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Women's Choices of STEM Degrees and Careers

A Comparison of Norway and UK

Aashild Jekteberg Nordpoll

Supervisor: Astrid Kunze

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NORWEGIAN SCHOOL OF ECONOMICS

Abstract

The aim of this thesis is to answer the two research questions whether more women in Norway choose STEM degrees and careers than in the UK, and why do we observe gender differences in the choices of STEM degrees and careers.

The first research question is answered through a statistical presentation of secondary data obtained from SSB, HESA and ONS. I found that more women in Norway do choose STEM degrees and careers than in the UK, but for certain fields the female ratio is higher in the UK.

The second research question is answered through a literature review on existing research. Gender differences in STEM degrees may be due to gendered stereotypes, a skewed opinion of girl's abilities to learn math and STEM-subjects, different preferences and lack of good role models. Observed gender differences in STEM degrees may be explained through a leaking pipeline caused by chilly work climate and women deterring entry to STEM-occupations for other women, and the toll of family responsibilities in a demanding work climate.

The thesis concludes with recommendations based on the findings and suggestions for further research.

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1. Introduction

1.1 Background

The underrepresentation of women in science, technology, engineering and math (STEM) education and workforce has become increasingly important to policy makers, researchers and businesses (Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2006). STEM skills are critical to innovation and to create competitive advantage in knowledge-intensive economies, and demand for STEM skills is anticipated to increase in the short and medium term (European Commission, 2014). The lack of women in STEM-fields is an untapped talent pool and represents today a huge loss for organizations and society. Increasing awareness and research is needed to better understand why women shy away from well-paid, high demand, prestigious STEM-fields and how we can bridge the gender gap in STEM.

1.2 Goal

The aim of this thesis is to map out the current situation for women in STEM education and occupations in Norway and UK, and to investigate if there are country differences. Through a literature review I draw on previous research and findings to explain why women are underrepresented in STEM.

I aim to answer the following research questions:

RQ1: Do more women in Norway choose STEM degrees than in the UK?

RQ2: Do more women in Norway choose STEM careers than in the UK?

RQ3: Why do we observe gender differences in choices of STEM degrees?

RQ4: Why do we observe gender differences in choices of STEM careers?

1.3 Relevance

This thesis contributes to the growing literature on women in STEM by adding evidence from Norway and UK and a comparison of the two countries. The study gives a unique overview of the current representation of women in STEM for Norway and United Kingdom, in addition to a review on explanatory factors for why women are underrepresented in STEM-fields. The findings can give useful insights for educators, employers, parents and policy makers who wants to learn more about women in STEM.

1.4 Structure

The remainder of the thesis is structured as follows: Chapter two discusses the definition of STEM. Chapter three presents an overview of the Norwegian and British school system. Chapter four describes data choices and research methodology. Chapter five presents statistical findings on the representation of women in STEM education and workforce for Norway and UK. Chapter six presents a literature review on gender differences in STEM entrance and retention. Chapter 7 discusses findings in data and literature. Chapter eight concludes.

2. Definition of STEM

STEM is an acronym for the subjects of Science, Technology, Engineering and Math. The acronym is used to distinguish and categorize studies and degrees where skills and abilities in these subjects are developed, as well as and occupations held by people with skills in these areas. It is also used to denote industries characterized by the prevalence of science, technology, engineering and math and associated professionals.

STEM skills are defined as skills "expected to be held by people with a tertiary-education level degree in the subjects of science, technology, engineering and math" (EU Skills Panorama Glossary). More precisely they include "numeracy and the ability to generate, understand and analyze empirical data including critical analysis; an understanding of scientific and mathematical principles; the ability to apply a systematic and critical assessment of complex problems with an emphasis on solving them and applying the theoretical knowledge of the subject to practical problems; the ability to communicate scientific issues to stakeholders and others, ingenuity, logical reasoning and practical intelligence." (UK Parliament 2012, UKCES 2011)

For this thesis, I have chosen STEM categories based on the definition used by leading organizations publishing statistics on STEM workforce in UK, such as WISE Campaign (source). More concretely, the UK Commission on Employment and Skills'(UKCES) grouping of baseline data into different STEM fields defines science, engineering and ICT as core STEM fields. This also includes the addition of more occupations in 2016 such as business research professionals, environmental professionals, airline pilots and flight engineers, health and safety officers. The definition of core STEM omits health and health associate professionals, which is a desired distinction due to the female majority in this field. Medical STEM is of little interest as I aim to discuss the female underrepresentation in STEM education and occupations.

3. School Systems in Norway and UK

This chapter serves as background information for the statistical findings in chapter five and presents an overview over the main aspects of the Norwegian and British school system. For a overview over both systems, see figure 1.

3.1 The School System in Norway

The Norwegian School system can be divided into three main parts: Primary school (barneskole), lower secondary school (ungdomsskole) and upper secondary school (videregående skole). Schooling from age 6-16 in primary and lower secondary school is mandatory.

3.1.1 Primary School

Norwegian children start school at the age of 6. They attend primary school through seven grades, until 12 years of age. No official grades are given at this level, but an introductory test can be given by the teacher to map out possible learning challenges or assistance needs.

3.1.2 Lower Secondary School

Lower secondary school goes through grades 8-10 at ages 13-16. At this level students receive grades in all subjects, and one elective in languages is introduced. Upon finishing 10th grade, students are required to take one written and one oral exam to complete their obligatory schooling. The final grades serve as basis for admission to upper secondary school.

3.1.3 Upper Secondary School

Secondary education in Norway primarily takes place in public schools. Since the introduction of the most recent national curriculum named *Kunnskapsløftet* in 2006, students can apply for general studies (studiespesialisering) or vocational studies path (yrkesfag). Each path has several sub-paths that students must choose among.

General studies last three years, and upon completion students receive the general university admission certificate (generell studiekompetanse) which allows them to apply for higher education at college or university. The GPA attained throughout upper secondary school is the criteria on which admission to specific studies are granted.

Vocational studies usually follow a structure named the “2+2 model”. The first two years of students receive school training that includes both theoretical teaching and practical training in workshops and shorter industry internships. This is followed by a two-year apprenticeship in an enterprise or public institution. At the end of the four-year study and apprenticeship, the students go through examinations in their vocational field and receive their certificate of apprenticeship and their education is completed.

3.1.4 Higher Education

Higher education in Norway is any studies beyond upper secondary school, and normally lasts three years or more. To be accepted to most HE institutions, students must have attained the before mentioned general university admissions certificate through general studies in upper secondary school. Some degrees also require special math and science electives in VG2 and VG3. One can also be admitted through the law of 23/5. This law states that if a person is above 23 years, have five years of combined schooling and work experience and have passed exams in Norwegian, mathematics, natural sciences, English and social studies, they are eligible for higher education.

Most studies are structured according to the Bologna system. This means that the usual degrees attained are bachelor (3 years), master (5 years) and PhD (8 years) titles, both in universities and university colleges. Universities also offer professional studies, e.g. medicine, pharmacy, psychology, dentistry and law. There is no formal distinction between vocational and non-vocational higher education in Norway (UNEVOC, 2013).

3.2 The School System in United Kingdom

Age	The Norwegian System	Exam/Diploma	The English System		Exam/Diploma
19	Higher Education	Bachelor Master Professional Degrees PhD	Higher Education		
18	Upper Secondary School	General University Admissions Certificate (*generell studiekompetanse*), qualifies for HE. Certificate of Apprenticeship, various vocational disciplines.			
17			Sixth from College (Academic)	Tertiary College (Vocational)	A2 level AS level Various Vocational qualifications Diplomas
16					
15	Lower Secondary School	Diploma of primary school education. Grades achieved forms the basis for admission to upper secondary school.	Secondary School		GCSE
14					
13					
12	Primary School				
11			Primary School		
10					
9					
8					
7					
6					
5	Kindergarten				
4			Nursery school		
3					

Figure 1: Comparing Norwegian and British school systems

In the United Kingdom, the education system is quite complex and multi-faceted compared to Norway. This is in part due to each of the countries of the United Kingdom having separate systems under separate governments. Although the structuring of the school year and the curriculum may vary throughout the four countries, there are still similarities. Evidence of this can be found in educational outcomes, which show many similar results between England, Scotland, Wales and Northern Ireland. Since many of the policies and programs adopted in England also have relevance for the other UK countries, I use the English school system as a baseline for understanding British education (Machin & McNally, 2013).

For each country, that is England, Scotland, Wales and Northern Ireland, the education pipeline is divided into five stages: early years, primary, secondary, further education (FE) and higher education (HE) (UK Gov, 2018).

3.2.1 State Schools and Independent Schools

In 2017, 91 % of English school children attended co-educational state schools, the remaining 9 % attended private schools, known as independent schools in Britain, financed by non-governmental means (Department for Education, 2017). The structure of and the terms given the different levels at independent schools are somewhat different from that of state schools, but the number of years of education received before entering higher education are the same for both institutions. Since the structure of state schools apply to the clear majority of UK school children, this structure will be elaborated upon in the following paragraph.

