses during the first year, with at least 7.5 credits per semester (N=56)
- *Has usable data from Studiebarometeret (N=50)*

3.3 Method of analysis

The way the data was analyzed can be divided up into a descriptive and exploratory analysis. The descriptive analysis aimed to answer the research question concerning characteristics and design of CS study programs. Therefore, the analysis was focused on describing and summarizing the data, which in this case involved creating sorted lists identifying top and bottom study programs according to the different variables, as well as calculating averages. Furthermore, the exploratory results focused on identifying possible correlations between variables, and thus exploring what impacts student contentment and learning experience. Correlation in this study is defined as a "statistical relationship between two variables", and for calculating this Microsoft Excel was used to calculate the Pearson Product-Moment Correlation Coefficient (Ringdal, 2012, p. 321).

4 RESULTS

The results of this study are both descriptive and exploratory. The descriptive results summarize and characterizes the various study programs, while the analytical/exploratory results try to identify some important correlations and relationships.

4.1 Descriptive results

The descriptive results summarize some important data about the various study programs. These results have been further divided up into four categories: the first-year composition, the student body, admission criteria and time commitment.

4.1.1 First year composition

The first-year composition category describes the academic content of the first year according to the variables *amount of CS-courses* and *programming language used*. This data gives a general overview of how much and what kind of CS each study program has included. The amount of CS courses in the first year varies from 100% to 25%. This variable is calculated by adding the number of credits categorized as programming courses (P) to computer science courses (D). The study programs with less CS, fills up the year with mathematics courses (N=33), miscellaneous courses (N=28) and in some cases a scientific philosophy course (N=14). Figure 1 gives the full summary of each study program and the categorization of courses.

