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Students' Perceptions of English Learning Materials

*A case study among Science, Technology,
Engineering and Mathematics (STEM)
undergraduates at the University of Oslo*

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Abstract

Within the context of international higher education, universities have a vital role in preparing students not only with transferable skills that can be put into different contexts, but also discipline-specific knowledge, particularly within the Science, Technology, Engineering and Mathematics (STEM) programs. Along with the increasing pressure for higher education institutions to compete internationally and to connect their study programs with usefulness to future work, students are expected to adapt to the implications of using English as a medium of instruction (EMI). Despite the initiatives in realizing the internationalization of Norwegian higher education, little research has looked into the repercussions of EMI implementation, especially struggles that Norwegian students face in English learning materials (Hellekjær, 2009) and instruction (Hellekjær, 2010; Schwach, Brandt & Dalseng, 2012). Thus, this thesis presents a study of Norwegian STEM undergraduates' perceptions of English learning materials to address the gap between meso-level policy and micro-level practice.

The aim of this study is to investigate Norwegian undergraduate STEM students' perceptions of English learning materials. Students' perceptions were analyzed through semi-structured interviews via Zoom with ten Norwegian undergraduates in five different three-year STEM programs at the Faculty of Mathematics and Natural Sciences, UiO. The conceptual framework employed Becher & Biglan's disciplinary characteristics (1973,1987) to understand the relationship between students' personal experiences, perceptions and beliefs, as the disciplinary differences in STEM courses may affect students' perceptions. Data were then coded thematically using Braun & Clarke's thematic analysis framework (2006). Afterwards, the relationship between students' personal experiences and perceptions were examined by looking into the language experiences and the disciplinary differences that persisted.

Results from the thematic analysis revealed three main themes: 1) language mismatch between the language of learning materials and the exam language, 2) vocabulary and terminology comprehension, as well as 3) lecturers' English and pedagogical skills. Additionally, this study may offer insights into multilingualism and contribute to the ongoing discussion about internationalization and linguistic consequences. The findings may be useful for educators, policy developers, and other stakeholders involved in EMI practices in the context of Norwegian higher education. Recommendations include clearer and measurable action plans on language for the institution, preparatory courses in Academic English and *akademisk norsk*, as well as the creation of a terminology database that would help to avoid domain loss and promote deeper comprehension.

Keywords: Norway, higher education, internationalization, undergraduate, STEM, EMI

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List of Abbreviations

DIKU	The Norwegian Agency for International Cooperation and Quality Enhancement in Higher Education
EMI	English-Medium Instruction
GDPR	The General Data Protection Regulation
HEIs	Higher Education Institutions
IELTS	International English Language Testing System
L1	First Language
L2	Second Language
NESH	The Norwegian National Committee for Research Ethics
NSD	The Norwegian Centre for Research Data
NOKUT	The Norwegian Agency for Quality Assurance in Education
NUCAS	Norwegian Universities and Colleges Admission Service
STEM	Science, Technology, Engineering and Mathematics
UiO	University of Oslo
VoIP	Voice over Internet Protocol

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1 Introduction

1.1 Background

One of the most notable tendencies in the higher education (HE) sector has been the internationalization of curriculum through substantial growth of English-taught programs in countries where English is not the first language/L1 (Wächter and Maiworm, 2014). The use of English-Medium Instruction (EMI) has been linked with higher education institutions' (HEIs) aspiration to "internationalize" themselves to accomplish several goals, such as generating income (O'Dowd, 2015), engaging more foreign academic staff in order to present an ambitious HEI profile (Gürüz, 2008), accomodating international community (Belhiah & Elhami, 2014) and moving upwards in the international university rankings (Rauhvargers, 2013; Hultgren, Dimova & Jensen, 2015). Nevertheless, a clear correlation between EMI and internationalization has not been confirmed yet (Hultgren, 2014). In several EMI settings, studies have shown that the stakeholders' language of instruction does not necessarily entail pure English instruction (Hu et al., 2014; Borg, 2015).

English holds the status of the academic lingua franca worldwide (Healey, 2008; Galloway & Rose, 2015; Rindal, 2014). In Norway, most HEIs offer English-taught master's degrees, and only a few offer English-taught bachelor programs in compliance with the political priority and the 2006 regulation from the Norwegian Agency for Quality Assurance in Education/NOKUT (NOKUT, 2006; St. meld nr. 7, 2020-2021). These English-taught courses are important offerings for Norwegian students who do not travel abroad, so that they can be exposed to the international dimension of their studies through taking an English-taught course for a semester together with international students (DIKU, 2020).

Moreover, EMI is perceived as a strategy to enhance the quality development of Norwegian higher education institutions nationally and internationally. This can be seen from the *Internationalization of Education* white paper (St.meld nr. 14, 2008-2009) and the most recent *A world of possibilities: International Student Mobility in Higher Education* white paper (St.meld nr. 7, 2020-2021), where the Norwegian government employed a dual strategy in realising internationalization of Norwegian higher education (HE) through internationalization at home and encouraging Norwegian students to study abroad. EMI establishment is one of the results of this policy, which challenged a national language policy to promote Norwegian use in different parts of society, including academia, as seen from another white paper (St.meld nr. 35, 2007-2008).

In the input letter from the Language Council, several Norwegian HEIs acknowledged the lack of English-taught subject at the bachelor's level, and pointed out that it can be a challenge for the academic staff to teach in English and for Norwegian students to embrace English-taught courses (St.meld nr. 7, 2020-2021, p.74). The Language Council proposed that HEIs must come with language plans for the subjects offered in order to avoid ad hoc decisions regarding the language of instruction. The Language Council also believed that “the HEIs must ensure that the Norwegian students are able to follow the lectures and that they are able to master technical terminologies in Norwegian when they later enter the working life” (St.meld nr. 7, 2020-2021, p.74). On the other hand, the University and College Council (UHR) implied that it would be nearly impossible to get more incoming students without broad offer of English-taught courses at Norwegian HEIs (St.meld nr. 7, 2020-2021, p.75). UHR also signified that the language debate in the HE sector must be taken into account.

Indeed, there is an ongoing discussion to balance the number of subjects taught in English and Norwegian with the needs of both international and Norwegian students. This issue of English-taught study programs was specifically addressed in the *International Student Mobility in Higher Education* white paper.

The Norwegian government called for Norwegian HEIs to be more aware of the parallelingualism situation that persists, to follow up on their responsibilities in maintaining and further developing Norwegian as a professional language, and to have a conscious relationship when it comes to making decisions related to the language of instruction (St.meld nr. 7, 2020-2021, p. 97). Moreover, the Norwegian Agency for International Cooperation and Quality Enhancement in Higher Education (DIKU) is a central body in the Norwegian HE which carries out research and generates reports on behalf of the Ministry of Education. The 2019 working note from DIKU highlighted some measures to actualize the internationalization of Norwegian HE, such as incorporating international perspectives in the curricula and teaching in English (Søvik & Tungesvik, 2019, p.14). In their newest report on language strategies in HE, DIKU suggested some follow-up measures that HEIs can take through several tasks, such as establishing of incentive schemes for work related to technical terminology in Norwegian, and offering language and pedagogical training for academic staff (DIKU, 2021, p. 5). The various levels of agencies related to language policy in Norwegian HE is summarized by figure 1 below:

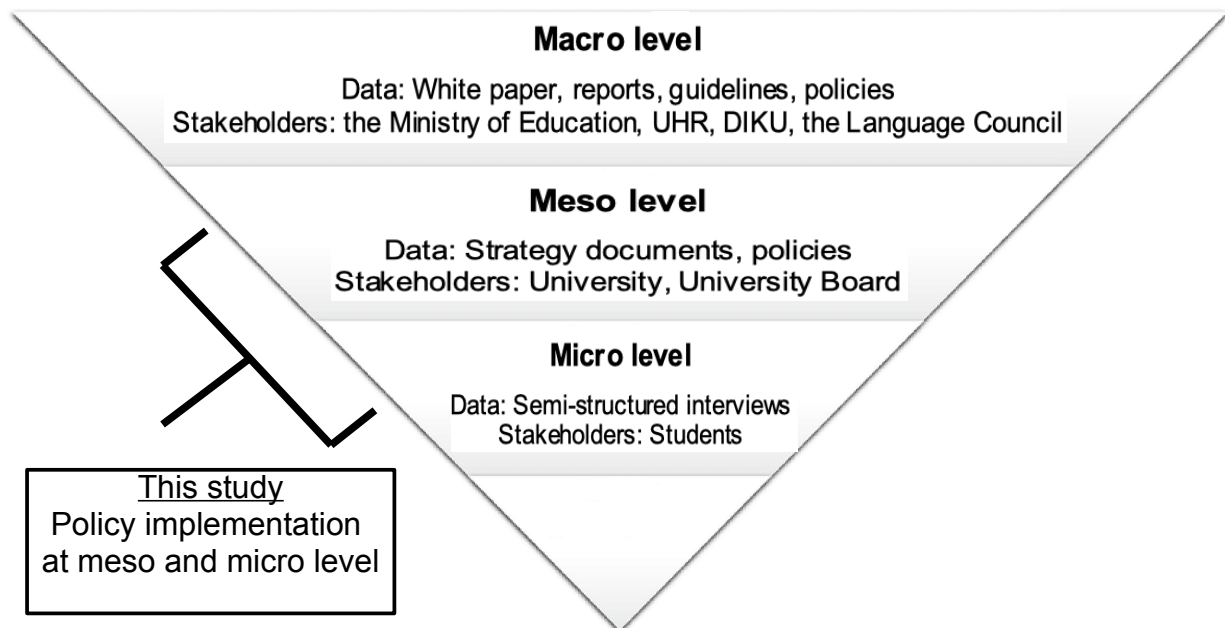


Figure 1. Language policy at macro, meso, and micro level

Furthermore, the research decision to focus on Science, Technology, Engineering and Mathematics (STEM) subjects is based on DIKU's finding in their 2020 condition report. DIKU stated that "STEM subjects are of particular importance for future value creation and welfare levels in Norway. Therefore, the research efforts in these subjects are seen as a national management parameter. Many of the long-term priorities in the long-term plan for research and higher education are aimed at strengthening research efforts in these subjects" (DIKU, 2020, p. 61).

Data from Statistics Norway (SSB) complimented this finding, as the number of Norwegian students who are enrolled in STEM subjects has grown significantly from 2016 to 2020. As table 1 below shows, there were 52,726 Norwegian students enrolled in STEM subjects in 2020, placing STEM subjects in the third position after Health, Social & Sports subjects and Economics & Administration subjects. This finding indicated that STEM is one of the most enrolled subjects in Norwegian HEIs.

	Studenter				
	2016	2017	2018	2019	2020
Begge kjønn					
Fagfelt i alt	288 989	293 123	293 287	296 182	306 367
Allmenne fag	328	292	387	371	694
Humanistiske og estetiske fag	29 202	29 588	29 987	30 259	30 175
Lærerutdanninger og utdanninger i pedagogikk	43 996	45 314	47 870	48 357	49 363
Samfunnsfag og juridiske fag	37 440	38 008	38 325	39 312	40 645
Økonomiske og administrative fag	55 567	56 042	54 631	55 210	60 477
Naturvitenskapelige fag, håndverksfag og tekniske fag	50 760	51 603	52 028	51 850	52 726
Helse-, sosial- og idrettsfag	59 313	59 474	59 453	60 141	61 895
Primærnæringsfag	1 497	1 526	1 591	1 605	1 705
Samferdsels- og sikkerhetsfag og andre servicefag	8 613	8 843	7 039	6 991	7 019
Uoppgitt fagfelt	2 273	2 433	1 976	2 086	1 668

Table 1. Norwegian students based by program and year from 2016-2020 (SSB, 2021)

One of the most often reported issue on the language implementation in HE is the role of the first language and second language (L1 and L2, respectively). On the surface, the definition of EMI appears to be general, but in actuality, it is a concept that has interchangeable meanings. For example, EMI can be understood as English as medium of instruction, English-medium content classes, English-medium programs and English-medium teaching. In this study, the definition of EMI will be the use of English to teach academic subjects in countries where the majority of the population does not use English in their day-to-day communication (Macaro, 2018, p.1). As EMI has a content-driven nature in its application, it is different from other language-driven concepts such as English for Academic Purposes, English as a Foreign Language, or English for Specific Purposes. The corresponding concepts of EMI will be discussed later in chapter 2.