3.2.2 Early Years

Children between three and five years old are entitled to 570 hours of free early education or childcare a year. This can be provided in nurseries, nursery classes in school or community childcare centers, and are usually distributed over 15 hours each week for 38 weeks of the year (gov.uk, 2018)

3.2.3 Primary and Secondary School

Children start primary school the year they turn 5. At 11 years old they transfer to secondary school until the age of 16. Upon completing examination, pupils receive the General Certificate of Secondary Education (GCSE), and their mandatory schooling is completed. However, the leaving age – the age at which a student may choose to end their education – was raised to 18 by the Education and Skills Act 2008. The law came into force in 2013 for 16-year-olds and in 2015 for 17-year-olds. This new act separated the school leaving age, which remains 16, and the education leaving age, which is now 18 (Legislation Government UK, 2008).

3.2.4 Further Education (FE)

As previously mentioned, since the introduction of the Education and Skills Act education or training are still compulsory until the age of 18. At this point, students can choose apprenticeships or tertiary education for vocational qualifications, or continue in full-time education at a separate sixth form college or in the sixth form of secondary school. There they will continue study for AS levels (Advanced Supplementary) or A2 levels (Advanced), both examinations leading to university entrance qualifications. AS levels take one year while A2 levels usually take 2 years. Hence, English students receive in total 13 years of schooling before entering higher education at 18 years of age (UK Gov, 2018).

3.2.5 Higher Education

Higher education in Britain can be separated into undergraduate and postgraduate education.

Undergraduate studies

The typical first degree offered at English universities is a bachelor's degree with honors, i.e. graded as opposed to pass/fail evaluation, which lasts three years. Exceptions to this are vocational foundation degrees lasting two years. Many institutions now offer integrated master's degrees as a first degree, particularly in STEM subjects. These typically lasts four years with the first three running parallel with ordinary bachelor's degree (Select Committe on Science and Technology, 2012).

Postgraduate education

When having completed a first degree, students can apply for postgraduate and graduate courses such as graduate certificates, postgraduate certificates, master's degree (1-2 years) or doctorates (3-4 years). Postgraduate studies are not automatically funded by the government.

4. Description of Data and Method

This chapter explains the reasoning behind selection of data, followed by an introduction of challenges raised by using this set of secondary data and a description of data and method used.

4.1 Using Survey-Based Secondary Data

In order to answer my two first research questions I use secondary survey-based data. This is existing data collected for some other purpose, and is made available as compiled data tables or downloadable matrixes of raw data. The data has been collected through censuses and continuous surveys by three national institutions: Statistics Norway (SSB), Higher Education Statistics Agency (HESA) and Office for National Statistics (ONS).

4.1.1 The Rationale Of Data Selection

There are several reasons why I have chosen to use secondary data from these statistics providers. Firstly, they provide longitudinal studies that cover a national population. As I want to map out the current situation for women in STEM education and occupations for both Norway and UK and compare the two, secondary sources provide me with rich and comparable data I otherwise could have had obtained within the scope of a master thesis.

Secondly, even though the data originally is collected for other purposes they still match my research questions' objective. That means that they offer me an overall suitability and the measurement validity is high. The selected data has also proved to provide sufficient coverage, so that unwanted data can be excluded and necessary data remains for analyses to be undertaken.

Thirdly, since the survey data is collected through trusted public institutions dedicated to research in their fields, it is likely that the information they provide is reliable and trustworthy. The published data is usually permanently and easily available, which makes it open to public scrutiny. Hence, I consider the reliability and validity of the data I use as high.

4.1.2 Challenges Related to Use of Secondary Data

I have also come across some challenges when using the chosen secondary data. The data I apply has been compiled for different purposes, and as a part of the compilation process, it will have been aggregated some way that does not suit my research. An example of this is the data used for STEM in higher education in Norway. The dataset was already compiled into few and wide categories, which may have been too coarse to give a nuanced and comparable picture of women studying for STEM-degrees in Norway. This is also an ethical problem, as I have a responsibility to manage the trust placed in researchers' integrity to not misrepresent collected data. As I have few other data options, this challenge is handled by clearly stating the limitations of my research where it is needed.

4.2 Higher Education Norway

The statistics for higher education in Norway is collected from Statistics Norway's (SSB) education statistics. The data can be found in SSB's table *Students in Higher Education in Norway and Abroad. Gender and Age. Numbers and Percentages,* table 08823: *Students in Higher Education in Norway and Abroad. Gender and field of study,* and table 03824: *Completed degrees at universities and colleges in Norway. Gender, level and field of study.*

For the presented statistics on higher education in Norway, core-STEM subjects comprise natural sciences, skilled trades and technical subjects. This follows SSB's categorization of study fields, and the category consisting of subjects closest to this thesis' definition of STEM is chosen.

4.3 Higher Education United Kingdom

In the general overview, the graph of male and female participation rate in higher education in UK is obtained from The Department of Education's statistical first release from September 28th, 2017.

The statistics for STEM in higher education in UK is collected from Higher Education Statistics Agency's table 12: *HE qualifications obtained by sex, subject area and level of qualification obtained 2011/12 to 2015/16.*

HESA uses JACS (Joint Academic Coding System) to classify academic subjects. I use the five categories defined by the UK Parliament for core-STEM for the presented statistics on higher education in UK: Physical sciences, mathematical sciences, computer science, engineering and technology, and architecture, building and planning (Parliament, 2018). This is in line with the working definition of STEM-subjects for this thesis.

4.4 The Workforce in Norway

The presented statistics on ratio of women in STEM occupation in the Norwegian Workforce is obtained from SSBs' table 11411: *Wage earners per 4th quarter, by gender, occupation, time and statistics variable*, and contains data from Q4 in 2016. The data only covers employees, not self-employed workforce. SSB uses the ISCO08-standard to categorize occupations, while ONS uses the SOC2010-standard. For comparability purposes of core-STEM occupations, the occupational unit groups have been translated to SOC2010 unit groups by using the official translation standard for the two occupational code systems.

4.5 The Workforce in United Kingdom

The statistics for women in STEM-occupations in the UK is derived from ONS' table EMP04: *All in employment by status, occupation & sex*, and contains data from Q2 in 2017. This is not the same period as the data regarding workforce in Norway, but the most recent numbers are used for both Norway and UK. Since the difference in time frame is relatively short (3 months), and both quarters are within the same work year I still consider the data to be comparable. The presented figures include both employees and self-employed, which might pose a challenge when comparing to the STEM-workforce of Norway (includes only employees).

4.6 Limitations

Differences in school systems and categorization of subjects pose some challenges for the comparability of presented data between Norway and UK.

4.6.1 Comparability

Firstly, it is important to note that the statistics presented for core-STEM in higher education in Norway covers both students studying at home and those studying abroad. The similar statistics for UK contains only students studying in UK. Hence it may weaken the comparability of the two data sets.

Secondly, the study field categories used by SSB are quite broadly defined. This might lead to an oversimplified definition and presentation of STEM subjects. Moreover, including skilled trades in the definition of core-STEM is not coherent with the definition used for the UK statistics on higher education. This variation may negatively affect the comparability of gender ratios in core- STEM subjects between Norway and UK in higher education. At the same time, the original SSB data does not allow for a finer distinction among study subjects. In addition, there is no formal distinction between vocational and non-vocational higher education in Norway. Despite the apparent difference, I believe that choosing the category of natural sciences, skilled trades and technical subjects will best represent core-STEM subjects in the Norwegian school system and the status for core-STEM in Norwegian higher education.

4.7 Research Methodology

The selected data has been downloaded to excel files for alteration. Firstly, the data has been grouped and selected to fit this thesis definition of STEM. Secondly, all tables have been coded to comply with either JACS for higher education or SOC2010 for data on workforce in Norway and UK. Norwegian data from SSB has been re-coded from ISCO08 to SOC2010 to be comparable with British data from ONS. Thirdly, ratios have been calculated for all available STEM-fields. Fourth, the processed data has been collected and put together in tables and figures for presentation.

5. Presentation of Data

5.1 Higher Education Norway

This section starts with a general overview of education participation in Norway. It is followed by a presentation of statistics female participation in STEM-subjects in Norwegian higher education.

5.1.1 General Overview

Currently 59.7 % of all students in higher education in Norway are women. The number of women seeking higher education has been ever increasing since 1960, with a particularly steep increase between 1970 and 2000. In the middle of the 1980s the number of women in higher education surpassed that of men. Since then this female majority has been augmented to the current level of around 60 %, which has been relatively stable over the last ten years.