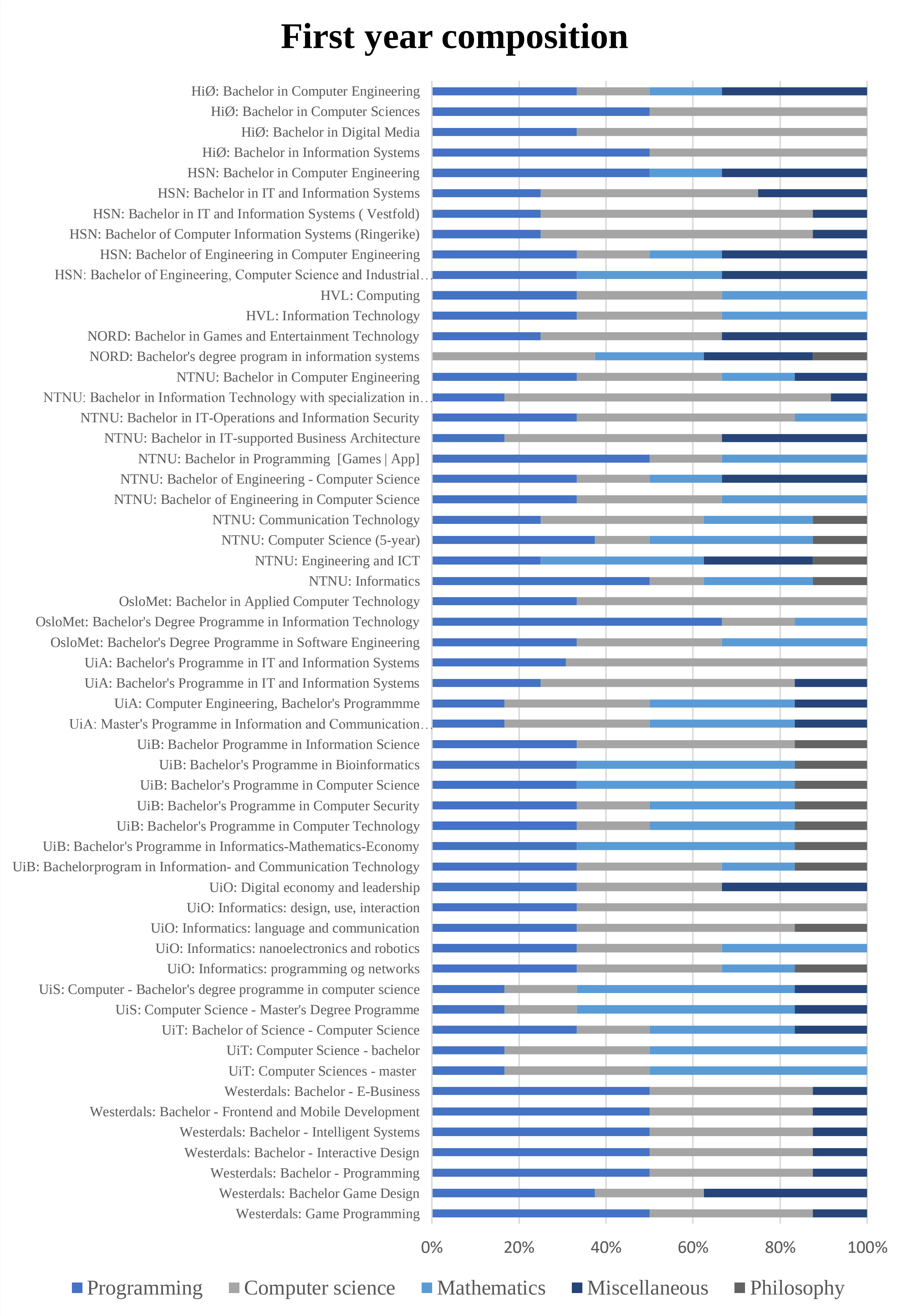

Figure 1: The composition of the first year of CS study programs in Norway, in alphabetical order.

When it comes to what programming language is used in the first year, this too varies. However, Java is by far the most popular programming language (N=48), followed by web-based languages such as HTML, CSS and JavaScript (N=25) and Python (N=18). A full summary can be found in Table 2.

Fall semester		**Spring semester**		**Total**
Arduino	0	Arduino	2	2
C	1	C	0	1
C#	2	C#	2	4
C++	3	C++	6	9
HTML, CSS	9	HTML, CSS	6	15
HTML, CSS, JavaScript	2	HTML, CSS, JavaScript	1	3
Java	15	Java	33	48
JavaScript	4	JavaScript	0	4
MATLAB	1	MATLAB	0	1
PHP, JavaScript	0	PHP, JavaScript	3	3
Python	9	Python	2	11
Missing (no data)	8	Missing (no data)	10	18

Table 2: Overview of programming languages used in the first year.

4.1.2 Student body

The student body category describes the composition of students according to the variables *number of students*, *gender balance*, and overall *satisfaction* with the study program. These numbers give a very general overview of the student population and their contentment.

The number of students in each study program and the corresponding gender balance is data gathered by Studiebarometeret via Database for Statistics on Higher Education. Overall, there are 8452 students enrolled in the included study programs. The number of students in each program vary from a total of 24 to 692, while the majority of programs have between 100 and 250 students. NTNU is the institution with the most CS study programs and also the most students in total with 2737 (32% of all CS students). Furthermore, the NTNU study programs Computer Science (engineering, 5-year) and Informatics (bachelor, 3-year) has the most students (N=692 and N=481 respectively), however they are not entirely comparable considering they are a different number of years. Nevertheless, the fact is that NTNU has more students than any of the other institutions as is evident in Table 3 below.

Institution	**Number of students**	**% of all CS students**	**CS programs**
NTNU	2737	32 %	11
UiO	811	11 %	5
OsloMet	642	9 %	3
UiA	772	11 %	4
UiB	686	10 %	7
HSN	717	10 %	6
HiØ	451	6 %	4
HVL	290	4 %	2
NORD	132	2 %	2
UiT	354	5 %	3

UiS	284	4 %	2
Westerdals	576	8 %	7

Table 3: Number of students at each institution. Note that one of UiOs programs started this fall, and therefore has 0 students in this statistic.