Several studies demonstrated that the textbooks coupled with the inadequacy of both students and teachers are some of the barriers found in EMI implementation at university level (Hamid et al., 2013; Hu et al., 2014; Chapple, 2015). Students' linguistic obstacles can be categorized in specific parts, namely difficulties encountered in following the lectures (Hellekjær, 2010), understanding lecturers' accents (Tange, 2010), making notes from academic English texts (Andrade, 2006), and understanding academic English texts caused by lack of vocabulary (Kirkgöz, 2005). That said, teachers' language proficiency also present its own challenge in EMI. For example, lower quality and depth of academic materials (Chapple, 2015), extra workload and preparation (Tsuneyoshi, 2005), incapacity in using accessible language (Tange, 2010), and the gap between teachers' actual English proficiency and the English proficiency needed to teach their subjects at university level (Borg, 2015).

1.2 Aims and Research Questions

While the aforementioned studies have contributed in examining and establishing what is already known about EMI in HE, there are still many areas in this field that are yet to be discovered. In order to fill this gap, this study will attempt to find out Norwegian STEM undergraduates' perceptions about English learning materials through the following research questions, with the first question being the overarching research question:

1. How do Norwegian STEM students perceive English learning materials?
2. How are English learning materials organized in STEM courses at UiO?
3. What are the similarities, differences, and factors affecting students' perceptions?

The rationale behind this study is to gain deep understanding from the undergraduate students in STEM programs, as well as to raise awareness of the influence of internationalization measures on discipline-specific knowledge. This study seeks to examine how Norwegian STEM undergraduates perceive English curricular literature at the University of Oslo (UiO) through semi-structured interviews. By using this approach, "people's own written or spoken words and observable behaviour" (Hatch, 2002, p.4) are generated, which is appropriate to answer research questions that look into the "what" and "how". From a wider perspective, there is a need to critically question EMI in the Norwegian context. Literature raises a concern with regards to benefits of access to a more international job market, in contrast to the disadvantage of local language and culture deterioration (Canagarajah, 1999; Troudi, 2009; Skutnabb-Kangas, 2000). By looking at EMI from the students' point of view, it is possible to anticipate a better way of using English learning materials and to identify some of the key issues of EMI. Hopefully, this study will offer insights into the use of English learning materials among Norwegian STEM students, enrich the understanding of EMI in a Norwegian context and contribute to the discussion in the field of multilingualism practices, internationalization and linguistic tensions in higher education.

1.3 Thesis Structure

This thesis is organized into six chapters. After the introduction in chapter 1, chapter 2 provides relevant literature to this study and the analytical framework used in this study. EMI and the ROAD-MAPPING framework from Dafouz & Smit (2016) will be introduced to identify the elements of English Medium-Instruction. The disciplinary characteristics from Biglan & Becher's disciplinary characteristics (1987; 1994) was also used in the analytical framework. The analytical framework is demonstrated to show the relationships between students' perceptions of English learning materials, students' language experiences, as well as disciplinary differences.

Chapter 3 explains the research design, methodology, and methods employed in order to answer the research questions of the study. This chapter is comprised of research design, data collection methods, interview guide development, participants, recruitment of participants, data transcription and analysis, quality criteria, and ethical considerations.

Chapter 4 presents the findings of data analysis acquired from the semi-structured interviews. This chapter consists of an overview of ten individual interviews, attempts in answering the research questions, and summary of results.

Chapter 5 presents the discussion of the findings. This chapter is comprised of perceptions of English learning materials, organization of English learning materials in STEM courses, and factors affecting students' perceptions of English learning materials.

Chapter 6 draws the thesis to an end. It consists of attempted responses to the research questions, limitations, and suggestions for future research.

2 Literature Review

This chapter is comprised of a literature review which includes the analytical framework of the study. It is made up of four parts; English-Medium Instruction (2.1), STEM Disciplinary Characteristics (2.2), Guidelines for Learning Materials in Undergraduate STEM Courses (2.3), and Analytical Framework (2.4).

2.1 English-Medium Instruction

The use of EMI is inevitable due to EMI being an increasingly global phenomenon in all educational settings (Dearden, 2015). One context to see EMI growth is through higher education (Brenn-White & Fæthe 2013; Fenton-Smith, Humphries & Walkinshaw, 2017). As more and more HEIs are offering undergraduate and postgraduate programs in English, there is a need to internationalize HEIs in order to attract more international students due to the competition of the state and private sector; address the decreasing admission numbers of local students and national budget cut in HEIs; as well as the status of English as an international language, especially in research publications (Knight, 2013; Lasagabaster, Doiz & Sierra, 2014). Several studies (Hamid, Jahan & Islam 2013; Kim, Tatar & Choi, 2014) have also discussed the absence of resources in the first language (L1) of their corresponding countries and the existence of English-only resources as reasons to integrate EMI in HE. This is also true in the case of STEM disciplines, where students pointed out the need to match the assessment system language with the language used in teaching (Belhiah & Elhami, 2014). EMI is a relatively new research field, as the majority of the literature were written after 2000 (Macaro, 2018). Thus, many scholars applied different terminologies to classify this phenomenon, although EMI itself is not necessarily a new phenomenon (Macaro, 2018).

With the lack of consensus on EMI definition and terminology, there are many inconsistencies that occur in the literature, such as “English Medium” (Kim & Shin, 2014). Table 2 below presents a summary of different terminologies related to EMI.

English medium instruction	Kim & Sohn, 2009; Kang & Park, 2005; Islam, 2013; Huang, 2015; Byun et al., 2011; Dearden, 2015; Macaro, Akincioglu, & Dearden, 2016; Dearden & Macaro, 2016
English-medium instruction	Kim & Shin, 2014; Kim, Tatar, & Choi, 2014; Ghorbani & Alavi, 2014; Cho, 2012; J. Y. H. Chan, 2014; Bolton & Kuteeva, 2012; Rogier, 2012; Studer, 2015; Tatzl, 2011; Yoxsimer Paulsrud, 2014
English medium of instruction	Khan, 2013; Chu, 2005
English as the medium of instruction	Lai, 2013; Ellili-Cherif & Alkhateeb, 2015; British Council/TEPAV, 2015; McMullen, 2014; Yip & Tsang, 2006
English as a medium of instruction	Belhiah & Elhami, 2014; Al-Masheikhi, Al-Mahrooqi, & Denman, 2014; Lueg & Lueg, 2015; Sultana, 2014; Tung, Lam, & Tsang, 1997; Wu, 2006; Vu & Burns, 2014; Tarnopolsky & Goodman, 2014; Ryhan, 2014
English language as medium of instruction	Ismail et al., 2011
English-medium education (English-medium higher education)	Kirkgöz, 2005, 2009; Earls, 2016
English-medium teaching	J. Y. H. Chan, 2014; Byun et al., 2011
English-medium higher education	Hellekjaer, 2010
English-medium courses	Yeh, 2014
English-medium programs	Hengsadeekul, Koul, & Kaewkuekool, 2014; Dafouz, Camacho, & Urquia, 2014
English as the lingua franca medium of instruction	Chapple, 2015; Bjorkman, 2010
English medium content classes	Iyobe, Brown, & Coulson, 2011

Table 2. Summary of various EMI terminologies (Macaro, 2018, p. 20)

When it comes to defining EMI, there are even more perplexing and diverse definitions than the terminologies. In his book about EMI, Macaro attempted to bridge the conceptual boundaries of EMI between approaches, themes, and disciplines. He affirmed that not many attempts are made in the literature to “define with sufficient specificity what is actually being talked about” (2018, p. 21). Table 3 below shows the various definitions of EMI from several authors.

EMI Definition	Author(s)
The teaching and learning of content through another language (English).	Dafouz, Camacho & Urquia, 2014, p. 224
EMI is a discipline-based “late late” immersion program without any bridging support, which is closely related to content-based instruction.	Kang & Park, 2005, pp. 157-158
English is used as the language of instruction, in particular, where English is not the native language of the students.	Kim & Shin, 2014, p. 42
EMI is the vehicle of teaching and learning.	Islam, 2013, p. 127
When non-language courses in for instance medicine, physics or political science are taught in English, to students for whom it is a foreign language. As often as not it is also taught by a lecturer who does not have English as a first language.	Hellekjær, 2010, p. 11
When English is the medium of instruction rather than studied as a foreign language.	Tarnopolsky & Goodman, 2012, p. 58
The use of the English language to teach academic subjects (other than English itself) in countries or jurisdictions where the first language (L1) of the majority of the population is not English.	Macaro, 2018, p. 1

Table 3. Summary of EMI definitions from various authors

Considering the recurring inconsistencies in EMI definitions and terminologies, it is easy to confuse EMI with other terminologies, such as “Content-Based Instruction (CBI)” or “Content-and-Language-Integrated Learning (CLIL)”. De Zarobe and Catalán (2009) argued that CBI and CLIL might be considered synonymous, as CBI is used frequently in North America and CLIL is used more often in Europe. Macaro (2018, p.289) asserted that EMI encompasses CBI and CLIL. CBI and CLIL have two continuum extremes, which are language and content, whereas in EMI, the emphasis is put on language improvement and content learning (Macaro et al., 2017). The term “English as a Medium of Instruction” might also be juxtaposed with “English as the Medium of Instruction”, because more than one language might be used in the instruction. Thus, specification pertaining to which kind of situation EMI is in, background information on the use of English in a specific location/HEI/country, as well as participants’ beliefs and ways of dealing with EMI is vital in establishing an EMI context for a research.

As mentioned previously, EMI in this study is defined as the “use of the English language to teach academic subjects (other than English itself) in countries or jurisdictions where the first language (L1) of the majority of the population is not English” (Macaro, 2018, p.1). With regards to this study, the use of EMI refers to the learning materials and resources in English that are used in the selected undergraduate STEM programs at the University of Oslo. The extent of EMI is measured within a series of courses on how much English is being used in the learning materials in the selected STEM programs within Electronics, Mathematics, Physics, Informatics and Life Sciences. This gives an indication of the position of English as a second language (L2) within STEM fields and its contribution to the teaching and learning therein. Since all of the courses are taught in Norwegian, the quantity of EMI might be affected as the lecturer could say something in L1 and then refer to the terminologies in English, which is also known as lexical borrowing.

In a global context, there are numerous studies which provide insights into how EMI as a phenomenon is introduced and accepted across the world, particularly in the HE sector (Graddol, 2006; Dafouz & Guerrini, 2009; Doiz, Lasagabaster, & Sierra 2013; Wächter & Maiworm, 2014). Dearden's survey of 55 countries revealed an expanding trend in EMI courses offered in both HE and secondary education, with the private education sector guiding the way and the public sector being forced to "play catch up" (Macaro, 2015). This private versus public competition is taking place in Japan (Chapple, 2015) and Bangladesh, where Hamid, Jahan & Islam (2013) presented proof of the private sector affecting student identities and prolonging a social divide.

In the European context, comparable questions are being asked and obstacles are being confronted by those included in the implementation of EMI, although each country has its own viewpoint (Hultgren, 2014). In their online survey of postgraduate courses in Europe, Brenn-White & Fæthe (2013) found that programs taught in EMI have increased by 42%, indicating a rapid increase. O'Dowd's survey of 70 European universities revealed that only 7% stated that they were offering no courses at all through EMI (2015). Earls (2016) found that both teachers and students in Germany assumed that in the context of globalisation of services, it is unavoidable that EMI would be the status quo. Moreover, teachers' motivations were focused on cross-cultural understanding as opposed to English language learning. Dearden & Macaro (2016) found that one advantage of integrating EMI in HE is to offer students the same chances of studying abroad, as they investigated attitudes of university teachers from Austria, Italy, and Poland towards EMI.