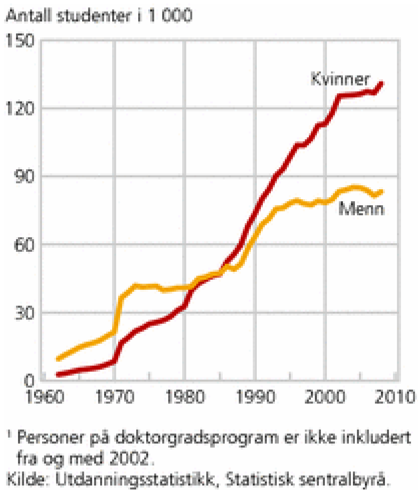

Figure 2: Development HE participation across all studies for Norway .

Note: Reprinted from Utdanningsstatistikk, SSB. Retrieved from https://www.ssb.no/befolkning/artikler-og-publikasjoner/fra-den-forste-kvinnelige-student

5.1.2 STEM Degrees

The overall female majority in Norwegian higher education is not reflected in women's choices of STEM subjects and degrees. The last fifteen years the ratio of women choosing STEM degrees has been fluctuating between 30-33.4 %, but with slight increase the last four years. 33.4 % of those choosing STEM degrees in 2016 were women.

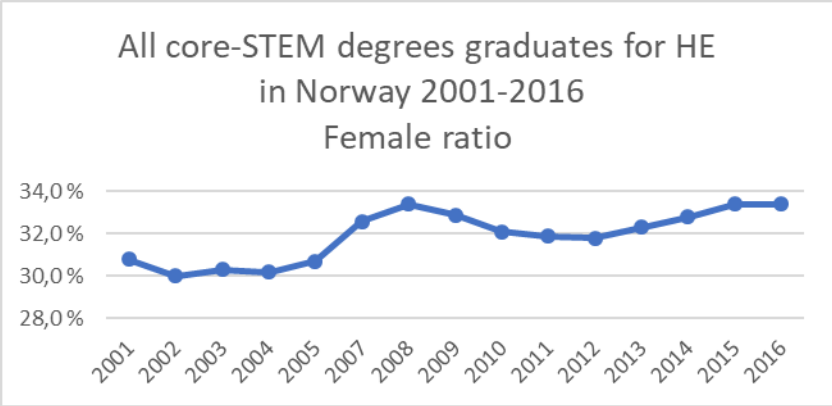

Figure 3: All core-STEM degrees graduates for HE in Norway 2001-2016. Female ratio. Note: Retreived from SSB, Studenter i høyere utdanning i Norge og i utlandet etter kjønn, fagfelt, tid og statistikkvariabel

The lowest representation is found in lower level STEM degrees with 28.6 % women in the school year of 2015-2016. The representation in higher level STEM degrees are nearly ten percentage points higher at 38.3 % in the same year. For students receiving PhDs there was a slight drop from 38.3 % women in 2014/15 to 35.5 % in 2015/16.

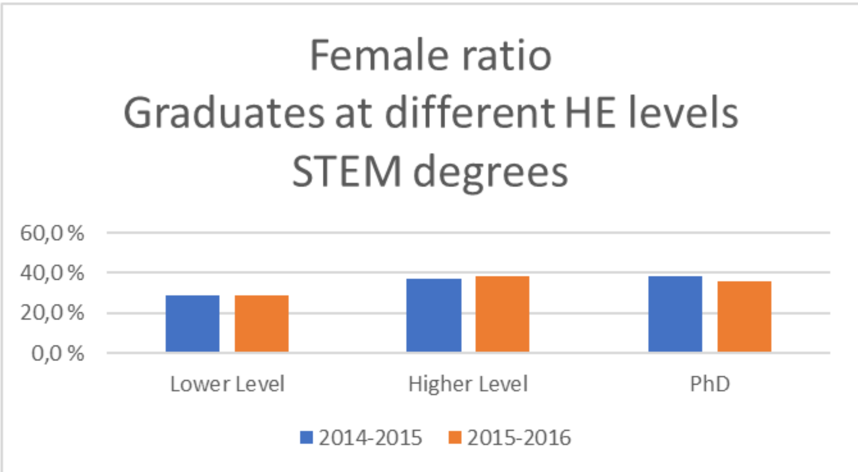

Figure 4: Female Ratio Graduates at different HE levels of STEM Degrees

[1]Lower level includes completed degrees with duration from 2 years up to and including 4 years.
[2]Higher level includes completed degrees with duration more than 4 years.
[3]PhD, the highest academic degree at university or college

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5.2 Higher Education UK

This section starts with a general overview of education participation in UK. It is followed by a presentation of statistics on female participation in STEM-subjects in UK higher education.

5.2.1 General Overview

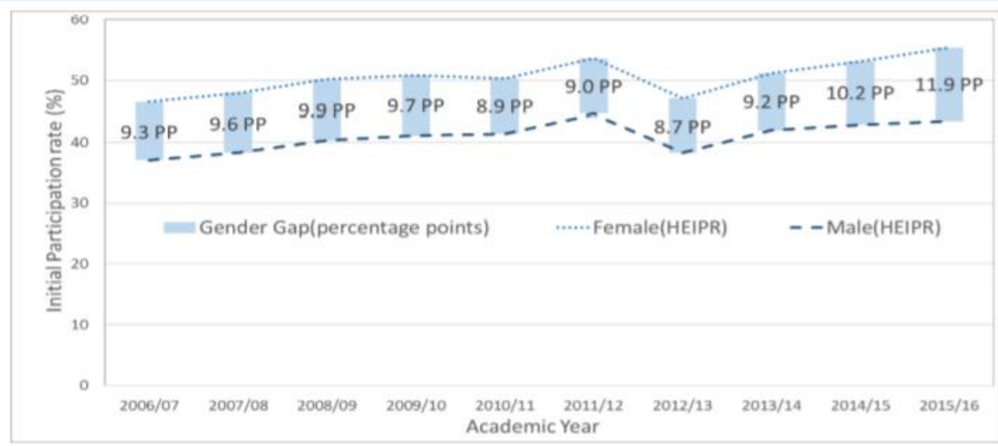

Figure 5 Participation rate and gender gap UK higher education.

Note: Reprinted from *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/648165/HEIPR_PUBLICATION_2015-16.pdf*

Figure 5 shows the anticipated likelihood of male and female participation in higher education across all studies for United Kingdom. While the likelihood of participation has increased for both males and females, the gender gap in 2015/16 has broadened, and is estimated to be 11.9 percentage points (Department for Education, 2017).

5.2.2 STEM Degrees

When it comes to core-STEM subjects the majority in UK is male graduates. Physical sciences are the core-STEM field with the highest female representation. For the 2011/12 school year 42 % of graduates in physical sciences were women, but this ratio has gradually decreased to 40 % in 2015/16. Mathematical sciences have a similar female representation, but also here the ratio of women graduating in this field has decreased from 41 % in 2011/12 to 39 % in 2015/16. On the other hand, the subjects covering architecture, building and planning have seen a five percentage points rise in female candidates, from 34 % women graduating in 2011/12 to 39 % in 2015/16.

The remaining core-STEM fields computer science and engineering and technology have a clear minority of female graduates. Although both fields have experienced a one percentage point increase over the last five years, the female ratio remains low at respectively 20 % and 18 %.

5.2.3 STEM Undergraduate and Graduate Levels

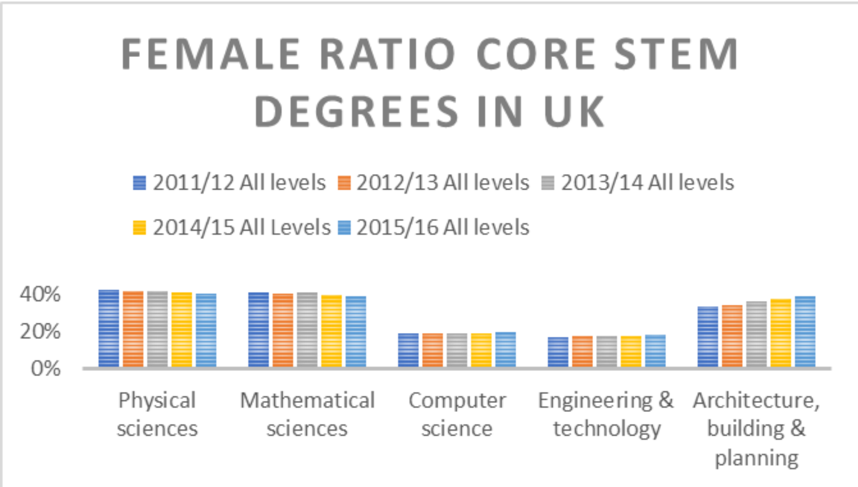

Figure 6 Female ratio core STEM degrees in UK.