Gender balance in CS study programs is a much debated topic, and one that has gotten a lot of attention over the last decade. This study found that there are 1393 female students and 6910 male students enrolled in CS-programs in Norway. That gives a percentage of 17% in total, while the average percentage is 16%. The ten study programs with the highest female percentage is listed in Table 4.

Program	**Students**	**Female**	**Male**	**% females**
UiB: Bachelor's Programme in Bioinformatics	24	15	9	63 %
Westerdals: Bachelor - Interactive Design	89	48	41	54 %
UiO: Informatics: design, use, interaction	302	128	174	42 %
NTNU: Communication Technology	229	90	139	39 %
NTNU: Engineering and ICT	257	87	170	34 %
UiO: Informatics: language and communication	65	22	43	34 %
UiB: Bachelor's Programme in Informatics-Mathematics-Economy	24	7	17	29 %
HiØ: Bachelor in Digital Media	53	14	39	26 %
NTNU: Bachelor in IT-supported Business Architecture	183	45	138	25 %
UiS: Computer Science - Master's Degree Programme	70	15	55	21 %

Table 4: Top 10 study programs according to gender balance.

In the national survey, Studiebarometeret, students are asked a number of questions about their experience as a student in the various study programs on a five-point Likert scale. The questions are grouped by different categories, hence creating an index. The categories are teaching, learning environment, organization, influence, inspiration, engagement, relevance, exams and expectations. In this study an average of these indexes was used to create a variable for overall satisfaction, which can be considered an indicator of student contentment. The satisfaction among students in CS programs vary from 2,13 to 4,13, with an overall average of 3,67. The scale is from 1-5, where 5 is the most satisfied. Table 5 below shows the top ten study programs according to satisfaction.

Program	**Satisfaction**
UiT: Computer Sciences - master	4,13
Westerdals: Bachelor - E-Business	4,08
HiØ: Bachelor in Computer Sciences	4,00
Westerdals: Bachelor - Intelligent Systems	4,00
Westerdals: Bachelor - Programming	3,99
HiØ: Bachelor in Digital Media	3,97
NTNU: Bachelor of Engineering in Computer Science	3,96
UiO: Informatics: programming and networks	3,95
UiO: Informatics: nanoelectronics and robotics	3,94
UiA: Master's Programme in Information and Communication Technology	3,93

Table 5: Top 10 study programs according to satisfaction.

4.1.3 Admission criteria

The admission criteria category describes the characteristics of the students enrolling in a study program according to the variables *grade point average (GPA)* and *admission requirements*. These variables can be used to indicate the popularity of a program, as well as the quality of the students enrolling.

As described in section 2.1, all students wishing to enroll in a public institution have to apply via NUCAS. In these cases, the only deciding variable for admission is the students' GPA from upper secondary school. GPA in NUCAS consists of both the students actual grade average and possibly some extra points given for certain subjects or accomplishments. For example, student can receive four extra points for taking science courses in upper secondary school, or they might get extra points for military service.

For enrollment in a private institution, local guidelines apply. In this study the only private institution is Westerdals Oslo ACT, and according to their admissions office they generally admit all qualified candidates. The remaining 55 study programs uses GPA to distinguish candidates, where the students with the highest grades, including possible extra points, will be admitted. In some cases, when the number of candidates is equal to or lower than the number of places in the program, all qualified applicants may be enrolled (these have been given the value 30). The NUCAS database publishes enrollment data for each year, including all the study programs and their corresponding lowest admitted GPA (Samordna Opptak, 2018b). Table 6 lists the top ten study programs in 2016 and 2017.

Program	**GPA 2016**	**GPA 2017**
UiO: Digital economy and leadership	-	62,1
NTNU: Computer Science (5-year)	57,0	58,5
NTNU: Communication Technology	56,7	57,0
NTNU: Engineering and ICT	55,9	56,2
NTNU: Bachelor in Computer Engineering	53,1	55,6
NTNU: Informatics	51,5	53,2
UiB: Bachelor's Programme in Computer Science	48,9	53,1
UiO: Informatics: nanoelectronics and robotics	52,1	53,1
UiO: Informatics: programming og networks	51,0	53,1
UiO: Informatics: design, use, interaction	50,9	53,0

Table 6: Top 10 study programs according to GPA in the regular admission[1]. Digital economy and leadership was created in 2017 and therefore has no data for 2016.