Numerous studies have addressed the issue of EMI in the Nordic region. The extensive exposure to English in Nordic countries has led to a coexistence of English and Nordic languages (Edwards, 2014; Buschfeld & Kautzsch, 2016). In a study

conducted by Jensen & Thøgersen (2011), several Danish lecturers suggested that the number of EMI courses should be increased so that they can appeal to non-Danish students. Many students who are exposed to EMI in Sweden avoid reading the textbook and rely on the teachers' slides (Pecorari, Shaw, Irvine, & Malmström, 2012). Another study by Airey (2011) revealed that lecturers in Sweden are concerned about students' English deficiencies in HE and suggested to maintain the local context and use humor when employing EMI, particularly when student diversity is being emphasized. In their Finnish study, Hahl, Järvinen, and Juuti (2016) looked into perceptions of the EMI teacher education programs in Finland. They reported that teachers' lack of fluency caused frustration for students and influenced their feeling of being professional educators. In her Icelandic study of students' perceptions towards EMI, Arnbjörnsdóttir (2020) revealed that students cannot differentiate informal conversational language and formal academic discourse despite almost ten years of prior formal English study. Furthermore, she found that students also demonstrated a lack of awareness of the nature of the linguistic challenges they face and did not question the legitimacy of the extra workload and lack of language support. There seems to be an assumption in the Nordic countries that conversational English appropriated at the grassroots level is sufficient at the professional level and in HE, where standard formal English is necessary (Arnbjörnsdóttir, 2020; Airey et al., 2016; Hult, 2012; Buschfeld & Kautzsch, 2016; Edwards, 2014; Higgins, 2009).

In Norway, EMI was first identified as low-level and underreported (Ammon & McConnell, 2002; Wächter & Maiworm, 2002). At the undergraduate level, the use of EMI was low, whereas in the graduate level, the use of EMI was divided among Norwegian HEIs, with 85% of students holding Norwegian citizenship (Schwach, 2009; Schwach et al., 2012).

The increasing usage of EMI in Norwegian HE programs is due to changes in function of disciplinary, institutional, and political motivations (Airey et.al, 2017). A study conducted by Bukve (2018) looked into 346 students' perspectives on EMI in law, natural sciences, and philosophy majors using surveys, and suggested that natural science students exhibited more positive attitudes towards EMI. This finding complements another study of language used in scientific research from Norwegian research institutions by Kristoffersen, Kristiansen & Røyneland (2014), which pointed out that almost 95% of natural sciences' research publications were in English. Another study by Arnsby (2013) indicated that beginner university students struggled with effective academic reading and handling unfamiliar vocabulary. As seen from these findings, there is a gap in literature about EMI in Norwegian HE and how Norwegian STEM undergraduates perceive EMI through English learning materials.

Several studies suggest a need for Academic English through EMI courses. The Norwegian Universities and Colleges Admission Service (NUCAS/*Samordna Opptak*) sets International English Language Testing System (IELTS) as one of the language requirements that must be met when applying to Norwegian HEIs, although different HEIs have different requirements. In a study conducted by Hellekjær (2005), two thirds of 217 students taking preparatory academic English reading courses did not achieve Band 6 level in IELTS. In another study, Hellekjær (2009) looked into the academic English reading proficiency of 578 Norwegian university students. His study revealed that almost half of the university students encounter English academic reading difficulties as they were not acquainted with the subject. While the majority of students might have adequate interpersonal speaking in English, this does not necessarily imply that they also possess satisfactory academic English, which is crucial for higher education and future careers (Lehmann, 1999; Hellekjær, 2008).

Hellekjær and Hellekjær (2015) argued that Norwegian HEIs have to actively cater students' needs for occupational English in combination with professional degrees through EMI courses so that students can be exposed to terminology and knowledge of domain-specific texts. A recent study by Hellekjær (2016) revealed that few Norwegian HEIs offer English modules as an integrated part of their degrees, and therefore fail to prepare students for their future careers. Thus, integrating language learning goals in the various EMI courses offered in Norwegian HEIs is more important than ever.

With regard to EMI framework, the ROAD-MAPPING framework for English-Medium Education (Dafouz & Smit, 2016) is used as a reference in this study. This framework is chosen due to its holistic model of integrative perspectives, which shows the resemblance and interpretation of the multidimensional nature of EMI. ROAD-MAPPING stands for the first letters of the six dimensions of the framework. Figure 2 below shows the ROAD-MAPPING framework.

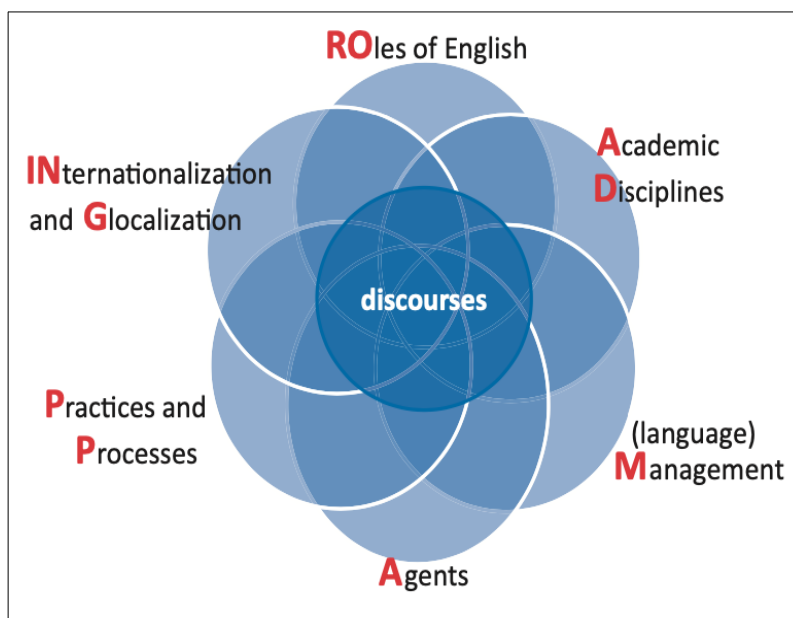


Figure 2. The ROAD-MAPPING framework

This framework serves as a reference in examining the dimensions' relevance and the Norwegian STEM undergraduates' perceptions of English learning materials, while taking into consideration the interplay between internationalization and multilingualism in higher education. Moreover, this framework will allow the researcher to transform the research findings in different cases (Dafouz & Smit, 2016, p. 399). Table 4 below shows the description of each conceptual dimension found in the ROAD-MAPPING framework.

RO	Roles of English refers to the communicative functions that language fulfils in HEIs, with the focus placed on English as the implicitly or explicitly identified main medium of education. In view of the diverse linguistic repertoires relevant to the settings in question, English intersects in dynamic, complementary but also conflictual ways with other languages. Additionally, English, and 'language' more generally, are seen as both product and process, being used both as individual codes and as a flexible form of multilingual communication
AD	Academic Disciplines encompasses two-related notions: academic literacies and academic (disciplinary) culture. Academic literacies refer to the diverse range of academic products (whether spoken or written) typically developed in an educational setting and conforming to socially conventionalised situated practices. By disciplinary culture we mean more particularly the subject specific conventions, norms and values that define different disciplinary areas. Both notions together are essential as means of exploring and constructing knowledge and for acculturating into the academic communities of practice
M	(Language) Management is concerned with 'direct efforts to [influence and] manipulate the language situation' (Spolsky, 2004, p. 8) in the form of language policy statements and documents. These texts differ in terms of policy type, but also with regard to which language(s) and which communicational activities are dealt with to what extent and in what ways
A	The Agents dimension encompasses the different social players (whether conceptualised as individuals or as collectives, concretely or abstractly) that are engaged in EMEMUS at diverse sociopolitical, institutional and hierarchical levels. Agents may adopt different roles and identities and thus implement (or not) changes in their respective HEIs, depending on their hierarchical status within such organisations, their professional concerns and/or their English language proficiency
PP	Practices and Processes is based on the understanding of social practices as 'cultural conception[s] of particular ways of thinking about and doing' (Leung & Street, 2012a, p. 9). It is thus concerned with the administrative, research and educational activities that construct and are constructed by EMEMUS realities. Such a process-focused perspective allows for dynamic analyses at all levels, for example classroom discourse, teacher professional development or stages of internationalisation
ING	Internationalisation and Glocalisation refer to the 'the tensions but also the synergies' (Scott, 2011, p. 61) that govern twenty-first century HEIs, and portray such organisations as transnational sites where stakeholders from different social settings, linguistic and cultural backgrounds and educational models are gaining presence. Equally important, nonetheless, are national and local drivers, such as the national and regional languages used in particular HE settings or the cultural and the pedagogical models for present day HEIs to remain relevant in their respective societies

Table 4. Definitions of ROAD-MAPPING dimensions (Dafouz & Smit, 2016, p.60)

In examining the dimensions' relevance and the Norwegian STEM undergraduates' perceptions of English learning materials, the researcher took into account the connection between conceptual dimensions from ROAD-MAPPING to inform the language situation at UiO, particularly in the STEM programs. In the first dimension (RO), English is used to complement Norwegian, yet the relationship is conflictual as some terminologies are commonly used in English. In the second dimension (AD), two disciplinary groupings are present in STEM programs. The third dimension (M) is concerned with the few language policies that are found in UiO, while the fourth dimension (A) concerns some key actors who are central in language policies implementation in Norwegian HE. The fifth dimension (PP) is in regards to the student-centered teaching at UiO. Finally, the sixth dimension (ING) covers the the drivers of EMI and the parallel language structure at UiO. Figure 3 below shows the description of each conceptual dimension found in the ROAD-MAPPING framework with regards to EMI at UiO.

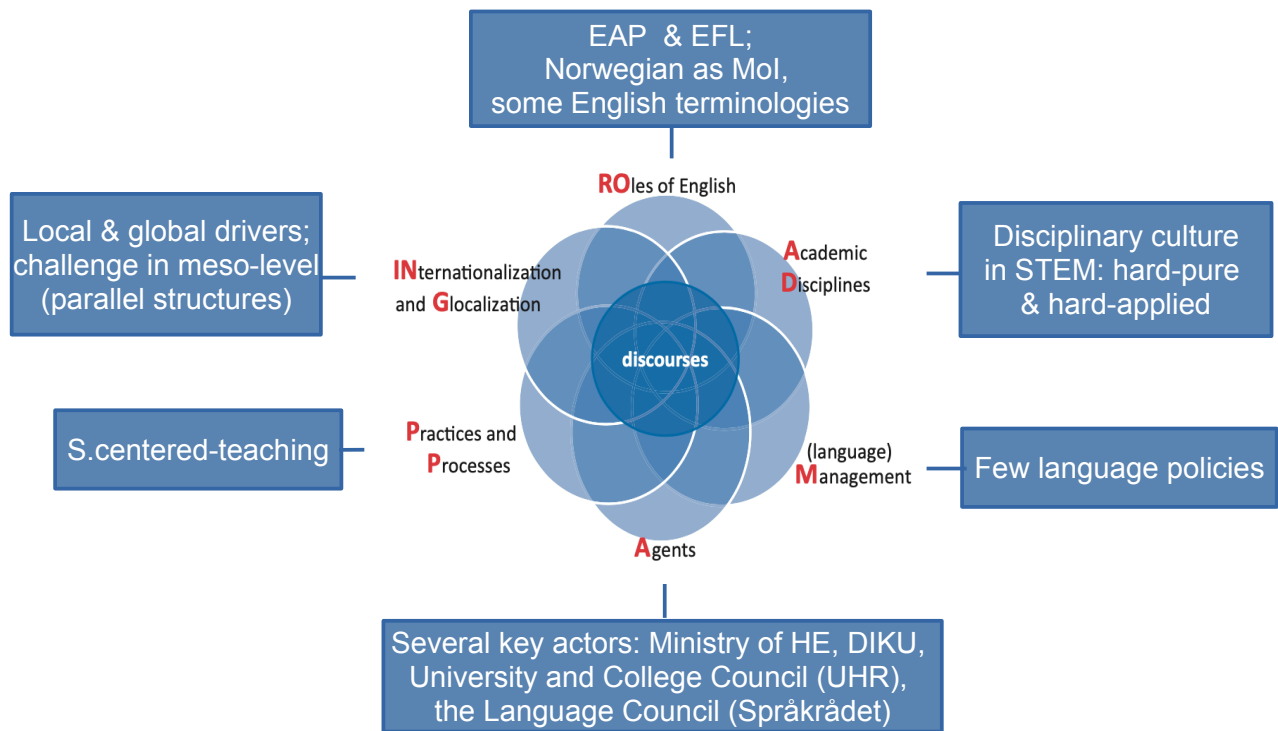


Figure 3. EMI at UiO using the ROAD-MAPPING framework

2.2 STEM Disciplinary Characteristics

This study assumes that one of the important factors in examining the differences and similarities among undergraduate STEM students is their disciplinary experiences. The awareness of disciplinary cultures is beneficial to conduct this study because the disciplinary experience is connected to disciplinary characteristics and ways of organizing knowledge, which plays a role in creating students' identities and perceptions of English learning materials. The disciplinary characteristics with regards to this study will be discussed in this section.