Note: Data retrieved from https://www.hesa.ac.uk/news/12-01-2017/sfr242-student-enrolments-and-qualifications

As seen in figure 6, mathematical sciences are the only core-STEM field where the ratio of women taking undergraduate degrees are greater than for postgraduate degrees. 39.3 % of students taking undergraduate degrees in mathematical sciences in 2015/16 were women, while the corresponding ratio for postgraduate studies were 38.3 %.

For physical sciences, we observe a reversal of this scenario where the ratio for women taking postgraduate degrees is slightly greater than for undergraduate degrees. 41.5 % of students taking postgraduate degrees in physical sciences 2015/16 were women, compared to 40.0 % for undergraduate degrees.

For the remaining core-STEM fields we observe a greater discrepancy between undergraduate and postgraduate studies. The biggest gap constitutes 12.7 percentage points and is found in the field of computer science were 28.5 % of postgraduate students and 15,8 % of undergraduate students are women. Furthermore, in engineering and technology the equivalent numbers are 24.5 % and 14.4 %, and in the field of architecture, building and planning 44.3 % and 35.3 %.

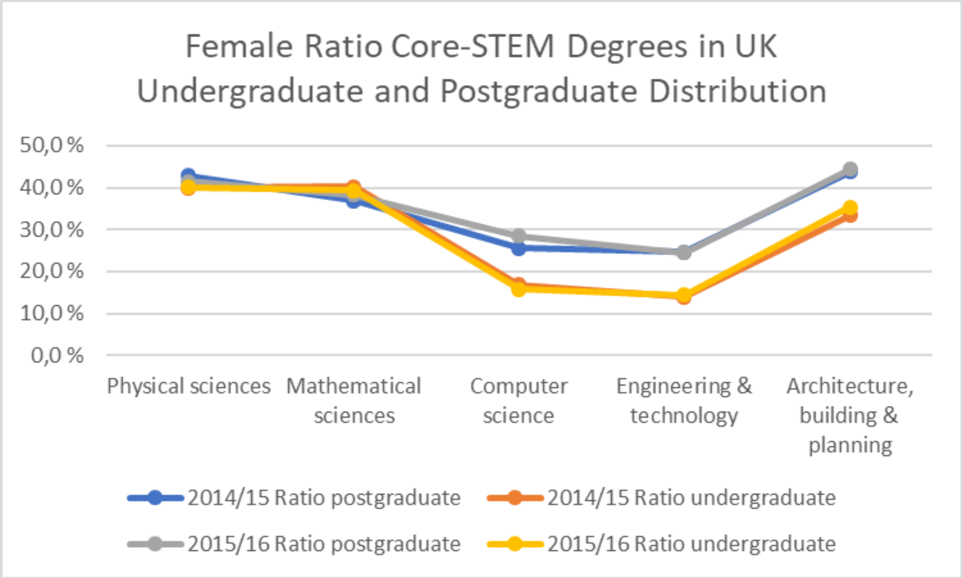

Figure 7: Female ratio core-STEM degrees in UK. Undergraduate and Postgraduate Distribution. Note: Data retrieved from https://www.hesa.ac.uk/news/12-01-2017/sfr242-student-enrolments-and-qualifications

5.3 Workforce: General Overview Norway and UK

Employment rate Women, % of working age population, 2000 – 2016

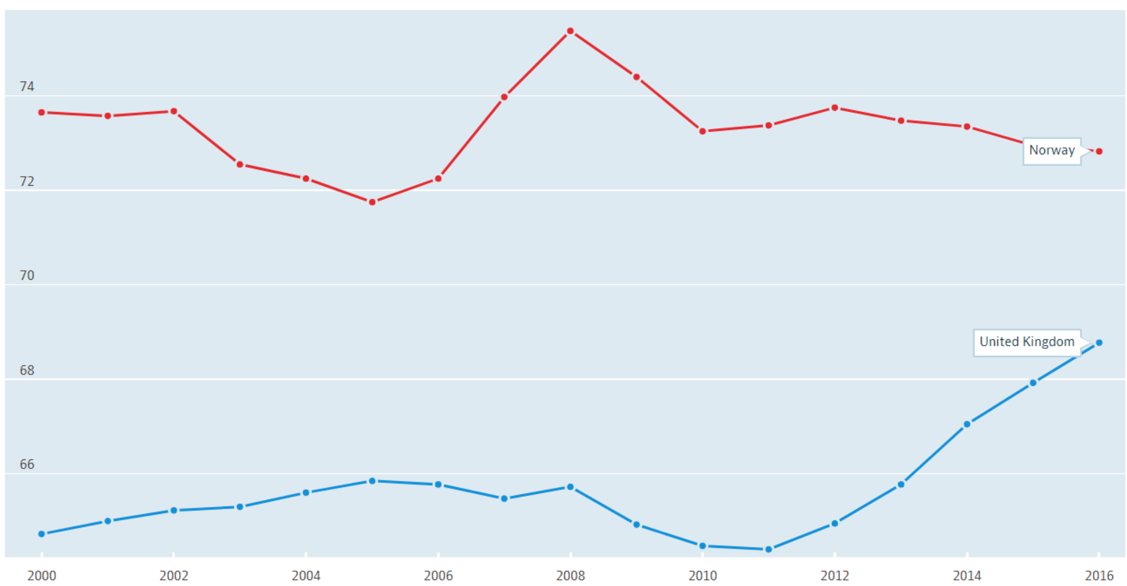

Figure 8: Employment rate. Women, % of working age population, 2000-2016. Note: Data retrieved from OECD Labor Force Survey.

As seen in figure 8, women's employment rate in Norway has since 2000 fluctuated from its lowest point at 71.8 % in 2005 to its highest at 75.4 % in 2008. Since 2010 women's participation in the Norwegian workforce has stabilized around 73 %, moderately lower than the 2000-level at 73.7 %.

The United Kingdom has historically had a lower participation of women in the workforce than that of Norway. In the period 2000-2016, UK had its lowest point in 2011 with 64.4 % of working age women in the work force. Since then the female employment rate has steadily climbed to its highest level in 2016 with 68.8 % of all eligible women in the work force.

Since the employment rate of women in Norway has overall declined during this period meanwhile it has risen in UK, the two countries currently hold their closest level of female employment. More precisely 68.8 % for UK in 2016, only four percentage points behind Norway at 72.8 %.

5.4 STEM Workforce Norway

The overall proportion of women with core-STEM occupations in Norway is currently 30 % (Q4 2016).

Based on the definition of STEM by xx and Statistics Norway's (SSB) classification of occupations in line with the ISCO08-standard Figure xx gives and overview of the ratio of women in core-STEM occupations in Norway. To better shed light on where the gender gap is most prominent, the relevant STEM-occupations have been further grouped into ten main categories with approximately similar proportions of women.

The environment and health sector clearly has the highest ratio of women among the given STEM-occupations at 62.1 % in 2016. This group consists of environmental protection professionals, environmental health professionals, management and organization analysts, policy administration professionals and health and safety officers.

The two next categories of chemists, mathematicians and biologists and architects and areplanners have almost identical female ratios of repectively 48.1 % and 47.4 % in 2016. The same is true for the two following categories; Draughtspersons and technicians n.e.c. and Physicists and geologists. The ratio of women in these categories of core-STEM occupations constitutes respectively 32.5 % and 32.1 % in 2016.

The five last categories all lie below the critical threshold of 30 % female employees. The group of IT Professionals and Technicians consists of system analysts, software developers, web and multimedia developers, IT operations technicians and IT user support technicians. In 2016, women constituted 20.9 % of the employees in this sector. Correspondingly, the ratio of women employed as engineering professionals was 21.3 % the same year. Even lower is the numbers for Engineering Technicians at 14.8 % and Production Managers at 12.0 %. The last-mentioned category includes managers in manufacturing, construction, mining and energy as well as information technology and telecommunications directors.

The last category is exceptionally narrow, containing only one core-STEM occupation. The proportion of women employed as aircraft pilots in 2016 was 3.7 %. Including aircraft pilots into the core-STEM definition of occupations is quite new and making aircraft pilots a category on its own can be somewhat artificial. At the same time the occupation does not fit well into the other categories. To keep the empirical presentation clear, aircraft pilots are kept as a separate category.

All categories except for draughtspersons and technicians n.e.c., IT professionals and technicians in addition to aircraft pilots experienced a slight rise in the proportion of women employed from 2015-2016. The three exempted categories had a minor drop in female representation during the same period.

