National Prior Knowledge Test in Programming Preliminary Analysis

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Abstract. The implementation of Kunnskapsløftet 2020 has made programming a mandatory part of the curriculum within mathematics subjects in secondary school. Three years later, the first cohort of students with this programming experience entered higher education institutions. This existing programming competence can have significant implications for the teaching of ICT subjects at universities and colleges. If students already possess a solid understanding of basic programming elements, instruction can be intensified and reach a more advanced level as early as the first semester. However, it is necessary to investigate whether this is the case. There has been significant variation in the quality of programming education during the implementation of Kunnskapsløftet 2020. Teachers' knowledge of programming varies greatly, with some having programming as part of their education while others have never coded before. Therefore, it is important to assess the extent and comprehensiveness of students' prior knowledge.

The National Prior Knowledge Test in Programming is a tool for assessing students' programming experience. The test covers the fundamental elements of introductory programming taught at different universities and colleges in Norway. The goal of the test is to evaluate students' level of knowledge regarding the curriculum taught at higher education institutions, regardless of what they have learned in secondary school.

This text provides preliminary insight into the results of the test. It only contains data, no statistical testing or deep analysis.

Keywords: Prior Knowledge · Test · Introduction to Programming · CS1

1 Introduction

The National Prior Knowledge Test has been administered to a cohort of 1652 students. The obtained results reveal an average score of 10.4 out of a possible 22.6.

1.1 Data Cleaning

The variables of gender, educational institution, and study program were provided by respondents in an open-text format. Consequently, a manual labeling process was employed to categorize and assign appropriate labels to these responses. For instance, terms like *jente*, *kvinne*, *ho*, etc., were all unified under the label *f* to represent the female gender. However, it is important to note that not all submissions received accurate labels, due to unintelligible responses, resulting in a reduced sample size for specific categories. Later analysis of the dataset will have a larger number of data points.

In the analysis pertaining to gender, only the binary classifications of *female* and *male* were considered, given the limited representation of other gender categories within the dataset. This decision was made due to the insufficient sample size of alternative gender identities for meaningful statistical analysis.

All students who reported having completed a university level course in programming have been ommited from this dataset.

2 Prior Programming Experience

In the initial segment of the test, we inquired with the students regarding their prior exposure to programming prior to commencing their higher education studies.

2.1 Graduation Year

The students were queried about the year in which they completed their secondary school education. Notably, the educational reforms outlined in Kunnskapsløftet 2020 were introduced in the year 2020, resulting in programming becoming a compulsory component solely for those students who graduated in 2023 and onwards. Nonetheless, a significant portion of test participants concluded their secondary education in preceding years. The distribution of participants according to their year of graduation, along with their corresponding mean scores and standard deviations, is presented in Table 1.

Graduation Year	n	Mean score	SD
2023	385	14.66	5.60
2021 - 2022	721	9.13	6.06
2020	112	8.22	4.93
Before 2020	251	8.49	5.44
All	**1469**	**10.4**	**6.30**

Table 1: Number of participants, mean score and standard deviation of each graduation year.

2.2 Elective Programming Subjects

During the secondary school phase, students have the option to select elective courses such as *Informasjonsteknologi 1* (IT1), *Informasjonsteknologi 2* (IT2), and *Programmering og modellering X* (PMX). The details encompassing the count of participants, the respective mean scores, and the associated standard deviations for these elective subjects are presented in Table 2. It's worth noting that the data for PMX is not exclusive in the following tables; an individual who completed PMX might also have undertaken IT1.

All

Elective	n	Mean	SD
Only IT1	95	12.18	5.94
Only IT2	37	16.23	5.28
IT1 + IT2	181	16.77	4.98
PMX	65	16.57	5.60
No electives	856	8.85	5.62

Table 2: Number of participants, mean score and standard deviation of those with electives.

Table 3 and Table 4 provides a more detailed breakdown of individuals possessing experience gained from elective subjects, categorized by the year of their secondary school graduation.

2023

Elective	n	Mean	SD
Only IT1	34	16.25	4.63
Only IT2	11	20.41	1.14
IT1 + IT2	75	19.40	2.77
PM X	26	17.57	5.05
No electives	246	12.53	5.30

Table 3: Number of participants, mean score and standard deviation by gender.

Pre 2023

Elective	n	Mean	SD
Only IT1	61	9.91	5.37
Only IT2	26	14.46	1.14
IT1 + IT2	106	14.91	5.37
PM X	26	17.57	5.05
No electives	610	7.37	5.04

Table 4: Number of participants, mean score and standard deviation by gender.

3 University & College

The assessment was administered to students across five prominent higher education institutions in Norway: University of Bergen (UiB), Western Norway University of Applied Sciences (HvL), University of Stavanger (UiS), University of Oslo (UiO), and Norwegian University of Science and Technology (NTNU). For a comprehensive overview, Table 5 presents the participant counts, along with the corresponding mean scores and standard deviations, specific to each institution.

Institution	n	Mean score	SD
UiB	325	9.59	5.45
HvL	52	9.57	6.87
UiS	111	10.14	6.76
UiO	60	13.24	5.81
NTNU	696	10.98	6.69
All	**1244**	**10.41**	**6.30**

Table 5: Number of participants, mean score and standard deviation of each university and university college.

4 Programming Concepts

Every task featured in the test pertained to a designated concept category. Table 6 gives the percentage of accurate responses achieved by all participants for each respective category.

Concept	%
Variables	82
Conditionals	60
Boolean	55
Datatypes	40
Functions	40
Loops	31
Lists	28
Total	**46**

Table 6: Percentage of correct answers per task category.

The percentage of students who managed each task category may not be a reflection on how well they know that concept, but rather the difficulty of the questions or how good a question was. A closer look at each task will be included in a later report.

5 Gender

Table 7 gives the number of participants, mean score and standard deviation by gender. Table 8 contains only students who graduated in 2023 and Table 9 contains all students who graduated in an earlier year.

All

Gender	n	Mean Score	SD
Female	512	8.03	5.28
Male	838	11.60	6.39
Total	**1350**	**10.24**	**6.23**

Table 7: Number of participants, mean score and standard deviation by gender.

2023

Gender	n	Mean	SD
Female	113	12.24	5.42
Male	230	15.53	5.37
Total	**343**	**14.45**	**5.60**

Table 8: Number of participants, mean score and standard deviation by gender.

Before 2023

Gender	n	Mean	SD
Female	314	6.95	4.57
Male	453	10.25	6.28
Total	**767**	**8.90**	**5.87**

Table 9: Number of participants, mean score and standard deviation by gender.

6 Further Work

As mentioned this report is only a preliminary analysis of the data. Later a full report will be made public with further details such as:

- Statistical testing to find any significant difference in the data presented in this report
- Analysis of the remaining data collected, such as:
  - Mathematics subject taken
  - Experience outside of formal education
  - Attitude towards programming
  - Study program
- Analysis of each programming task to understand how well the students understood its topic and whether the task was valid for determining the proficiency of the student for the respective concepts. This will not feature in the public report, but a private version which will be made available to the project group developing and distributing the test.
- Reflection and discussion on the data presented
- Overview of Kunnskapsløftet 2020
- How the test was constructed and what it contains