Discipline can be defined as a “specialized form of organization which specialize by subject, that is, by knowledge domain” (Clark, 1983, p.29). Comparably, Becher (1994) interpreted discipline as the “life-blood”, “social framework”, and the “organizing base” of higher education, while Bailey (1977) defined discipline as a “tribe” which has a part in the collective culture of its own community at various levels. In this study, a specific community is looked into, namely STEM, with its subdisciplinary specialisms, namely Mathematics, Physics, Electronics, Informatics and Life Sciences.

The five selected study programs belong into two disciplinary groupings, namely *hard-pure* (Physics, Mathematics, Life Sciences) and *hard-applied* (Electronics, Informatics). These five study programs are similar to each other, in a sense that they share a common trait, that is, belonging to the “hard” subject group in Biglan & Becher’s classification of disciplinary groupings (Biglan, 1987; Becher, 1994). As indicated by table 4 below, the nature of knowledge in the *hard-pure* group is identified as progressive, structured, related to universals, quantities, simplification and creates invention/explanation, while the nature of knowledge in *hard-applied* group is characterized as purposive, deals with know-how via hard knowledge, is about mastery of physical environment and creates products/techniques (Becher, 1987).

Table 5 below presents Becher's classification (1987), which is adapted from Biglan's cognitive aspects (1973).

Disciplinary Groupings	Nature of knowledge	Nature of disciplinary culture
Hard-pure (Physics, Life Sciences, Mathematics)	Cumulative; atomistic (crystalline/tree-like); concerned with universals, quantities, simplification; resulting in discovery/explanation.	Competitive, gregarious; politically well-organized; high publication rate; task-oriented.
Hard-applied (Electronics, Informatics)	Purposive; pragmatic (know-how via hard knowledge); concerned with mastery of physical environment; resulting in products/techniques.	Entrepreneurial, cosmopolitan; dominated by professional values; patents substitutable for publications; role-oriented.

Table 5. Selected STEM programs according to Biglan & Becher's groupings (Biglan, 1973; Becher, 1987, p. 154).

In terms of English learning materials, it is assumed that all STEM disciplines are incorporating English in their learning resources, as evidenced from the semi-structured interviews with the participants and from the literature list on the university's website. Thus, it could be easier for STEM disciplines to relate to English learning materials than humanities disciplines, which have a relatively higher proportion of Norwegian learning materials to English. Another interesting point to make here is on the distinctions between disciplines, and how disciplinary characteristics are translated into curricula literature in the selected study programs. As multidisciplinary studies are becoming more common, the lines between disciplines are less clear. This is true in the case of STEM programs at UiO, where some of the offered study programs were a combination of more than one subject, for instance Mathematics with Informatics, or Physics and Astronomy. Moreover, this study presumes that undergraduate STEM students who are majoring in these five subject areas have different experiences in handling English learning materials as a consequence of disciplinary characteristics reviewed above, and therefore, develop their perceptions of English learning materials in various ways.

As the selected STEM study programs differ in their nature of knowledge and discipline, the learning objectives description provided by UiO are examined in order to categorize their disciplinary group. This study presumes that undergraduate STEM students who are majoring in these five subject areas have different exposure to English learning materials. Thus, their perceptions of English learning materials vary according to the resources they have been exposed to, as well as the learning objectives they aimed to achieve. A closer look into the learning objectives can be seen from table 6 below.

Disciplinary Group	Learning objectives description
Hard-pure	<p><i>Physics</i> You have knowledge of the basic principles and laws of nature; the development and application of these laws; and their significance for other natural sciences.</p>
	<p><i>Life Sciences</i> You understand the basic physical, chemical and biological principles of life at all levels; from molecules to ecosystems - via cells, organisms and populations. You understand the fundamental role of evolutionary processes in the evolution of life, the diversity of organisms, the relationship between them and their environmental adaptations.</p>
	<p><i>Mathematics</i> You have a secure understanding of mathematical theory and at least one applied subject. You understand the interplay between the general and the special in mathematics, and between mathematics and other subjects.</p>
Hard-applied	<p><i>Electronics</i> You have basic knowledge of physics, informatics and mathematics. You have basic knowledge of analog and digital electronic components and circuits.</p>
	<p><i>Informatics</i> You understand how IT affects the individual, organization and society and vice versa. You have knowledge of how computers, embedded systems and robots work, and how these can understand and adapt to the world.</p>

Table 6. Learning objectives from selected STEM programs (UiO, 2021).

2.3 Guidelines for Learning Materials

This section examines the guidelines for learning materials in undergraduate STEM courses at UiO. UiO encourages parallellingualism, which refers to the use of Norwegian as the primary language at UiO and to the use of English as the main foreign language (UiO, 2019). UiO's language policy guidelines are informed by three documents, namely the Language Use Act in the Civil Service, the Guide for Language Choice in the University and University College by the Language Council, as well as the Regulations on Standards and Criteria for Accreditation of Studies and Criteria for Accreditation of Institutions in Norwegian Higher Education by NOKUT. With regards to the language of the study program, the following statement was enclosed: "The institution shall have suitable premises for teaching: The institution shall actively participate in international cooperation within subject areas relevant to the study program, (and) the institution shall have arrangements for internationalization related to the study." (Kunnskapsdepartementet, 2005).

Moreover, there are several language-related statements found in the internal strategy documents from UiO. The Strategy 2020 document (UiO, 2010, p. 7) stated:

"A stronger focus on internationalisation requires investment in Norway in improving language skills in research, instruction and administration. An international campus, a UiO website more international in character, and a professional system for welcoming and integrating international students and employees are important elements in promoting internationalisation at UiO."

Later, in the Strategy 2030 document, UiO mentioned that "The university manages important part of our national memory and has a special responsibility for the renewal and knowledge dissemination about the Norwegian society, Norwegian language, history and nature" (UiO, 2020, p. 2). UiO also "will facilitate integrated study courses across languages, national borders and subject" (UiO, 2020, p. 3). These findings complement overall and teaching objectives from UiO's policy guidelines, namely:

Main objectives

- The University's language policy shall be designed to promote and develop use of Norwegian and technical terminology
- English or other foreign languages shall be used when appropriate or necessary for academic reasons
- In teaching and other academic communication, language proficiency shall be considered a part of the learning outcome

Teaching

- Norwegian is the main language of instruction
- Norwegian, Swedish and Danish are considered equal for teaching purposes
- Students are expected to know and be able to use technical terminology in Norwegian and English or another foreign language
- Students are not obliged to use English or another foreign language in teaching or examinations, unless this is part of the subject and is defined in the course description. Reference is also made to the provisions in Regulations relating to programmes of study and examinations at the University of Oslo
- Teaching should enhance students' language proficiency and scholarly writing skills (Retrieved from UiO, 2019).

From these points, it appears that the language policies at UiO are designed to encourage the coexistence of Norwegian and English, particularly in a context where it is academically appropriate to promote parallelism in the language of instruction, learning materials and language of assessment. These policies are then translated into the faculties, one of which is the Faculty of Mathematics and Natural Sciences. On the faculty's website, the academic staff at MN have three options in choosing the language of instruction for their courses, namely Norwegian, Norwegian with English on the side (when requested), and English (UiO, 2020). At UiO, bachelor courses at 1000 level are taught in Norwegian (UiO, 2020). The option of using Norwegian with English on the side (when requested) is used on courses that the department offers to incoming exchange students, international master's students and PhD candidates. Furthermore, some bachelor's courses may have English as the language of instruction, following the guide from the Language Council (UiO, 2020).

In their Guide for Language Choice in the University and University College, the Language Council disclosed ten recommendations with regards to the language choice in Norwegian HE. Out of all goals from the document, the researcher found that some objectives were highly relevant to the language choice for learning materials at UiO. The Language Council wishes to assure:

- 1) Students are proficient in the use of Norwegian and English in their academic or professional areas of expertise after completing their education.
 - 2) Students and academic staff are able to acquire Norwegian and English as technical and academic languages.
 - 3) Students develop bilingual proficiency in their subject fields in keeping with the described learning outcome for the programme/discipline.
 - 4) Academic personnel are able to provide instruction in both Norwegian and English.
 - 5) Effective coordination of language services at the institutions.
- (Retrieved from the Language Council, n.d.)

Based on these points, some improvements at UiO pertaining to language in learning materials can be made. For example, there is no clear regulation from UiO on what the ratio of distribution should be between Norwegian and English learning materials, and what it would mean for the assessment language. This may contribute to inefficient time management for students and language mismatch between the language of the learning materials and the assessment language. Additionally, as not all English learning materials are available in Norwegian, glossary list and/or supplementary materials in Norwegian are needed to preserve the consistency of terminologies, as well as to ensure that parallelingualism is achieved across various subjects and/or courses.

2.4 Analytical Framework

This section discusses about the analytical framework used to answer the research questions. The analytical framework of this study is informed by two factors, namely language experiences (Dafouz & Smit's ROAD-MAPPING framework, 2016) and disciplinary differences (Biglan & Becher's disciplinary characteristics, 1987; 1994). This study attempts to investigate the relationship between undergraduate STEM students' perceptions and individual experiences by inviting the students to reflect on disciplinary differences and language experiences. Firstly, the ROAD-MAPPING dimensions from Dafouz & Smit (2016) is used as a reference to examine students' language experiences. Although the framework was used in an English Medium Education context, the students will be able to reflect on their language experiences as they have dealt with EMI through the English learning materials in their programs. Secondly, this study highlights the specific disciplines as exerting influence on undergraduate students' experiences with English learning materials due to similarities and differences in the disciplinary attributes (Biglan & Becher's disciplinary characteristics, 1987; 1994). Figure 4 below illustrates the analytical framework of this study.

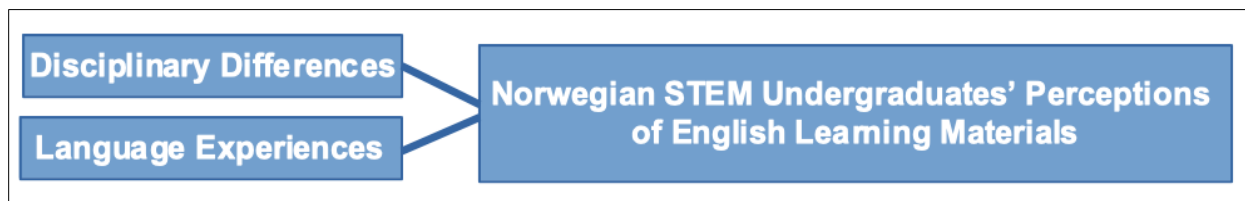


Figure 4. Analytical framework

The left side of the figure describes the main experiences and disciplinary differences which are assumed to be the main sources of Norwegian STEM undergraduates' perceptions of English learning materials. By incorporating this framework, this study aimed to explore Norwegian STEM undergraduates' perceptions of English learning materials and how their perceptions are related to their language experiences involving disciplinary differences as an essential factor which impacts students' perceptions.

3 Research Methodology

This chapter presents the research design and methods employed to answer the research questions. The following sections describe the design of this study: research design (3.1), semi-structured interviews (3.2), recruitment of participants (3.3), participants (3.4), data collection (3.5), data analysis (3.6), quality criteria (3.7), and ethical matters (3.8).