	Ratio women	
	2015	**2016**
Environment & Health	62 %	62 %
Chemists, Mathematicians & Biologists	48 %	48 %
Architects & Areaplanners	46 %	47 %
Draughtspersons & Technicians n.e.c.	34 %	33 %
Physicists & Geologists	32 %	32 %
IT Professionals and Technicians	21 %	21 %
Engineering Professionals	21 %	21 %
Engineering Technicians	15 %	15 %
Production managers	12 %	12 %
Aircraft pilots	4 %	4 %

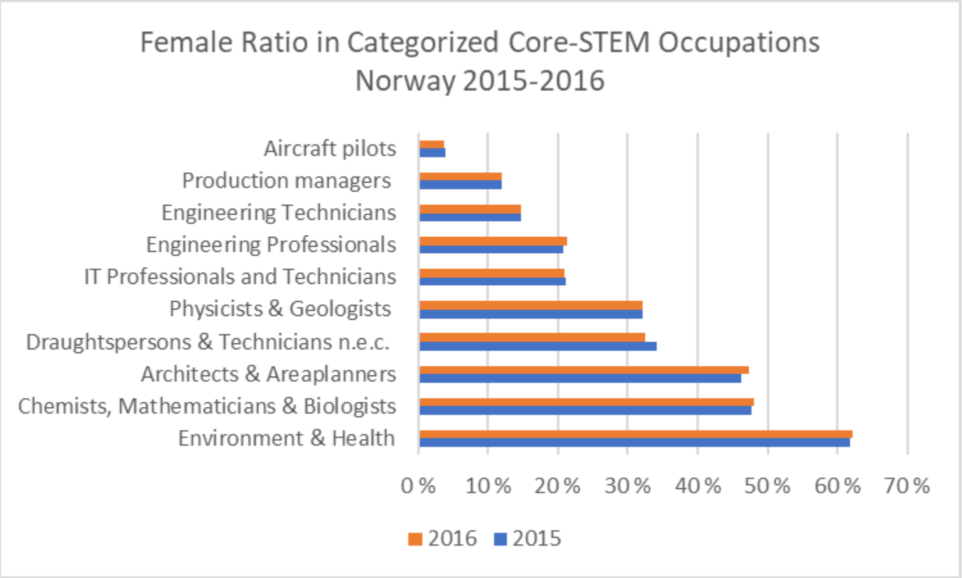

Figure 9: Female ratio in categorized core-STEM occupations Norway 2015-2016. Note: Data retrieved from SSB.

5.5 STEM Workforce UK

The overall proportion of women with core-STEM occupations in UK is currently 22.6 % (Q2 2017).

The category with the highest proportion of women in UK core-STEM occupations in 2017 is Chemists, Mathematicians and Biologists at 46 %. Occupations within Environment and Health comes second with a 38 % percentage of female workers. On the other end of the scale is Engineering Professionals with a 11 % proportion of women in the workforce. Although a low figure, this is a climb up from 8 % last year with nearly 12,000 more women working as professional engineers (WISE Campaign, 2017). A related category, Engineering Technicians holds a notably higher share with 27 % women in 2017, the same as for 2016. Despite the constant ratio the number of women working as engineering technicians this year grew by 22,000, making the total 97,064 (WISE Campaign, 2017). A fairly low percentage of women is working as IT Professionals and Technicians, they make up 18 % of the total workforce for this category in 2017.

	Female ratio
Chemists, Mathematicians & Biologists	46 %
Environment & Health	38 %
Engineering Technicians	27 %
Physicists and geologists	25 %
Production Managers	25 %
Architects and Areaplanners	22 %
IT Professionals and Technicians	18 %
Draughtspersons and Technicians n.e.c.	16 %
Engineering Professionals	11 %

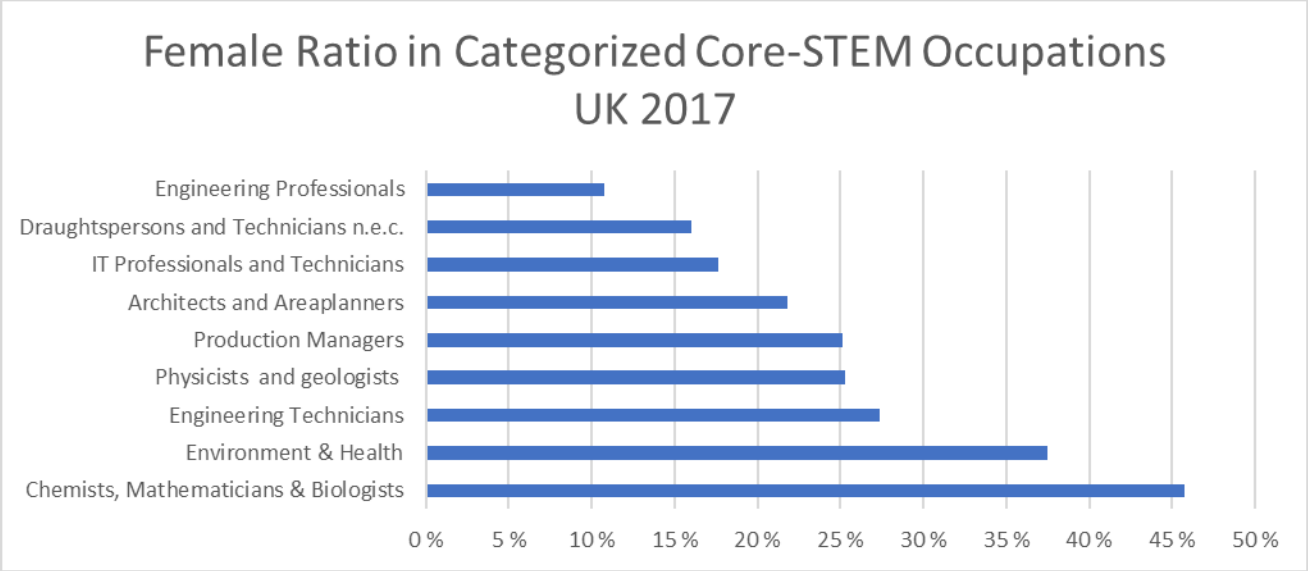

Figure 10: Female ratio in categorized core-STEM occupations UK 2017. Note: Data retrieved from ONS.

5.6 Comparing STEM Workforce Norway and UK

The share of women in core-STEM occupations in Norway and UK are most similar for the category chemists, mathematicians and biologist. With the ratio 48 % for Norway and 46 % for UK, both countries have nearly achieved workforce gender balance in this STEM-category. The female share of IT-occupations is also somewhat similar, with 21 % for Norway and 18 % for UK. The most substantial disparity between the two countries are found in the category for architects and area planners. While Norwegian women make up 47 % of the workforce in that category, the corresponding proportion for UK is 22 %.

Norway has a higher proportion of women in all core-STEM categories except for Engineering technicians and Production Managers. In these occupations UK has a female percentage of respectively 27 % and 25 %, about double that of Norway at 15 % for engineering technicians and 12 % for production managers.