In addition to GPA, some study programs will also have an admission requirement. Some study programs require students to take a certain amount of math and science courses in order to qualify for admission. Table 7 summarizes the results and explains the various requirements found in CS study programs.

Requirement	**Explanation**	**Number of CS programs**
MATRS	Math for natural sciences level 1 OR Math for social sciences level 1 + 2	19
GENS	General admission, no special requirements	14
HING	Math for natural sciences level 1 OR Math for social sciences level 1 + 2	13

[1] There is also a quota of first time applicants, which is also often used, but in this case, it is the regular admission. That means all qualified applicants compete.

	Physics level 1	
REALFA	Math for natural sciences level 1 Math for natural sciences level 2 OR other science course level 1	4
ING4R2	Math for natural sciences level 1 OR Math for social sciences level 1 + 2 Math for natural sciences level 2 with grade minimum of 4 Physics level 1	3
SIVING	Math for natural sciences level 1 OR Math for social sciences level 1 + 2 Math for natural sciences level 2 Physics level 1	3

Table 7: Summary and explanation of the various requirements

4.1.4 Time commitment

The time commitment category describes the time students spend studying according to the variables *organized teaching activities* and *self-study*. These numbers give an overview of the students' time commitment which is an interesting possible indicator of education quality.

The total amount of time students in CS study programs spend studying varies from 20 hours a week to 52, while the average is 35 hours which is the national average for all students in Norway (NOKUT, 2018a). This total time commitment variable is calculated from student reported time spent in organized education (lectures, labs, etc.) and time spent studying independently (reading, doing assignments, alone and in groups etc.). Table 8 shows the top 10 study programs according to time commitment.

Program	Organized education	Self-study	Time commitment
UiT: Computer Sciences - master	10	42	52
UiS: Computer Science - Master's Degree Programme	13	31	44
UiA: Bachelor's Programme in IT and Information Systems	18	26	44
UiA: Bachelor's Programme in IT and Information Systems	18	26	44
HSN: Bachelor of Engineering in Computer Engineering	19	25	44
UiT: Computer Science - bachelor	5	38	44
HiØ: Bachelor in Computer Sciences	17	26	43
Westerdals: Bachelor - Programming	19	22	41
UiO: Informatics: nanoelectronics and robotics	17	23	40
Westerdals: Bachelor - E-Business	22	18	40

Table 8: Top 10 study programs according to time commitment

4.2 Exploratory results

In addition to these descriptive results the researchers were interested in investigating possible correlations between these variables. Especially, what had the most impact on time commitment and overall satisfaction. Therefore, a correlation analysis was done comparing the various variables described above with time commitment and satisfaction. The results of this correlation analysis are shown in Table 9.

Variable	Correlation	
	Time commitment	**Satisfaction**

Number of students	0,19	0,12
Number of females	0,09	0,07
Number of males	0,21	0,13
GPA	0,24	0,04
Has math requirement	0,09	-0,23
Has natural science level 2 math requirement	0,26	-0,05
Has math and science requirement	0,14	-0,11
Amount CS in first year	-0,02	0,11

Table 9: Results of correlation analysis.

5 DISCUSSION

In the following section the results presented above will be discussed further following the same categorization. This discussion includes both descriptive and exploratory results, as well as reliability and validity considerations.

5.1 First year composition

As showed in Figure 1 the design of the first year CS study programs vary considerably. Notably, there seems to be no correlation between the amount of CS courses and time commitment or satisfaction. One might assume that students pursuing a degree in computer science would be more satisfied with a study program with a high CS content, however, these results indicate otherwise. On the other side, all included study programs have CS courses in both semesters. Subsequently, the categorization process might not reflect the full content of these courses. The quality of the course websites varied considerably, and it is possible they were not up to date.