3.1 Research Design

Qualitative study is vital to determine the potential factors about which little has been known or explored (Strauss & Corbin, 1998). As the nature of this study is interpretive, the study is based on the observations and interpretations of people's perceptions of an issue (Neuman, 2011). In order to produce a thorough view of EMI from the perspectives of students who have been subjected to EMI implementation, as well as their perceptions and understandings about EMI, an exemplifying single case study approach was chosen as extensive data collection from various sources serves as the backbone of this study.

The first rationale for selecting an exemplifying case study is that it enables the objective to "capture the circumstances and conditions of an everyday or commonplace situation" (Yin, 2009, p.48). Despite its name, an exemplifying case is often chosen not due to its extremity or peculiarity, but because it epitomizes a broader category of cases or it provides a suitable context for certain research questions to be answered (Bryman, 2016, p.62). The second rationale is that it allows the researcher to investigate key processes within a specific issue. Therefore, exemplifying case is an appropriate context for the working-through of the research questions and illuminates the relationships between various processes within the issue of EMI at UiO.

Figure 5 below informs in detail about the research steps of this study.

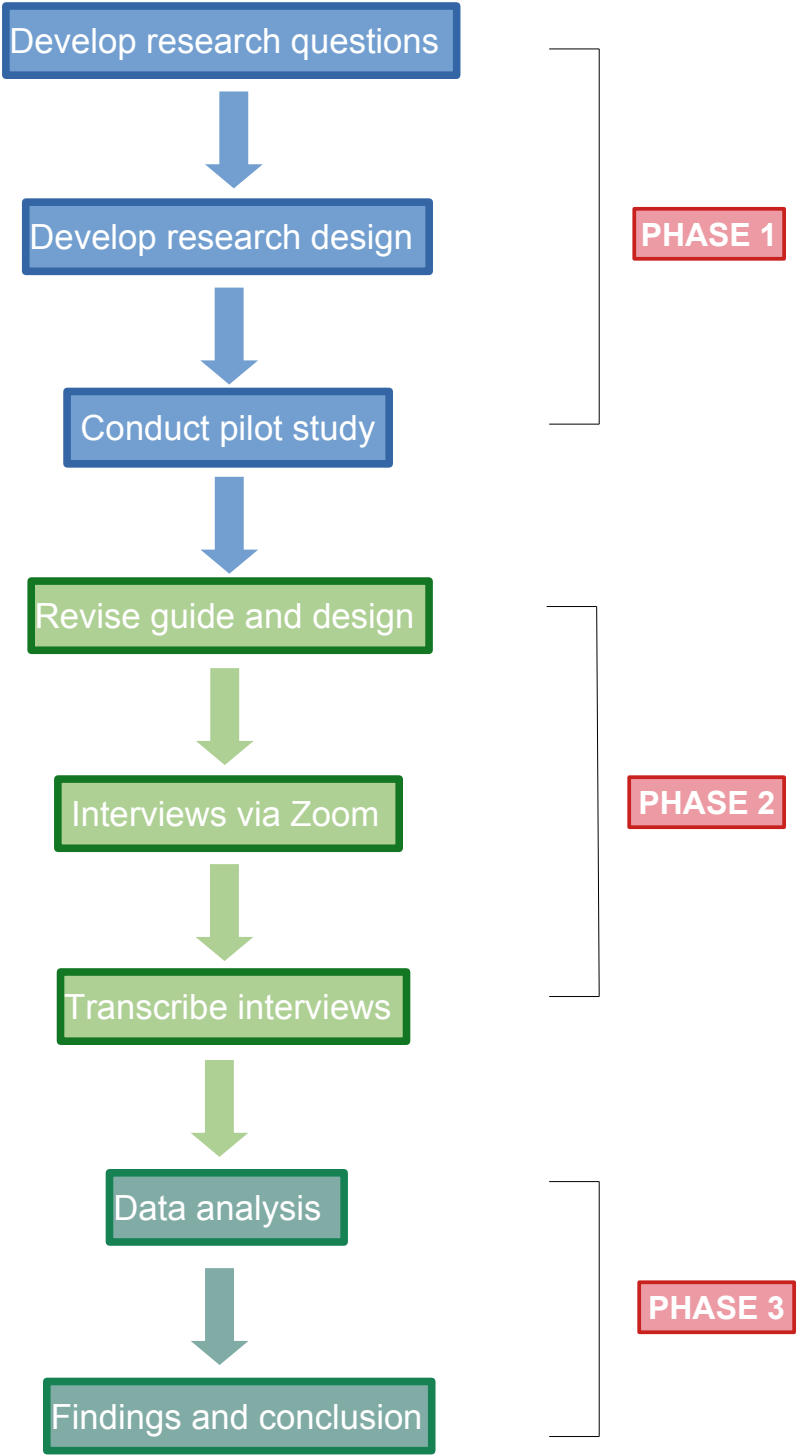


Figure 5. Research steps

The methodology selected for this study is a single case study, which is “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 2009, p.18). This study fulfills this criteria, as its aim is to obtain an understanding of students’ perceptions of English learning materials as they themselves describe them. The participants recruited for this study were from five different STEM programs, ensuring that the results are not heavily influenced by only one program. As the goal of the study is to reach a deep understanding of students’ general perception, common patterns, differences, and variations in expressing meaning are identified. The research interest lies in the comparison between five study programs. Ten students, which consists of five female students and five male students, form one unit of analysis. Thus, this study can be categorized as a holistic, single case study which relates to the “global nature” of an organization, which in this case is UiO (Yin, 2009, p.46; Thomas, 2011, p.138).

In terms of the sampling of a relevant site, UiO was chosen firstly because of the language-related policies in its strategic plan, as evident from document A and B. Secondly, it is considered as an old and prestigious HEI in Norway, a flagship university (Gornitzka & Maassen, 2017) in the Norwegian higher education landscape. Also, UiO is involved in change processes pertaining to language in higher education with its engagement in international cooperation and its ambition to become one of the best universities in the world, which makes UiO a an important case. The Faculty of Mathematics and Natural Sciences (MN) was chosen for its specific disciplinary perspective on the topic, namely its combination of pure and applied study programs. Furthermore, for ease of access and convenience reasons, the study is conducted at the same institution at which the thesis is written. Recruiting participants from all faculties across the university would have significantly prolonged the recruitment process, the data collection process and impacted thesis completion.

As this study moved from the more abstract methodology questions to the more concrete questions related to methods and materials, several considerations were made to ensure a coherent research design. “Methodology” refers to the general ideas about what counts as data and how data will be analyzed (Nygaard, 2017). “Methods” concerns about the specific techniques that the researcher use within a particular approach, while “materials” are the concrete items that the researcher employs to carry out the method (Nygaard, 2017). Figure 6 below shows the relationship between methodology, methods, and materials of this study.

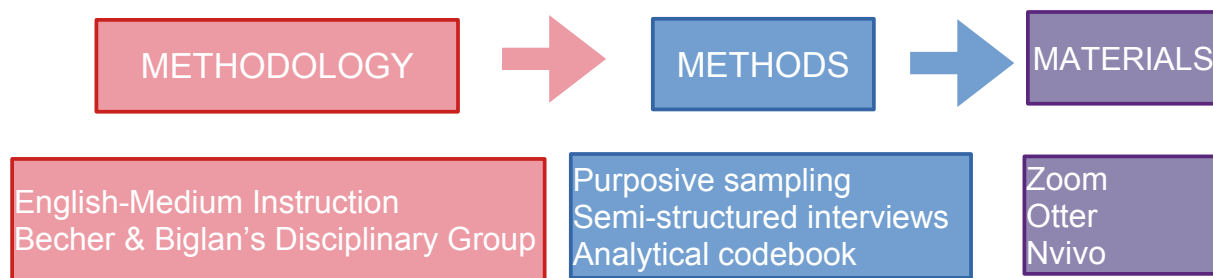


Figure 6. Relationship between methodology, methods, and materials
(adapted from Paltridge & Starfield, 2007, p. 123)

3.2 Semi-Structured Interviews

This study employed semi-structured interviews, which applies to a type of interview in which the interviewer has a set of questions that are in the general form of an interview guide but is able to vary the sequence of questions. The questions are “somewhat more general in their frame of reference rather than the questions typically found in a structured interview” (Bryman, 2016, p.201). Semi-structured interviews were perceived as most fitting to this study as they offer comprehensive qualitative findings analysis and allow the participants to accurately describe their opinions and insights (Bryman, 2012). The comparatively unstructured nature of semi-structured interviews and their ability to provide insights into how participants view the world is central in this study, as the main research aim of this study was to explore students’ perceptions of English learning materials.

As the researcher began this study with a fairly clear focus on the use of English learning materials in selected undergraduate STEM courses at UiO, semi-structured interviews were utilized to enable the researcher to ask more specific issues. By using semi-structured interviews with open-ended questions, the researcher would collect participants' meanings and perceptions of English learning materials, while being both flexible and structured in approaching the process.

Additionally, semi-structured interviews offer flexibility and subjectivity to be innovative in the discovery of the relationship between practice and attitudes in the context of deep understanding (Silverman, 2001). They focus on how the interviewees frame and understand the issue at hand -- that is, what the interviewees perceive as important in explaining and understanding patterns, events, and forms of behaviour (Bryman, 2016, p.468). In preparing the interview guide, the researcher considered the "questioning that allows interviewers to glean research participants' perspectives on their social world and that there is flexibility in the conduct of the interviews" (Bryman, 2016, p.469). The strategy documents, existing literature, webinars and reports from various institutions, as well as discussions with colleagues and friends, served as the bases of the questions for the interview guide. The researcher created a particular amount of the topic areas to make certain that the questions would flow naturally, while also being prepared to adjust the questions' order accordingly in the actual interviews, following the interviewees' lead and articulation. The researcher also took into consideration that the interviewees are Norwegian undergraduate students and ensured that the language used is comprehensible to them. Furthermore, the researcher prepared an overview of the participants containing general information (name, age, gender, study program, email) to contextualize their answers.

Face-to-face interviews and in-person interviews are the tried form of generating data in qualitative studies (Opdenakker, 2006; Gill, Stewart, Treasure, & Chadwick, 2008; Creswell, 2013). However, meeting participants in person is impractical when strict social distancing measures are applied, participants are unable/unwilling to travel, and are geographically dispersed. Hence, video conferencing can provide a convenient and cost-effective alternative for both researchers and participants. This study utilized Zoom as an interview tool, as the pandemic led to strict social distancing measures worldwide, and in Oslo especially. Given the benefits of synchronous online individual interviews via Zoom compared to in-person interviews, the former was used. The researcher recorded the interviews, with the interviewees' consent prior to the actual individual interviews, and took some detailed notes from the semi-structured interviews to complement the recordings and strengthen the data analysis process.

Literature on the use of voice over internet protocol technologies (VoIP) for virtual qualitative data collection is limited (Weller, 2017; Lo Iacono, Symonds & Brown, 2016). VoIP as an online interview method varies from asynchronous method (such as email and IM) and synchronous method (such as Skype, Zoom). These impressions suggest that virtual personal interviews have several benefits compared to in-person interviews. The latter allows last-minute adjustments to the interview schedule, has fewer safety concerns for both parties (Bryman, 2016, p.492), and the quality of online interview did not differ from in-person interview (Cabaroglu, Basaran, & Roberts, 2010; Deakin & Wakefield, 2013; Gray et al., 2020). However, there are some constraints that need to be assessed, such as the occurrence of potential technological problems, fluctuations in the quality of internet connection, and the higher probability of non-attendance from the respondents (Bryman, 2016, p.492). The researcher found that the benefits of Zoom as an interview tool outweighed the challenges encountered. Also, the participants' familiarity and preference for Zoom was particularly noteworthy given that most have used Zoom and are familiar with other video conference platforms.

Zoom as a video conferencing software was chosen as an interview tool because of its advantages in research utility and its similarity to in-person interview. Firstly, it doesn't require account registration or program download, so only the researcher is required to download the program and create electronic meeting invitations. That being said, the respondents are also able to download the program should they choose to. Secondly, it has a screen-sharing function where attendees can display images, videos and other materials during the conversation. Thirdly, it allows secure recording and storage options without third-party software, which is vital in handling sensitive data. Moreover, the researcher was aware that rapport-building may look different in this type of interview, so the researcher exchanged several emails and messages prior to the interview to establish a rapport. The researcher was also aware that technology proficiency and personality could influence rapport-building, so the researcher prepared sufficient knowledge to troubleshoot preceding the interviews and learned the appropriate skills to conduct interviews on a virtual platform. Overall, the semi-structured interviews length varied from 30 minutes to an hour. Figure 7 below shows the seven stages of an interview inquiry from Brinkmann & Kvale (2018, p.41) that this study followed to achieve satisfactory interview results.