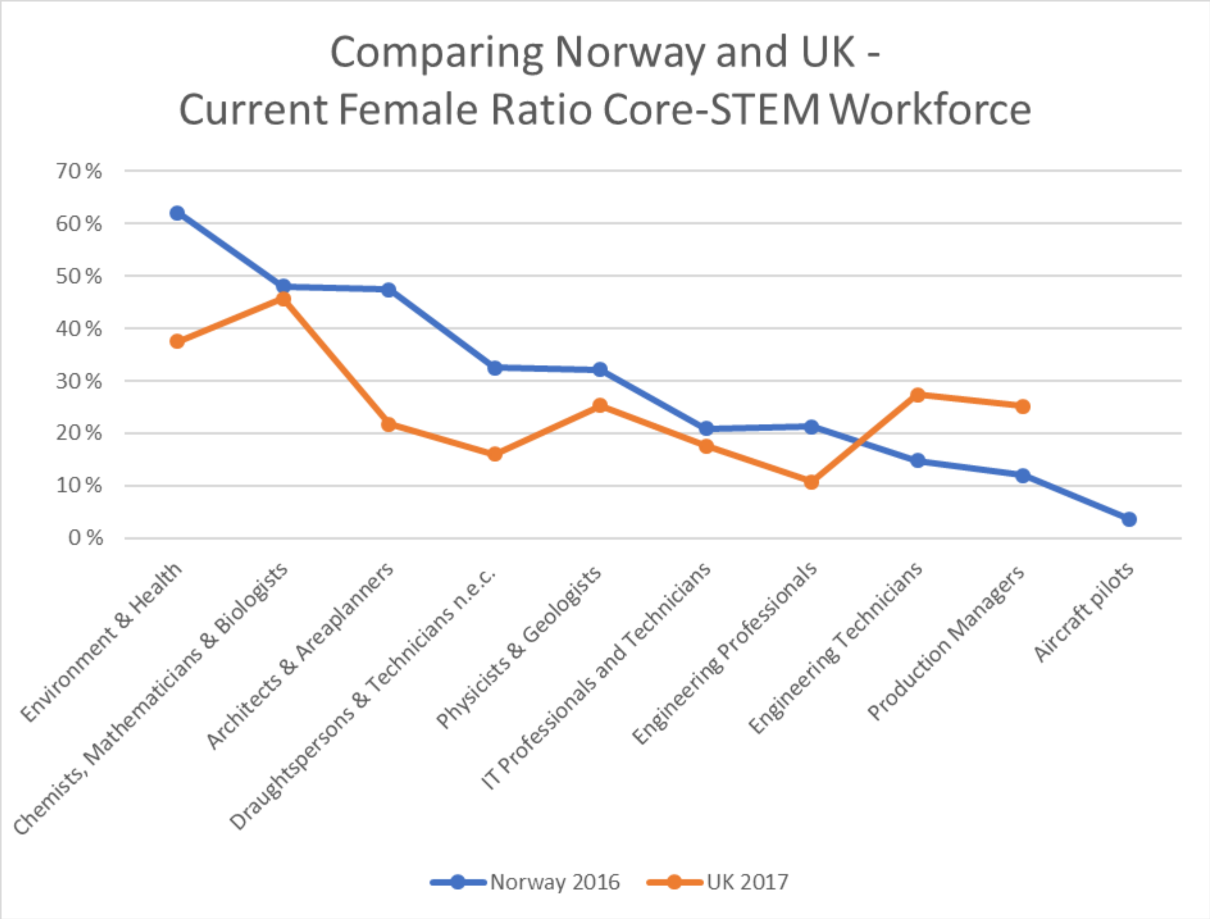

Figure 11: Comparing Norway and UK. Current female ratio core-STEM workforce. Note: Data retrieved from SSB and ONS.

6. Literature Review

This chapter presents a literature review on current studies and research on why women are not choosing STEM degrees and careers. The chapter is divided in two main parts, giving and overview over challenges related to STEM entrance and STEM retention for women.

6.1 Challenges Related to STEM Entrance

Challenges related to STEM entrance occur already in early years and education. The effect and importance of stereotypes, abilities and preferences, and role models are elaborated upon in the following section.

6.1.1 Stereotypes

The first obstacle girls and women might face as a hindrance towards choosing a STEM education and occupation is prevailing gender stereotypes. Because of rational decision making, individuals refrain from making untraditional choices fearing it will lead to problems in the future, or because of the discomfort of being a minority (Jonsson, 1999).

In the further review literature on how stereotypes affect girls' and women's education and career choices, I will concentrate mainly on math gender stereotypes and how family, parents, teachers and culture contribute such stereotypes. Math is a core component of most STEM education, and the findings gives an understanding of how math stereotypes affect STEM choices.

Parents play an important role in forming their children's view on math and math abilities. Eccles & Jacob (1986) and Eccles, Jacobs, & Harold (1990) found that mothers with gendered stereotypes would rate their daughter's ability lower than the teacher's evaluation of ability. Especially for children taking extra math classes, the mother's beliefs had a greater impact on children than their children's actual performance. These findings suggest that parent's gendered stereotypes cause their children to also adopt these beliefs and leads to gender differences in student's attitudes towards math (Eccles & Jacobs, 1986).

Parents can also affect their children's math and STEM performance positively. Parents with a math growth-mindset - the mindset that abilities are not fixed, but can be developed through learning and hard work - transfer this to their children, and the effect is twice as large on girls as on boys (Cheng, Koptic, & Zamarro, 2017). The growth mindset of parents is also associated with children's performance in mathematics and STEM. Cheng, Koptic, & Zamarro (2017) found that parents' math growth-mindset increased children's growth mindset with the effect on girls twice as large as on boys. Even so, the role of the family only explains to a small extent the gender gap in STEM achievement (Xie & Schauman, 2003).

Teachers also play an important role in forming opinions and attitudes towards math and STEM subjects. Children learn stereotypes early on, and it seems that boys and girls learn this bias in school. A study by Cvencek, Meltzoff, & Greenwald (2011) found that girls and boys implicitly and explicitly associated math with "males" already by second grade. Boys also self-identified with math and girls self-identified with reading. Lavy & Sand (2015) also found that girls in elementary and middle school that had biased math teachers took fewer high school math courses and were less likely to major in STEM fields and have STEM occupations. Teachers also influence gender views by being role models themselves. This will be expanded on in section 7.1.3 Role Models.

Cultural differences may also influence math stereotypes. Findings show gender gap in mathematics disappears in gender-equal countries (Guiso, Monte, Sapienza, & Luigi, 2008)

6.1.2 Abilities and Preferences

Abilitites

A second variable relevant for explaining gender differences in STEM, can be found by delving deeper into women's abilities and preferences in education and job choices. One could argue that the gender gap is due to rational choices based on the view that men and women have comparative advantages for success in different studies (Jonsson, 1999). Men might for example have higher abilities in math relative to other subjects than women, hence men have higher probability for success in science and technical subjects. If this is the case, it would be rational that a higher percentage of men choose science and technical subjects than women (Støren & Arnesen, 2003).

Two concepts found in literature challenge this view; growth mindset and success expectancy. Researchers have found a correlation between a math growth mindset and math performance, math interest, and math course-taking in middle school and high school (e.g., Blackwell et al. 2007, Nix et al. 2015, Good et al. 2012). Evidence from psychological literature shows that the belief that math abilities can change and be developed is selffulfilling. This ‘growth mindset’ is more likely to be held by boys, particularly from high school age (Bian, Leslie, & Cimpian, 2017). Yet simple interventions have shown to make a difference on growth mindset. When girls learn math using a growth mindset, they improve math scores so that they perform at the same level as boys or better.

Success expectancy

Success expectancy, i.e. self-perceived likelihood of success is an important determinant of academic motivation. As individuals pursue fields in which they perceive themselves to become successful, women who lack confidence in their abilities might not pursue a STEM career. When testing a sample of women from STEM undergraduate majors Robnett & Thoman (2017) identified a group of “self-doubting achievers”. This group was characterized by having low expectations for success in STEM despite relatively strong academic achievement. They also found that women were less likely to be characterized by both strong academic achievement paired with high success expectancies. This lower self-perceived likelihood of success among women cannot be attributed to gender differences in achievement and ability (Herbert & Stipek, 2005). On the contrary, Woodcock and Bairaktarova (2015) found that with equivalent performance on engineering tasks, women rated their performance significantly lower than did men. This was due to women underestimating and men overestimating their own performance.

Preferences

From early on, boys and girls show interest and preferences towards different subjects. Acting as a determinant for later education and occupation choices, these preferences show themselves to be of great importance. How well students enjoy their coursework has shown to be the largest determining factor of college majors choices for both genders (Zafar, 2013). Scholars argue that preferences are induced by gender norms (Xie & Schauman, 2003). Psychology literature takes another approach, finding that on average men are more thing-oriented while women are more people-oriented; arguing that this might explain educational preferences and choices. More recent findings uncover that gender differences in entering STEM and non-STEM fields is best predicted by women’s greater preference towards altruistic and people-oriented work (Eccles & Wang, 2016). This gender difference in preferences may help explain the high numbers of women pursuing careers in Medical STEM, such as biology, medicine and psychology (Kahn & Ginther, 2017).

6.1.3 Role Models

A third factor that may throttle the inflow of girls and women to STEM education and occupations is the lack of role models and mentors. Especially teachers, instructors and professors serves as powerful examples throughout the course of education. Several studies substantiate this statement. Antecol, Eren, & Ozbeklik (2015) found that girls in primary school achieved higher math scores if taught by women rather than men, but this was only true for female teachers with strong math backgrounds. Girls taught by female teachers with a weak math background received lower scores. Bottia, Stearns, Mickelson, Moller, & Valentino (2015) found that exposure to women STEM teachers in high school boosted the probability of female students majoring in STEM at university. This effect was especially strong for girls with high abilities in math.

At college level studies have found positive effects for women when taught by same-sex teacher, such as decreasing the likelihood of dropping a course (Hoffman & Oreopoulos, 2009). Also in college, a higher representation of women in STEM faculty increases the probability of female students pursuing STEM (Canes & Rosen, 2005). At research-intensive schools, women are less likely to major in STEM-fields, but more female graduate students moderate this effect (Griffith, 2010). When assigned a female STEM instructor, women with highest ability had higher probability of pursuing a STEM major and achieve better grades (Carrell, Page, & West, 2010).

Parents' occupational choices also works as an example to follow for their children. Having a parent employed in a STEM occupation increases the child's probability of majoring and working in STEM, and the effect is larger for girls. Also, where mothers are working in STEM, girls are more likely to be employed in the "hard sciences" (Kahn & Ginther, 2017).

These findings highlight the importance of role models at home and throughout their entire education pipeline to help close the gender gap in STEM education and work life.

6.2 Challenges Related to STEM Retention

Challenges related to STEM retention may be explained through the existence of chilly climates, unforeseen effects of critical mass and family responsibilities.