When it comes to programming languages taught in the first year it is not surprising that Java is the most popular programming language. However, it is interesting that Java is most common in the second semester. Additionally, that web-based languages are equally popular in the first semester. The debate about what programming language is the best to start out with is ongoing, and this study does not aim to settle this debate. Nevertheless, these findings can provide an interesting base for further research on the topic.

5.2 Student body

The results on the topic of number of students and number of CS study programs vary considerably, therefore it is impossible to draw any conclusions as to what characterizes CS study programs in Norway accordingly. However, the numbers do reflect the changes the higher education reform implemented over the last four years (Kunnskapsdepartementet, 2015). Several institutions have merged which has changed the dynamics in Norwegian higher education. In the case of CS education, NTNU and HSN (now USN) has been the most impacted, as is evident from the number of study programs.

On the topic of gender balance the graphs have been pointing slightly upwards over the last couple of years, at least according to numbers from NTNU (DBH, 2018). However, a total average of 17% female students is not high enough. Especially considering that recruiting more female candidates is the best source to increasing CS enrollment. An interesting observation from the results of this study is that two of the three top study programs all include design of some sort, while the two bottom study programs are both related to game programming (Westerdals: Game Programming, 1,9%, and NTNU: Bachelor in Programming [Games | App], 5,2 %). These results seem to confirm that certain stereotypes and possible misconceptions are indeed present in the student population. However, more research into this topic is needed before any conclusions can be made.

When it comes to student satisfaction the overall average of 3,68 indicates that students in CS study programs in Norway are generally very content. While contentment is a subjective interpretation of the students' experience, this is still a variable that can be used in study quality assurance work. Considering the results from the correlation analysis it is interesting to determine that not one factor, out of these variables, seem to have any considerable impact on student satisfaction. The highest correlation is the math requirement with -0.23, which is difficult to interpret and needs more research. The math requirements may result in enrolled students that are more dedicated or more hard working, which in turn may lead to increased student satisfaction. On the other side, the unit of analysis in this case was the study program, and it might be more interesting to investigate at the individual student. Therefore, the researchers plan on continuing the work with this by examining individual student data from Studiebarometeret.

5.3 Admission criteria

The GPA variable along with the number of applicants is often used as a measure of popularity and prestige by the institutions. In addition, this number can give some indication of the quality of students enrolled. The study programs with higher GPA are enrolling students who performed well in upper secondary school, which would seem to indicate “good students” in higher education. However, the correlation analysis done in this study only produces a value of 0,24 between time commitment and GPA, which can indicate otherwise. That is, if one considers time commitment as an indicator for quality of the student. In this case, the high performing students in upper secondary school can be spending less time studying in higher education because they have a good knowledge base to build on. However, the correlation indicates that GPA has a positive impact on time commitment. Looking at GPA in higher education would perhaps be a better indicator, unfortunately these numbers were not available in the data used in this study. On the other side, grades in higher education are more difficult to compare considering there are no national exams or such, as there is in upper secondary education.

Considering the admission requirements for CS study program they can be divided up into various levels of math requirements. Only 14 study programs do not require any math, which additionally do not have any requirements at all. Consecutively there was 23 study programs with no math courses in the first year, however they might include math later in the program. The remainder of study programs require some level of math, and in some cases also some type of science course. In this regard it is striking that no study programs have CS as a prerequisite, however, four study programs do have it as a possibility (REALFA). When it comes to the impact of these requirements on time commitment and satisfaction, the only notable correlation is the math for natural sciences level 2 requirement on time commitment which is 0,26.