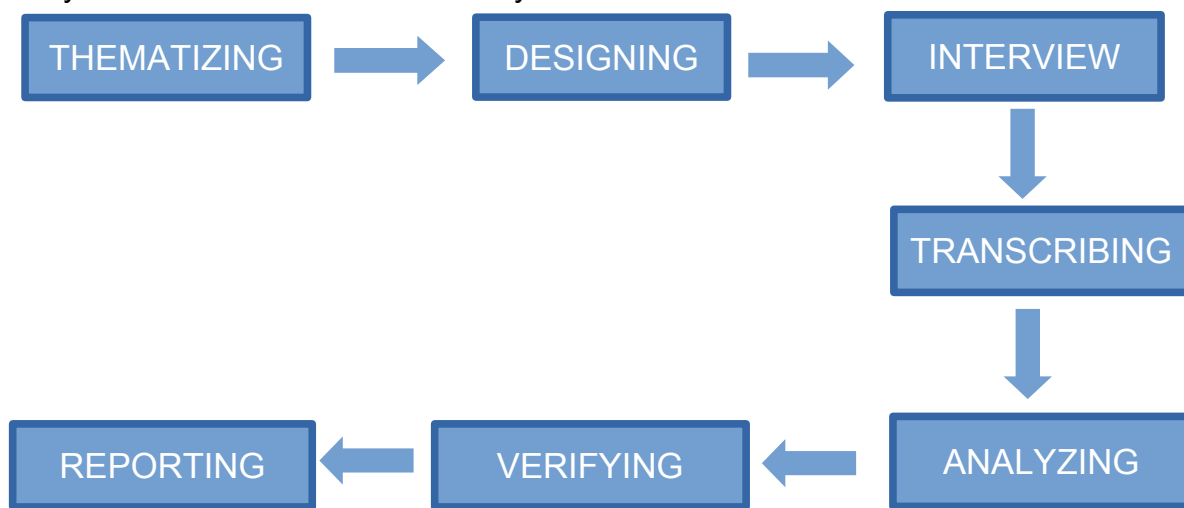


Figure 7. Seven stages of an interview inquiry (Brinkmann & Kvale, 2018, p.41)

3.3 Recruitment of Participants

Given the aims of this study, the purposive sampling method was seen as the most fitting for the recruitment of participants. As the scope of this master's thesis is limited, a sample of ten participants from five different STEM study programs at UiO was considered suitable. The selection of potential participants were based on the two criteria:

1. They should be native Norwegian-speaking.
2. They should be enrolled in a 3-year undergraduate STEM study program at UiO.

From these criteria, some students fulfilled both criteria and some not. The researcher contacted the study consultants at the Faculty of Mathematics and Natural Sciences to help spread the word, as most students were not on campus at the time of thesis writing due to digital lectures. The researcher also contacted various student association groups on Facebook to recruit potential participants. This resulted in twenty potential participants from five STEM study programs at UiO. The potential participants were asked to sign up on Nettskjema, which included necessary information such as name, e-mail address, study program, and batch year to get in touch with them later. However, due to cancellation, non-responsiveness and unfulfilled criteria, only some potential participants remained, resulting in ten final participants. Being mindful of ethical concerns, the researcher made sure that all students had filled out the forms accordingly and checked the relevant boxes in the consent form. After these ten final participants had sent in their signed consent forms, the interviews were arranged.

3.4 Participants

The researcher was looking for those who “have had experiences relating to the phenomenon to be researched” (Kruger, 1988, p.150), as the selection of case (EMI) and unit of analysis (individual students) with reference to the quest for the generation of a theoretical understanding will be emphasized (Bryman, 2012, p.410). When it comes to the sample size, literature shows a split on what is an agreeable minimum sample size. Boyd (2001) argued that 2-10 respondents or participants are sufficient in reaching saturation in a research project, whereas Creswell (1998, p.65) believed that “long interviews with up to ten people” are acceptable. Thus, considering the time limitations of this study, a sample size of ten students was considered sufficient. Two participants from five different study programs were selected, resulting in a total of ten participants. To ensure the anonymity of the participants, the participants were given male and female pseudonyms. Table 7 below shows the demographic of the participants.

Name	Study Program	Age	Year	Experience Abroad
Aksel	Electronics	23	3	Short vacation trips in EU
Trond	Mathematics	22	3	None
Nicolas	Physics	23	1	Study and work trips in EU
Nora	Physics	20	2	Study trip to England
Astrid	Life Sciences	20	1	Short vacation trips in EU
Oscar	Electronics	28	2	Short vacation trips in EU
Elin	Mathematics	21	3	None
Erlend	Informatics	24	3	Study and vacation trips to England
Maja	Informatics	20	2	Lived in the USA and England
Hilde	Life Sciences	21	1	Studied in Denmark, volunteered in Asia

Table 7. Participants demographic

The selected programs at UiO are three-year bachelor programs in STEM subjects with 180 credits. Students in the selected programs specialize in different subjects with different credits for main subjects and sub-subjects. These subjects vary from obligatory and elective courses or exchange semester courses. In regards to the international dimension of the programs, all students are encouraged to study abroad through exchange programs. There are numerous choices of countries and time periods, depending on the subjects. However, there was no clear description about students' Academic English competence as a learning outcome in the STEM programs as a whole.

Interestingly, the information from the university website about study programs can only be accessed in Norwegian, as the bachelor programs are taught in Norwegian, while some of the learning materials are in English. Since most programs are taught in Norwegian, the majority of both students and lecturers are Norwegian, which reveals a monolingual tendency. Out of twenty-eight bachelor studies in STEM programs offered by UiO, five studies were selected in order to preserve the holistic understanding of the programs, namely Mathematics, Electronics, Life Sciences, Physics and Informatics. This is illustrated by figure 8 below.

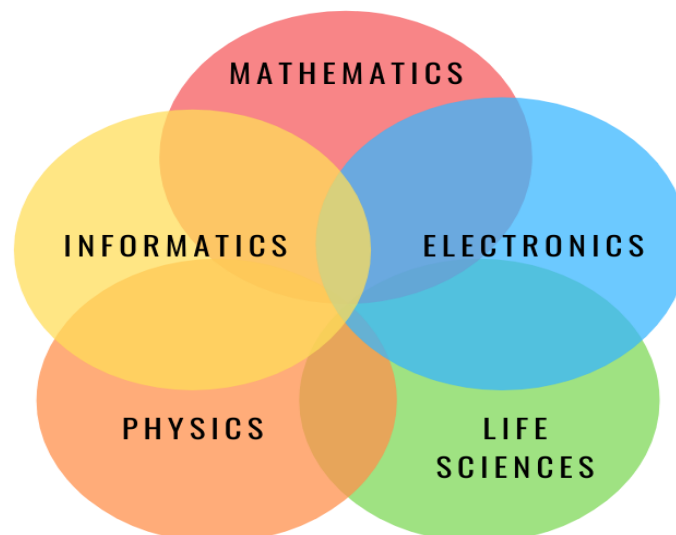


Figure 8. Five selected STEM programs at UiO

3.5 Data Collection

The research questions guided the study in determining the data collection and the corresponding unit of analysis. Since the research design is a case study, combinations of data collected from watching, listening, asking, and recording would enable the researcher to engage in the act of interpretation (Radnor, 2002, p. 48). The goal of this study was to explore students' perceptions of English learning materials with regard to the different STEM study programs and factors affecting their perceptions. In order to answer the research questions, data on students' perspectives are needed, and thus, interviews seemed to be suitable. Interviews were chosen as they are capable of producing knowledge of the human condition because they investigate participants' ways of experiencing and understanding their world in ways that the researcher can interpret them (Kvale, 2007). Utilizing interviews as a data collection method would enable the researcher to conduct data triangulation, in which data will be analysed, contrasted and validated (Bryman, 2012). Data triangulation would also allow the researcher to cross-check observations and findings from the semi-structured interviews, as well as to make decisions, avoid misunderstandings, and achieve data representativeness (Bryman, 2012, pp. 392).

Video data has numerous advantages for educational studies (Blikstad-Balas & Sørvik, 2014) and served as the primary data in this study. The recorded videos were re-watched and transcribed by the researcher. In collecting the data, the researcher made use of several applications: Zoom to conduct and record online semi-structured interviews, and AI-assisted transcription software, Otter Voice Meeting Notes, to transcribe the interviews. The researcher manually cross-checked the transcriptions from Otter with the recorded videos to ensure coherence and word clarity. While there are many benefits of using videos as primary data, there are also some considerations that have to be taken into account, such as the researcher's familiarity with the context, participants, and research sites (Dalland, 2011; Maxwell, 2013).

In conducting the semi-structured interviews, the researcher considered that individual interviews would be more appropriate than focus group discussions, because a group setting may affect interpersonal relationships and enhance the possibility of losing face in front of other people (Goffman, 1974). The researcher was also concerned that the participants might know each other due to the close proximity of the faculty and study programs, hence, individual interviews were deemed the most fitting for this study.

As the researcher had minimal training in conducting interviews, pilots prior to the actual interviews were necessary. Two pilot participants of the same age as the final interviewees were contacted and interviewed on Zoom on different dates. The pilot interviews were comprised of the interviews and reflections upon the interview processes. Even though the pilot participants were not studying STEM, the researcher gained important interview practice, and had some feedback to revise the interview guide preceding the actual interviews. Revisions made in the interview guide were regarding time allocation and the way the interviewer could follow up on participants' responses. As the final participants vary from 20-28 years old, the researcher was aware that differences in verbalizing responses may occur due to personal willingness and openness. Thus, a strategy of acknowledgement can help younger respondents to verbalize their responses (Dalen, 2011). Then, the researcher tested these improvements on the other pilot subject and applied adjustments in the revised interview guide.

Another point that was revised in the interview guide was time allocation. Originally, the researcher had planned to incorporate two interactive sessions. However, as the pilot revealed, the researcher needed to make an adjustment and omitted the second interactive session to manage time and improve efficiency of response retrieval, as verbalizing in L2 takes longer time and varies greatly.

By translating the thematics from research questions into the interview questions, thematic knowledge could be evoked and contribute to a good conversation. The research questions, which in this case would be questions pertaining students' experiences and perceptions of English learning materials, had to be translated into informal daily language to obtain impromptu and rich descriptions from the respondents. The researcher could get varied information by looking at the theme from different viewpoints. The primary job for the researcher as the interviewer was to obtain descriptions, so that they become both relevant and reliable materials that could be interpreted for further analysis. Testing of interpretations and hypotheses would be either verified, falsified, or improved. Table 8 below describes the translation of the thematics from the research questions into the interview questions. As table 8 displayed, one research question can be explored through many interview questions.

Research Questions	Interview Questions
1. How do students perceive the use of English learning materials?	+ What do you think of English materials in course X? + How does English influence your understanding of the material? + How has your understanding of English materials developed throughout the semesters?
2. How is English learning materials organized in STEM courses at UiO?	+ What subject areas have you been studying in your program? + How are English learning materials used in course X? + What types of support do you get from your department/faculty?
3. What are the similarities, differences and factors affecting students' perceptions?	+ What comes to your mind when you think of English learning materials? + Do you notice any similarities or differences between Norwegian and English materials? + Do you often reflect on what you have learned from the materials?

Table 8. Research questions and interview questions

Following Brinkmann & Kvale’s suggestion (2018), an interview guide was made. Since the interviews were intended to be semi-structured, the interview guide was organized thematically according to the research questions and had predominantly open-ended questions. By using this guide, the researcher was able to administer organized and versatile interviews. Table 9 below presents an overview of the guide, with revisions made based on the pilot.