6.2.1 Leaky Pipeline

Chilly Climates

Chilly climates, that is uncomfortable work environments for women due to underrepresentation, might explain women's propensity to leave STEM careers. Overt discrimination, lack of other female role models and a sense of not belonging lead to insecurity and discomfort (Solnik, 2014). Hunt (2010) found that women are more likely to leave jobs that are heavily male. Glass, Sassler, Levitte, & Michelmore (2013) used a longitudinal panel survey to compare the trajectories of women in STEM-related occupations to other professional occupations. They found that women in STEM occupations are significantly more likely to leave their field than women in other professional fields, especially early in their career. This occurs due to women in STEM move to non-STEM jobs at high rates, not because they exit the labor force. Those who leave are also unlikely to return. When accounting for family factors and differences in job characteristics, these variables did not explain the disproportionate loss of STEM workers. A surprising find is that women in STEM occupations does not react positively to increasing job satisfaction, job tenure and aging as most workers in other fields do. This suggest a chilly climate or that lack of job fit persist over longer time for women in STEM fields. Also increased educational investment decreases retention for women in STEM occupations, suggesting that jobs requiring more advanced degrees either are more isolating or noxious than jobs requiring a bachelor's degree (Glass et al. 2013).

Critical Mass

It has been suggested that critical mass, or a better gender balance in organizations, would break the ground for further inclusion of women through being more tolerant of difference (Kanter, 1977). Powell, Bagihole, & Dainty (2006) problematize critical mass theory through their findings in semi-structured qualitative interviews and focus groups with female engineering students. They found these students accept gender discrimination and have a positive view on the industry. Women engineering students value their novelty status and are critical towards other women's entrance to the industry. This mean that women in engineering will act as gatekeepers for other women, deterring entry and reinforce existing culture.

6.2.2 Family Responsibilities

Economic theories explain the gender gap in STEM as a result of rational choices. Women choose different than men when it comes to education and occupation, as they expect to spend more time on family duties than men. Hence, women tend to pursue jobs that is easily combined with care obligations ((Mincer & Ofek, 1982). Some researchers also claim that women will choose an education that they will benefit from as well when carrying out care tasks (Jonsson, 1999). In addition, these education choices often lead to jobs that carry a relatively small financial penalty associated with periodically full or partial withdrawal from the labor market (Støren & Arnesen, 2003).

One of the greatest concerns women are facing when considering persisting in STEM, is indeed work/life balance (Shapiro & Sax, 2011). At the time women has gone through undergraduate and graduate studies, many STEM professionals are already starting or planning to start a family. Combining motherhood with a demanding STEM-career might be too challenging for many women (Solnik, 2014). Typical STEM jobs that demand long hours and leaves less time for family considerations, are jobs that women are less likely to choose and more likely to leave. Family care taking responsibilities also affect the choice of work sector, the decision on whether to work in a job related to one's STEM degree, or even whether to work at all (Kahn & Ginther, 2017).

More specifically there is evidence that married women with children are less likely to complete their STEM degree, to pursue a STEM career, to participate in the labor force, to be promoted in a STEM job, and to move on to better jobs (Xie & Schauman, 2003). In engineering, a lack of part-time work available has been associated with women leaving engineering occupations. There also exists findings that for those with bachelor's degrees in engineering, the gender retention gap is caused by women leaving the labor market entirely, and that it is highly correlated with having children. At the same time, women in engineering are less likely to leave the labor market than in other majors, and the likelihood is lower for single women without children than for men (Kahn & Ginther, 2017).

Summarized, the literature on this topic points toward the case that the having to combine the time commitments demanded by work and raising a family is an unfavorable situation that affect the probability of women pursuing STEM careers and their perseverance in those careers.

7. Discussion

This chapter aims to present some answers to the research questions posted in the introduction chapter.

7.1 Do More Women in Norway Choose STEM Degrees than in the UK?

33.4 % of those choosing STEM degrees in Norway in 2016 were women. The corresponding number for UK was 25 %. This shows that women are underrepresented in pursuing degrees within STEM both in Norway and in UK. The ratios might not be fully comparable due to SSB's and HESA's different classification of core-STEM subjects for higher education. Still, the gap which make up a 33 % difference indicates a discrepancy between the two countries when it comes to female representation in STEM education. However, when looking further we find a more nuanced picture. From the most popular STEM-field for women (physical sciences), where two out of five graduates are women, to the least popular (engineering and technology), where less than two out of ten graduates are women, representation vary greatly within the five core-STEM fields in UK higher education.

7.1.1 Undergraduate and Graduate Levels

In 2016, 28.6 % of lower level STEM degree graduates in Norway were women. The corresponding number for higher level degrees and PhDs is 38.3%. While the ratio of female graduates in higher level STEM and PhD studies in general is higher in Norway, some fields in the UK have a higher female ratio. These are postgraduate degrees in physical sciences (41.5 %), and architecture, building and planning (44.3 %). UK also has considerable lower female rates in undergraduate studies within computer science (15.8 %) and engineering and technology (14.4 %).

7.2 Do More Women in Norway Choose STEM Careers than in the UK?

The overall proportion of women in core-STEM occupations in Norway in 2016 was 30 %. The corresponding number for UK was 22.6 %. This follows the pattern from higher education where Norway has a higher ratio than UK of women in STEM. Although the ratio of women in STEM workforce between the two countries are constant to that of higher education, both Norway and UK do not have as big of a portion in STEM workforce as in STEM higher education. This indicates that having increased female representation in education is not the same as increasing female representation in the work place.

The ratio of women is higher in Norway than in Britain in seven out of nine STEM-fields, and the difference is considerable, with one exception. Chemists, mathematicians and biologists are quite evenly represented with respectively 48% (Norway) and 46 % (UK). Even though more women in Norway choose STEM careers than in the UK for all STEM-fields combined, there are two categories where UK outperforms Norway quite significantly. 27 % of engineering technicians in UK are female, while the corresponding number for Norway is 15 %. An even greater difference is found for productions managers, where UK have 25 % women while Norway has its lowest female ratio in STEM-fields (except aircraft pilots) at 12 %.

7.3 Why Do We Observe Gender Differences in Choices of STEM Degrees?

The reasons why women to a lesser extent choose to enter STEM education and attain STEM degrees might be found in a conglomerate of cultural influences throughout childhood and adolescence, gender specific preferences and perceived abilities. In the following we will draw on earlier research and studies presented in the literature review to identify factors that may cause gender differences in choices of STEM-degrees and education.

Factors that may hinder girls in choosing math-intensive studies such as STEM are many. They range from gender stereotyped parents with little faith in their daughter(s)' math abilities, to teachers forming opinions and attitudes that math and STEM subjects are for boys. Living in a country with low gender equality might also have a negative impact on gender gap in math. Girls also might perceive themselves as less likely to succeed in STEM-subjects, despite strong academic achievements. A female preference toward people-oriented tasks and occupations might also explain why STEM might seem unattractive to girls. Finally, a lack of female role models teaching STEM-subjects throughout the course of education, especially from high school and up, decreases the likelihood of women choosing STEM-degrees.

Factors that may boost STEM-interest, achievement and educational choices are having parents and teachers with a growth mindset for learning, teachers aware of gendered stereotypes and having female role models learning and teaching STEM-subjects throughout the education pipeline.

7.4 Why Do We Observe Gender Differences in Choices of STEM Careers?

Some explanatory factors for why we observe gender differences in choices of STEM careers, or why retention of women in STEM-fields is challenging, can be due to chilly work climates, female gate keepers and family responsibilities.

7.5 Recommendations and Suggestions for Future Research

Based on the previous discussion there might be some takeaways for increasing the rate of women in STEM education and occupations.

7.5.1 To parents and educators

Teaching girls a growth mindset for learning, where abilities are not perceived as fixed, but can be developed through learning and hard work, might help girls better handle the nature of STEM-subjects. Teaching girls to be brave, trial and error, and not to be perfect may lay a good foundation for future interest in and pursuing of STEM.

7.5.2 To recruiters

Understanding that girls might prefer people-oriented things may help tailor recruitment efforts for both higher education and work life. To better showcase how core-STEM subjects, not only medical-STEM, can be a powerful way of helping people might skew previous perceptions about core-STEM with girls.

7.5.3 To policy makers

Amending teacher's education to better consider biases and underlying stereotypes about math and STEM-subjects, in addition to how boys and girls learn and perceive their abilities differently, might help girls in the future to better self-identify as capable math and STEM-students.

7.5.4 Suggestions for Future Research

Future research efforts might consider elaborating upon what causes the differences in female ratio between STEM-fields within core-STEM. Such occupations should have somewhat similar characteristics, and it would be interesting to know why the female representation in the different core-STEM fields vary so greatly. More research into what is causing chilly climates in the workplace and how business owners and organizational leaders can prevent this would also be a useful insight helping augment the underrepresentation of women in STEM degrees and careers.

8. Conclusion

The aim of this thesis was to answer the research questions whether more women in Norway choose STEM degrees and careers than in the UK and why do we observe gender differences in the choices of STEM degrees and careers.