5.4 Time commitment

Time commitment in CS study programs on average is within the norm for Norwegian students, however compared to a traditional work-week in Norway it is a bit low. Notably, for a large majority of study programs students spend more time on self-study than in organized teaching activities (N=43). The findings of this study do not reflect the reason for this, or what kind of activities the students are doing, but considering the number of students in CS study programs is increasing this might be an increasing number in the future. Nonetheless, it is important to consider that these numbers are an average of all student responses, and there are likely individual differences here. Furthermore, it is important to consider that these numbers are self-reported by the students themselves. Therefore, they may not be entirely accurate. Some students may be understating their time commitment; however, some may overstate.

For the purpose of educational research, time commitment can be an interesting variable to use as an indicator for the quality of a student or a study program. Compared to GPA, which is an obvious alternative, time commitment can be more relevant for comparison between institutions and countries. Additionally, time commitment has in some cases been found to be a good predictor for academic performance, however, there are also studies suggesting the contrary (Nonis & Hudson, 2006; Plant, Ericsson, Hill, & Asberg, 2005; Schuman, Walsh, Olson, & Etheridge, 1985). Nonetheless, time commitment is an interesting variable to further investigate, and the authors of this paper plan on doing more research on the topic in the future.

5.5 Exploratory results

The correlation analysis of the different variables for the most part resulted in few significant results. However, the lack of correlation is also interesting because they can contradict common assumptions.

In this case, the lack of correlation between student satisfaction and number of students (both genders) is interesting because smaller classes of student are commonly assumed to create a better class environment.

6 CONCLUSIONS

This study has through a systematic review of Norwegian CS study programs attempted to identify some characteristics and important factors that impact student contentment and learning experiences. The study has found that Norwegian CS study programs vary in number of students, admission requirements, student satisfaction and time commitment. Concurrently, the gender unbalance is a consistent across all programs, and we found that there are similarities as to how the first year is designed. Further research is needed to deepen the understanding of what affects the students' contentment and time commitment. For example, additional research using individual data should be conducted. This research should focus on gender unbalance, factors impacting student satisfaction and further exploration of time commitment as an indicator for study quality. Additionally, there are variables not included in this study that could also be interesting to investigate, such as degree of completion and performance in the job marked.

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APPENDIX A

Program	**CS**	**NoS**	**%F**	**S**	**T**	**GPA**
Institution abbreviation: English name of study program	*Amount CS in first year*	*Number of students*	*Amount female students*	*Satisfaction*	*Time commitment*	*Admission GPA for 2017**
HiØ: Bachelor in Computer Engineering	50 %	125	7 %	3,68	39	30
HiØ: Bachelor in Computer Sciences	100 %	144	11 %	4,01	43	30
HiØ: Bachelor in Digital Media	100 %	53	26 %	3,98	33	30
HiØ: Bachelor in Information Systems	100 %	129	12 %	3,70	37	42,8
HSN: Bachelor in Computer Engineering	50 %	129	12 %	3,70	33	30
HSN: Bachelor in IT and Information Systems	75 %	125	10 %	2,84	32	38,8
HSN: Bachelor in IT and Information Systems (Vestfold)	88 %	121	16 %	3,79	25	43,7
HSN: Bachelor of Computer Information Systems (Ringerike)	88 %	117	12 %	3,32	32	37
HSN: Bachelor of Engineering in Computer Engineering	50 %	96	7 %	3,85	44	30
HSN: Bachelor of Engineering, Computer Science and Industrial Automation	33 %	129	7 %	3,63	40	30
HVL: Computing	67 %	194	12 %	3,49	39	48,8
HVL: Information Technology	67 %	96	14 %	3,73	32	46,8
NORD: Bachelor in Games and Entertainment Technology	67 %	88	15 %	0,00	.	41,9
NORD: Bachelor's degree program in information systems	38 %	44	11 %	2,52	32	30
NTNU: Bachelor in Computer Engineering	67 %	232	13 %	3,68	36	55,6
NTNU: Bachelor in Information Technology with specialization in Network administration.	92 %	132	10 %	3,78	30	50,2
NTNU: Bachelor in IT-Operations and Information Security	83 %	147	12 %	3,54	38	44,2
NTNU: Bachelor in IT-supported Business Architecture	67 %	183	25 %	3,37	35	49
NTNU: Bachelor in Programming [Games | App]	67 %	96	5 %	3,74	37	45,3
NTNU: Bachelor of Engineering - Computer Science	50 %	148	5 %	3,41	24	43,3