Part	Subject	Revisions made based on pilot
Opening	Informing participants about details on the interview, the procedure and their consents	None
Warm up	General, open-ended questions about themselves and their language background to establish rapport between interviewer and respondent	Allocating more time for respondents to open up to reduce anxiety caused by unfamiliarity, possible technical issues or needing more time to verbalize thoughts in English as L2
Experiences	Open-ended questions related to RQ2, asking the respondents about the use of English learning materials in their study programs	Adding acknowledgment statements to dig deeper and obtain more data, allocating more time for respondents to scroll through and choose course
Perceptions	Open-ended questions related to RQ1 & RQ3, asking the respondents about their insights and understanding on English learning materials	Allocating more time for respondents to verbalize meaning in L2, applying probing and follow-up questions more often according to the respondents’ lead
Wrap up	Thanking the participants, informing them about data and transcription validation	None

Table 9. Revised interview guide

All respondents were comfortable speaking in English. Considering this, English was used for the interviews and the interview guide. The interviews were video recorded using Zoom and lasted for about 45-60 minutes. Afterwards, the participants were given a token of appreciation for their time and were sent thank you email letters. The complete interview process took approximately one month to finish.

3.6 Data Analysis

The interviews were later transcribed first using a Zoom-synced transcription software called Otter. They were later manually checked by the researcher to ensure word accuracy. Nonetheless, the transcriptions will never be absolutely unbiased and reflect “artificially constructed language” (Brinkmann & Kvale, 2018) as they changed from oral to written form. Given the reliance on interview-based transcripts in this study, quality of transcription is achieved with the assistance of AI to minimize human errors due to mishearing, fatigue, or carelessness (Bryman, 2016, p.483). Also, since transcriptions are reductions of the raw data materials, this could entail information loss. In order to avoid this, transcriptions were checked with the audio and video recordings. The recorded interviews were transcribed using Word 2016, which is stored in UiO OneDrive, an online storage platform provided by UiO.

The data was analyzed using thematic analysis, which is appropriate with the co-constructive nature of this study, in which “the ways individuals make meaning of their experience, and, in turn, the ways the broader social context impinges on those meanings” (Braun & Clarke, 2006, p. 9). Thematic analysis would provide an insightful theme analysis while still keeping focus on the research questions that the researcher asked. Having a detailed and rich analysis would enable the data analysis to be as transparent as possible. The data analysis was derived from one primary data source, and later organized into themes, described and meaningfully interpreted (Cresswell, 2007) using NVivo, a Computer-Assisted Qualitative Data Analysis Software (CAQDAS).

A data analysis should allow change from describing the data to presenting discovered patterns and meanings (Twining et al., 2016). In this study, a qualitative approach was taken using inductive coding. As clear, consistent and thoughtful data order in qualitative research may stimulate careful analysis and give credibility to the study (Radnor, 2002), the data analysis started after the interviews were conducted.

The researcher coded the data emerging from the interviews using nodes and cluster analysis features on NVivo. Then, the research questions were answered based on the findings from the semi-structured interviews. Afterwards, the researcher would construct the discussion and conclusion of the study accordingly while preserving coherence throughout all parts of the thesis.

For the first and third research questions, the data material is comprised of the responses from the semi-structured interviews. The analysis consisted of gathering the responses for the various functions in separate categories, before comparing the responses and inductively developing codes and an analytical codebook that reflected Norwegian undergraduate STEM students' perceptions of English learning materials using codes/nodes. After the researcher coded the themes, the researcher clustered them on the basis of the coding using the cluster analysis feature on NVivo.

Visualization offers “an ability to comprehend huge amounts of data”, “allows the perception of emergent properties that were not anticipated”, “often enables problems with the data itself to become apparent”, and “facilitates understanding of both large-scale and small-scale features of the data” (Ware, 2000, p.3). While NVivo offers a range of possibilities in visualizing data analysis, this study focuses on the cluster analysis feature to map the evolving thematic connections between codes. Cluster analysis was used to give an overview of the structure of the data, allowing the researcher to gain some distance to supplement thematic understanding arising from close reading of the nodes (Guest & McLellan, 2003). In other words, cluster analysis was employed in an explanatory manner to get preliminary view and to provoke ideas (Bazeley & Jackson, 2013).

For the second research question, the data material consisted of students' responses from the semi-structured interviews, plus the learning materials that the students chose in their respective study programs. As there was little research done previously on the topic within a Norwegian context, the initial data analysis started with inductively coding students' responses and comparing these with the written interview memos taken by the interviewer, where details, ideas and possible connections between responses were noted. Then, the researcher reviewed the codes through comparison and later organized them into larger groups based on themes that emerged from the responses. Each theme group was assessed in turn, and codes were recoded where needed. Patterns that indicated relationships between the overarching themes were also considered. Both audio and video recordings were also replayed to guarantee accurate transcriptions.

As software alone is not enough to analyze data, the researcher also did some work manually, such as transcription, coding, interpreting and theorizing. These processes may take a longer time than the interviews themselves (Tight, 2012), but applying semi-structured interviews offered a richer understanding of how behaviour happens, and participants' perspectives on their happening (Ritchie & Lewis, 2003), and how they would fit the framework of co-constructed knowledge through interaction between the interviewer and the interviewees (Kvale, 2007; Wellington, 2000). Eventually, this resulted in a finalized set of categories, which were compared to existing theories and reviewed deductively. As the researcher applied the theories to categories, renaming some of them ensured that the codes were adjusted to the students' responses. The researcher also reviewed and double-checked the data to make certain that there was no missing information.

Furthermore, this study employed Braun & Clarke's thematic analysis framework in identifying, analyzing, and reporting themes within data (2006, p.16). This framework was chosen because of its usability to describe the circumstance of this study. The six phases in Braun & Clarke's thematic analysis framework are: 1) Get familiar with the data; 2) Create initial codes; 3) Search for themes; 4) Review themes; 5) Define themes; 6) Write-up (Braun & Clarke, 2006, p.16). In first stage, the researcher reviews the transcriptions thoroughly to get familiar with the data. The researcher also read the interview notes that were taken during the interviews and highlighted the relevant parts that would be useful in answering the research questions.

In the second stage, the researcher labeled terms, phrases and sentences in the transcriptions that are relevant to the research questions. For instance, in attempting to answer RQ1: *How do Norwegian STEM students perceive the use of English learning materials*, the researcher labeled the statements that are related to the research questions, as such: "Disciplinary Differences" for disciplinary differences, "Language Experience" for language experience, and "Difficulties" for the difficulties that the students encountered. The researcher employed the cluster analysis on Nvivo to look for patterns and identify sub-codes. For example, in "Difficulties", the researcher reviewed each statement within the code and noticed potential sub-codes: difficulties in reading, difficulties in vocabulary, and difficulties in pronunciation. Throughout this process, the researcher went through trial and error stages, in which interconnected codes are joined together and irrelevant codes are removed. The codes and sub-codes are displayed in Appendix D.

In the fourth stage, the researcher grouped the codes from the third stage based on the research questions and the themes generated. For example, under the theme “Perceptions of Learning Materials in NO and ENG”, the sub-themes “Positive”, “Neutral”, and “Negative” were created. The researcher also looked for sub-themes by checking the connection between codes, and whether or not the codes are similar/dissimilar. For instance, on the “Students’ Reflection” theme, related sub-themes were added, such as “Easiness of Use” and “Future Career Relevance”. Afterwards, all the codes and sub-codes were appropriate in one or more themes. In the final stages, the researcher made sure that coherence is maintained throughout all stages and investigated the codes. Additionally, the researcher reviewed the transcriptions to ensure that the “essence” of each theme is represented, and that there were no absent codes (Braun & Clarke, 2006, p. 23). This resulted in a cluster analysis (Appendix E) which allows the researcher to interpret the relationships between themes and sub-themes whilst maintaining an overview of the themes that have similar values.

3.7 Quality Criteria

There has been a lot of discussion about standards of qualitative studies, and three of the most prominent criteria in qualitative studies are validity, replicability, and reliability (Bryman, 2016; Johnson, 2013; Creswell, 2013). Validity in qualitative research concerns the integrity of the conclusions that are generated from a piece of research, while replicability in qualitative research is connected to an investigations’s capacity to be replicated, and reliability in qualitative studies refers to the consistency of the researcher’s approach (Bryman, 2016; Creswell, 2013). Although generalizability is not the goal of this study due to small sample, this study attempts to test the analytical framework presented in chapter 2 to examine the research questions.

3.7.1 Validity

Validity in qualitative studies can be described as a study's credibility, whether a study has investigated what it claims to investigate and whether the findings are accurate (Creswell, 2013). Validation, then, refers to the procedures and strategies utilized in order to "emphasize a process" (Creswell, 2013, p.250). As this study looked at ten participants, generalizability was not the focus, but rather "analytic generalization", that is, how well the data supports the theoretical arguments presented in this study (LeCompte & Goetz, 1982 ; Yin, 2009). To achieve this, the interview guide was developed according to the research questions and analytical framework to explore students' perceptions. By following the thematic analysis stages, the researcher ensured that connections between the data, research questions, and framework were complete.

The researcher was aware that some issues might emerge in this study in various stages. With regards to the internal validity, the researcher's main concern was potential research bias. This type of bias could occur at any stage in the data collection process, such as the participants' sampling, semi-structured interviews, transcription, as well as in the data analysis stage through the way the researcher presents the results (Johnson, 2013; Creswell, 2013). While the researcher took some measures to avoid biasing on the respondents' results, the conversation is asymmetrical (Brinkmann & Kvale, 2018). Also, as the researcher is older than most participants, it could be perceived as intimidating for some respondents.

Given the aforementioned problems, the researcher implemented some strategies to strengthen the validity of this study. Firstly, the researcher ensured that reflexivity is achieved through using a guide to avoid potential bias (Johnson, 2013; Creswell, 2013). Secondly, during the semi-structured interviews, the researcher was careful in determining results since what people claim to think, feel or do does not necessarily align with their actions (Arksey & Knight, 1999, pp.15-16). Thus, the researcher employed AI-assisted transcription software and cross-checked transcription data from individual interviews with the participants to make sure that their responses were understood correctly and meanings were clarified (Johnson, 2013). This was done to improve clarity and avoid misinterpretation.

In addition, the researcher also practiced in two pilot studies prior to the actual interviews, which contributed to the dependability of this study and resulted in revision of the pilot guide and limited human error (Dalen, 2011). Thirdly, rich descriptions of the context interpretation, as well as participants' intentions and motivations, were included to achieve transferability (Ponterotto, 2006). In the individual interviews, the participants shared information about their backgrounds and experiences, which allowed the researcher to contextualize their responses. The researcher also took notes and observed several visible elements during the interview that could be beneficial to the analysis, such as participants' body language, facial expressions and ways of verbalizing. Lastly, the researcher did not interrupt the respondents during the verbalization to limit the researcher's influence and avoid information loss (Brinkmann & Kvale, 2018).

3.7.2 Reliability

Reliability in qualitative studies is about the question of whether a different researcher could have produced the same answers from the interviews (Brinkmann & Kvale, 2018). The main concern for reliability in qualitative research is leading questions, while neutral questions strengthen reliability (Brinkmann & Kvale, 2018; Dalen, 2011). This study employed open-ended questions in the interview guide, and they were asked in the similar order for each interview, allowing consistency in each interview. Additionally, follow-up and probing questions, as well as spontaneous thoughts, were made on the spot and could cause a hindrance in duplicating the study. However, the researcher as the interviewer was positive that the selection of choices would enrich the human feature and the originality of semi-structured interviews, and thus produced representative and comprehensive data.

Furthermore, human errors can persist during the interview and transcription process. These errors can be cultural differences, mishearing, misinterpretation, and language affecting interpretation (Bryman, 2016). In order to manage this, the researcher employed a high-quality video recorder to ensure transcription accuracy with the help of AI-assisted transcription. Longer quotes were also checked with the originals. Moreover, while the double-checked transcriptions can be considered accurate, they do not fully disclose body language and human connection that happened during the interviews. Thus, with the video recordings, the reliability of this study was enhanced and the researcher could understand students' perceptions better, as some respondents employed body language to express their meanings. In maintaining the objectivity of the study, the researcher tried to avoid exhibiting any personal stand by concentrating on examining participants' thoughts and perceptions.