The first research question is answered through a statistical presentation of secondary data obtained from SSB, HESA and ONS. I found that more women in Norway do choose STEM degrees and careers than in the UK, but for certain fields the female ratio is higher in UK.

The second research question is answered through a literature review on existing research. Gender differences in STEM degrees may be due to gendered stereotypes, a skewed opinion of girl’s abilities to learn math and STEM-subjects, different preferences and lack of good role models. Observed gender differences in STEM degrees may be explained through a leaking pipeline caused by chilly work climate and women deterring entry to STEM-occupations for other women, and the toll of family responsibilities in a demanding work climate.

The thesis concludes with recommendations based on the findings and suggestions for further research.

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Appendix

Unit Groups Defined as Core-STEM Occupations

SOC2010	*Unit Group*
1121	Production managers and directors in manufacturing
1122	Production managers and directors in construction
1123	Production managers and directors in mining and energy
1136	Information technology and telecommunications directors
2111	Chemical scientists
2112	Biological scientists and biochemists
2113	Physical scientists
2121	Civil engineers
2122	Mechanical engineers
2123	Electrical engineers
2124	Electronics engineers
2126	Design and development engineers
2127	Production and process engineers
2129	Engineering professionals n.e.c.
2133	IT specialist managers
2134	IT project and programme managers
2135	IT business analysts, architects and systems designers
2136	Programmers and software development professionals
2137	Web design and development professionals
2139	Information technology and telecommunications professionals n.e.c.
2141	Conservation professionals
2142	Environment professionals
2150	Research and development managers

2423	Management consultants and business analysts
2424	Business and financial project management professionals
2425	Actuaries, economists and statisticians
2426	Business and related research professionals
2431	Architects
2432	Town planning officers
2433	Quantity surveyors
2434	Chartered surveyors
2435	Chartered architectural technologists
2436	Construction project managers and related professionals
2461	Quality control and planning engineers
2462	Quality assurance and regulatory professionals
2463	Environmental health professionals
3111	Laboratory technicians
3112	Electrical and electronics technicians
3113	Engineering technicians
3114	Building and civil engineering technicians
3115	Quality assurance technicians
3116	Planning, process and production technicians
3119	Science, engineering and production technicians n.e.c.
3121	Architectural and town planning technicians
3122	Draughtspersons
3131	IT operations technicians
3132	IT user support technicians
3512	Aircraft pilots and flight engineers
3550	Conservation and environmental associate professionals
3567	Health and safety officers

Coding Key for Occupational Categories Norway

Category	*Unit Group (ISCO08)*
Production managers	**1223 Forsknings- og utviklingsledere**
	1321 Ledere av industriproduksjon mv.
	1322 Ledere av olje- og gassutvinning mv.
	1323 Ledere av bygge- og anleggsvirksomhet
	1330 Ledere av IKT-enheter
Physicists & Geologists	**2111 Fysikere og astronomer**
	2114 Geologer og geofysikere
Chemists, Mathematicians & Biologists	**2113 Kjemikere**
	2120 Matematikere, statistikere mv.
	2131 Biologer, botanikere, zoologer mv.
Engineering Professionals	**2141 Sivilingeniører (industri og produksjon)**
	2142 Sivilingeniører (bygg og anlegg)
	2143 Sivilingeniører (miljøteknikk)
	2144 Sivilingeniører (maskin- og marin-teknikk)
	2145 Sivilingeniører (kjemi)
	2146 Sivilingeniører (geofag, petro-leumsteknologi, metallurgi mv.)
	2149 Andre sivilingeniører (unntatt elektroteknologi)

	2151 Sivilingeniører (elkraftteknikk)
	2152 Sivilingeniører (elektronikk)
	2153 Sivilingeniører (telekommunikasjon)
Architects & Areaplanners	**2161 Sivilarkitekter**
	2164 Arealplanleggere
	2165 Landmålere, kartografer mv.
IT Professionals and Technicians	**2511 Systemanalytikere/-arkitekter**
	2512 Programvareutviklere
	2513 Nett- og multimediautviklere
	2519 Andre programvare- og applikasjonsutviklere
	3511 Driftsteknikere, IKT
	3512 Brukerstøtte, IKT
Engineering Technicians	**3112 Bygningsingeniører**
	3113 Elkraftingeniører
	3114 Elektronikkingeniører
	3115 Maskiningeniører
	3119 Andre ingeniører
Draughtspersons & Technicians n.e.c.	**3118 Tekniske tegnere**
	3139 Andre prosesskontrolloperatører
	3143 Skogteknikere
Aircraft pilots	**3153 Flygere**

Environment & Health	**2133 Miljøvernrådgivere**
	2263 Helse- og miljørådgivere
	2421 Organisasjonsrådgivere mv.
	2422 Høyere saksbehandlere i offentlig og privat virksomhet
	3257 Helse- og miljøkontrollører

Transferring ISCO08 Unit Groups for Core-STEM to SOC2010

SOC2010	Unit Group	ISCO08	Unit Group
1121	Production managers and directors in manufacturing	1321	Manufacturing managers
1122	Production managers and directors in construction	1323	Construction managers
1123	Production managers and directors in mining and energy	1322	Mining managers
1136	Information technology and telecommunications directors	1330	Information and communications technology services managers
2111	Chemical scientists	2113	Chemists
2112	Biological scientists and biochemists	2131	Biologists, botanists, zoologists and related professionals
~~***2113****~~	~~*Physical scientists*~~	~~*2111*~~	~~*Physicists and astronomers*~~
-		~~*2114*~~	~~*Geologists and geophysicists*~~
2121	Civil engineers	2142	Civil engineers
2122	Mechanical engineers	2144	Mechanical engineers
2123	Electrical engineers	2151	Electrical engineers
2124	Electronics engineers	2152	Electronics engineers
2126	Design and development engineers	2149	Engineering professionals not elsewhere classified

2127	Production and process engineers	2141	Industrial and production engineers
2129	Engineering professionals n.e.c.	2149	Engineering professionals not elsewhere classified
2133	IT specialist managers	2519	Software and applications developers and analysts not elsewhere classified
2134	IT project and programme managers	2519	Software and applications developers and analysts not elsewhere classified
2135	IT business analysts, architects and systems designers	2511	Systems analysts
2136	Programmers and software development professionals	2512	Software developers
2137	Web design and development professionals	2513	Web and multimedia developers
2139	Information technology and telecommunications professionals n.e.c.	2519	Software and applications developers and analysts not elsewhere classified
2141	Conservation professionals	2133	Environmental protection professionals
2142	Environment professionals	2133	Environmental protection professionals
2150	Research and development managers	1223	Research and development managers
2423	Management consultants and business analysts	2421	Management and organization analysts
2424	Business and financial project management professionals	2421	Management and organization analysts
2425	Actuaries, economists and statisticians	2120	Mathematicians, actuaries and statisticians
2426	Business and related research professionals	2422	Policy administration professionals
2431	Architects	2161	Building architects
2432	Town planning officers	2164	Town and traffic planners
2433	Quantity surveyors	2149	Engineering professionals not elsewhere classified
2434	Chartered surveyors	2165	Cartographers and surveyors
2435	Chartered architectural technologists	2161	Building architects
2436	Construction project managers and related professionals	1323	Construction managers

2461	Quality control and planning engineers	2149	Engineering professionals not elsewhere classified
2462	Quality assurance and regulatory professionals	2421	Management and organization analysts
2463	Environmental health professionals	2263	Environmental and occupational health and hygiene professionals
3111	Laboratory technicians	3111	Chemical and physical science technicians
~~3112**~~	~~*Electrical and electronics technicians*~~	~~*3113*~~	~~*Electrical engineering technicians*~~
		~~*3114*~~	~~*Electronics engineering technicians*~~
3113	Engineering technicians	3115	Mechanical engineering technicians
3114	Building and civil engineering technicians	3112	Civil engineering technicians
3115	Quality assurance technicians	3119	Physical and engineering science technicians not elsewhere classified
3116	Planning, process and production technicians	3139	Process control technicians not elsewhere classified
3119	Science, engineering and production technicians n.e.c.	3119	Physical and engineering science technicians not elsewhere classified
3121	Architectural and town planning technicians	3112	Civil engineering technicians
3122	Draughtspersons	3118	Draughtspersons
3131	IT operations technicians	3511	Information and communications technology operations technicians
3132	IT user support technicians	3512	Information and communications technology user support technicians
3512	Aircraft pilots and flight engineers	3153	Aircraft pilots and related associate professionals
3550	Conservation and environmental associate professionals	3143	Forestry technicians
3567	Health and safety officers	3257	Environmental and occupational health inspectors and associates

*The two categories Physicists and astronomers and Geologists and geophysicists are merged into one: Physical scientists.

** The two categories Electrical engineering technicians and Electronics engineering technicians are merged into one: Electrical and electronics technicians.