Program *Institution abbreviation: English name of study program*	CS *Amount CS in first year*	NoS *Number of students*	%F *Amount female students*	S *Satisfaction*	T *Time commitment*	GPA *Admission GPA for 2017**
NTNU: Bachelor of Engineering in Computer Science	67 %	140	6 %	3,96	35	47,1
NTNU: Communication Technology	63 %	229	39 %	3,78	38	57
NTNU: Computer Science (5-year)	50 %	692	20 %	3,74	36	58,5
NTNU: Engineering and ICT	25 %	257	34 %	3,77	36	56,2
NTNU: Informatics	63 %	481	16 %	3,73	32	53,2
OsloMet: Bachelor in Applied Computer Technology	100 %	218	20 %	3,71	28	51,1
OsloMet: Bachelor's Degree Programme in Information Technology	83 %	153	16 %	3,67	33	49,9
OsloMet: Bachelor's Degree Programme in Software Engineering	67 %	271	15 %	3,40	30	49
UiA: Bachelor's Programme in IT and Information Systems	83 %	216	11 %	3,85	44	47
UiA: Bachelor's Programme in IT and Information Systems	100 %	216	11 %	3,85	44	47
UiA: Computer Engineering, Bachelor's Programmme	50 %	261	10 %	3,81	32	30
UiA: Master's Programme in Information and Communication Technology	50 %	79	10 %	3,93	38	30
UiB: Bachelor Programme in Information Science	83 %	252	16 %	3,48	23	46
UiB: Bachelor's Programme in Bioinformatics	33 %	24	63 %	.	.	46,6
UiB: Bachelor's Programme in Computer Science	33 %	61	13 %	3,87	29	53,1
UiB: Bachelor's Programme in Computer Security	50 %	79	9 %	3,08	25	45,7
UiB: Bachelor's Programme in Computer Technology	50 %	175	9 %	3,87	35	52,2
UiB: Bachelor's Programme in Informatics-Mathematics-Economy	33 %	24	29 %	.	.	46
UiB: Bachelorprogram in Information- and Communication Technology	67 %	71	21 %	2,62	20	47,8
UiO: Digital economy and leadership	67 %	.	0 %	0,00	.	62,1
UiO: Informatics: design, use, interaction	100 %	302	42 %	3,83	31	53
UiO: Informatics: language and communication	83 %	65	34 %	3,83	32	51,1
UiO: Informatics: nanoelectronics and robotics	67 %	103	17 %	3,94	40	53,1
UiO: Informatics: programming og networks	67 %	341	16 %	3,95	34	53,1
UiS: Computer - Bachelor's degree programme in computer science	33 %	214	10 %	3,78	39	43,7
UiS: Computer Science - Master's Degree Programme	33 %	70	21 %	3,85	44	30
UiT: Bachelor of Science - Computer Science	50 %	134	15 %	3,61	37	30
UiT: Computer Science - bachelor	50 %	118	9 %	3,56	44	45,1
UiT: Computer Sciences - master	50 %	102	9 %	4,14	52	44,7
Westerdals: Bachelor - E-Business	88 %	110	15 %	4,09	40	30
Westerdals: Bachelor - Frontend and Mobile Development	88 %	53	8 %	.	.	30
Westerdals: Bachelor - Intelligent Systems	88 %	109	8 %	4,00	37	30
Westerdals: Bachelor - Interactive Design	88 %	89	54 %	3,78	33	30
Westerdals: Bachelor - Programming	88 %	106	8 %	3,99	41	30
Westerdals: Bachelor Game Design	63 %	56	16 %	3,53	33	30
Westerdals: Game Programming	88 %	53	2 %	.	.	30

Programs are listed in alphabetical order. Value of . indicates that there was no available data for that variable.

** Value of 30 indicates that all applicants were admitted.*