3.8 Ethical Matters

This chapter discusses the ethical considerations that the researcher took into account in this study. Research in social science is about investigating people and social systems, and reporting truthfully what the researcher sees, not what the researcher wants to see (Nygaard, 2017). As a master’s student, the researcher did not have sufficient experience to foresee all the “potentially troublesome aspects of research” (Nygaard, 2017, p. 36). Thus, the researcher picked an appropriate set of guidelines by the Norwegian National Committee for Research Ethics (NESH) and followed them as closely as possible. The researcher kept following ethical principles in mind: integrity about the research, consideration for the informants, respect for the process, and openness to the reader (Nygaard, 2017, p. 47).

As this study emphasized research on people as individuals, particularly undergraduate students, many of the ethical matters are related to how the researcher interacted with the people this study is written about. The researcher was aware that acquiring the ethical clearance letter from NSD alone is not enough, considering that ethical relationships with the participants through the research design, data collection, and writing stages is necessary. Table 10 below shows the ethical questions that the researcher asked in different research stages.

Research Design	<ul style="list-style-type: none"> • Who will my participants be? • How will my position influence access? • How will I obtain informed consent forms? • How will I make participation worthwhile for participants?
Data Collection	<ul style="list-style-type: none"> • What relationships am I developing with my participants? • How do I handle sensitive topics? • How do I protect and store my data?
Writing	<ul style="list-style-type: none"> • How can I assure confidentiality and anonymity? • How can I accurately represent participants’ perspectives? • How can I be transparent about my role?

Table 10. Ethics related to the participants (adapted from Nygaard, 2017, p. 37)

According to Norwegian law, any research studies that store personal information need to be reported and approved in some cases. Following the guidelines from NSD and UiO about the General Data Protection Regulation (GDPR), an ethical research form was sent before conducting the data collection process. This study was approved by the Norwegian Centre for Research Data/NSD (*Norsk senter for forskningsdata*). All parts of the consent form were disclosed to the participants before signing the form and all participants gave their written consent prior to the semi-structured interviews. In writing the consent form, the researcher was informed by NSD's recommendations, such as participants' awareness of project involvement, purpose of the research, research procedures, risk and benefit of the research, the voluntary nature of participating in the research, and protection of parties involved (Cohen et al., 2007).

Other ethics related to the participants, especially regarding personal safety, informed consent, compensation, and boundaries were also considered. In order to comply with social distancing measures and ensure safety for both researcher and respondents, Zoom was employed as a virtual interviewing tool. To avoid possibly exposing participants to danger due to recognition issues, information about their details and recordings were deleted upon completion of this study to minimize identification risk. The respondents were not made aware of each other, and while their study consultants were contacted during the purposive sampling of participants, the final selection of ten respondents was not shared with the study consultants. In addition, pseudonyms were used to ensure full anonymity for the participants and to make sure that they took no risk by participating in this study.

Additionally, the researcher maintained the professional boundaries and respected the participants' time by offering a token of appreciation for their participation. An appropriate honorarium was given to the participants as compensation upon the completion of the interview. The participants were not informed about this prior to interview to preserve unbiased answers in their responses.

4 Findings

This chapter presents the findings from the ten semi-structured interviews. This chapter consists of: Overview of Individual Interviews (4.1), Answering the Research Questions (4.2), and Summary of Findings (4.3). The goal of this study was to explore students' perceptions of English learning materials with regards to the different STEM study programs, as well as the factors affecting their perceptions. While the interviews revealed a lot of information, different interviewees had different values and preferences in terms of the scope of discussion during the interviews. Besides, their answers vary as different study programs have different approaches in realizing the parallelingualism policy followed by the institution. The participants showed multifarious preference for English learning materials. All of the participants had Norwegian as their L1 and the interviews were conducted in English.

4.1 Overview of Individual Interviews

The interview transcriptions were split into answer units. A unit in this study relates to an excerpt of text from an interview. The answer units are open, meaning that the researcher asked both major questions and follow-up questions as the interview guide suggested. Participants were asked about their experience of English use in their study programs. Excerpts are presented within their contexts. Thus, the inference presented in this section is understandably a case of interpretation because what the researcher would consider important is related to the research questions. The interviewees are presented in the sequence of the interviews conducted on Zoom, and pseudonyms are used. Some quotations are italicized while some are in bold to emphasize examples or point of interest. The attempted responses in answering the research questions as well as summary of findings followed in section 4.2 and 4.3, respectively.

4.1.1 Aksel

Aksel is a 23-year old third-year student enrolled in the Electronics program. He is in his last semester of his studies, and has always wanted to have a job that has something to do with computers. He has been building computers for years and is passionate about electronics. He wants to get into a master's upon graduation and follow his passion. In the interview, he explained that he is exposed to English from school, TV, movies and video games. Aksel also explained that he experienced language as a way of thinking, as described in excerpt 1 below:

“I think that the way you think about something when you start thinking in a language, you can't really just translate that into another language, like, readily, that just doesn't work. So I end up thinking in English and losing a problem in English because I started that way. There's like a forced perspective associated with the language in that way, where you just can't snap out of that. Or you can't leave, because if you do, you can't think the same way that you did. What I find fascinating about language is the way that **switching language will switch the way you think about a problem or the way you perceive something.**”

Excerpt 1. Language as a way of thinking

Aksel remarked that the most exasperating thing about STEM is the halfway curriculum that is implemented in his major, which means that the learning material would be in English while the lectures and the lecture notes are in Norwegian. When asked to elaborate upon this issue, he discussed the difficulties he encountered in acquiring clear and consistent language in learning materials. He explained it in excerpt 2:

“So we have this hardware and a lot of LEDs and we had to program these boards. And apparently they changed the book from Norwegian to English. From a student's perspective, it would be hard to sort of break through and understand what you're supposed to go and gain from this, you know, because if you're trying to learn a whole new language then you also relate to a new information and abstract concepts in many ways. **If the communication isn't very clear either, it's the worst way you can structure this curriculum- when you haphazardly mix English with Norwegian, and not staying consistent.** Then it gets way more confusing than it has to be.”

Excerpt 2. Language consistency

Aksel's biggest barrier in comprehending learning materials in STEM courses has been the limited Academic English skills of his lecturers, which according to him, influenced his understanding of learning materials in math and physics. Upon asking to elaborate on this issue, Aksel put it clearly in excerpt 3 below:

“One thing you could say is that a lot of these are not written by someone with a professional degree in English, it doesn't go through editorial phase. It's another thing with STEM courses, because the professors rely on their English competence, it's up to their competency to write. **The biggest barrier for me so far has been the professor who doesn't have substantial amount of English training which leads to a huge problem in communication, especially in math and physics, where you want to communicate as clearly and directly as possible.** Maybe the professor is not adept in one language and accomodating students. Most professors either have a knack for teaching or not.”

Excerpt 3. Challenges with English learning materials

Lastly, when asked about his perception of English learning materials, Aksel expressed that he was rather neutral in terms of the language preference, and would rather preserve language consistency throughout the courses. Aksel seemed to value a clear language of instruction over the choice of language itself. Aksel demonstrated his perception in excerpt 4:

“It is a lot easier to be able to follow a course in one language. If you have the course in Norwegian, but if it's in English for whatever reason, then it should stay in English. It's so frustrating to weave through Norwegian and English halfway. **Consistency needs to be there, it's the big key here, so staying in one language throughout the course is definitely important to go about a course and gain something valuable from it.**”

Excerpt 4. Perceptions of English learning materials

4.1.2 Trond

Trond is a 22-year old third-year student enrolled in the Mathematics program. He is passionate about numbers and machine learning. Upon graduation, Trond wants to work on high-level research and make new models, and continue with a master's degree in the same institution. Trond is exposed to English often in his university environment when communicating with exchange students or professors in his faculty. He worked part-time as a teaching assistant in some courses at his department.

When asked about learning materials in his study program, Trond commented that the learning material quality varies greatly from book to book. Trond explained that in his study program, namely mathematics, it is beneficial to understand a concept in order to prove it. Trond revealed that some authors are good in writing and explaining concepts, but that not everyone can do it. Trond believed that a good book would help the reader to understand something first before jumping into the formalization of the proof. Trond came to the conclusion that the better the author's explanation is, the thicker the book. Trond illustrated this in excerpt 5:

“The book really matters. If you have a good book, you can learn a lot just from the book. But then you also have a lot of bad books which doesn't really line up with the lectures and just reading the book is frustrating because it explained the barely concept. But yeah, that varies from course to course, from book to book. There are some excellent books and there are very bad books. I have no doubt that the author is very proficient in their field, but when you learn something new, you have to be exposed to topics in different way so you can grasp it before generalize it. **So in mathematics in general, a good book will explain the general idea of a proof, and then do the formal proof.** So we don't have to read the formalization of the proof while at the same time understanding what's happening. I think good books are thicker because they explain more things.”

Excerpt 5. Quality of learning materials in mathematics

Trond also stated that his first math course was taught in Norwegian, which was a huge advantage for him because he could adapt to the course easier. He also explained that he struggled in Academic Reading at first, but as he read more English and Norwegian textbooks these days, he became well-adjusted and was completely fine with that. This can be seen in excerpt 6:

“You know, university textbooks, it’s a thing on its own. It’s not like reading anything else. It’s really hard, you have to, like, do exercises all the time. And you have to read the same section many times to get a thorough understanding. So, reading your first university textbook is hard, it takes time. Doing that in Norwegian first probably made the transition easier. **I know that I’m expected to learn in English, at least the books.** So I guess I’m alright with that.”

Excerpt 6. Experience of Academic Reading

Trond also stated that he is irritated because he had to learn terms in both English and Norwegian. He gave some examples of the terminologies used in Mathematics, namely *injective* and *surjective*, which can also be understood as *one to one* and *on*. Trond reported that the use of the latter terms often lead to misunderstanding of the words. He explained it in excerpt 7 below:

“I can do one a sample which luckily applies both in English and Norwegian in mathematics. So we have the very specifically defined notion of a function and maybe functioning in self is kind of fine, but you have some specifications that the function may or may not have, which have many names because they appear very frequently. The names are *injective* and *surjective*, and it’s the same in Norwegian, and I like that. But some other frequently used names that I do not like is *one to one* and *on*. So when you have a *surjective* function you can say that it’s *on*. First of all it sounds strange, and also it’s very general and can mean different things, while the definition of *surjective* is very specific. **So I think it’s annoying to have these casual terminologies.** Also, this *one to one*, is kinda nice, because you can visualize it, but when you want to talk specific, it’s better to use the *injective* definition. Because *one to one* can also mean another thing, obviously most people do not take math courses, and they use *one to one*, and make the meaning more ambiguous.”

Excerpt 7. Examples of terminologies in mathematics

In drawing things to a close, Trond indicated that he is in favour of English learning materials over the Norwegian ones. He justified his stand by saying that most learning materials are in English, so it makes sense to use the English terminologies that match the language of the learning materials. Trond also noted that authors should consider using L1 to their advantages as explaining concepts clearly in L1 is better than explaining them in L2 with lesser clarity. His argumentation can be found in excerpt 8:

“Learning materials are important in general, and most learning materials are in English, therefore English learning materials are extremely important. I would choose English learning materials over Norwegian, because **most learning materials are in English anyway, and it makes it easier to use the same terminologies because most of them are in English**. However, I think that maybe authors of other languages should write in their languages, because you write better in your own language and have someone professional translate it to English. But in other case, English would be the preferred language.”

Excerpt 8. Perception of English learning materials

4.1.3 Nicolas

Nicolas is a 23-year old first-year student enrolled in the Physics program. He speaks four European languages and is used to language. He has traveled around Europe and has been exposed to international communities. Nicolas is passionate about arts and physics. He aspires to take a master’s degree after finishing his bachelor’s. Nicolas believed that English plays a central role in the bachelor’s program and strongly preferred English over Norwegian learning materials due to its international audience and richer explanation. He explained this in excerpt 9 below:

“I prefer the English literature that we have over the Norwegian one. So it’s more... I mean, the more you tested, and the more people would like it, the better, you can maybe choose books out of that. And if you want Norwegian literature, the well there’s only the Norwegian people who are going to read it. I think that **English literature checks out and it’s very thorough. It’s concise, to the point and explains things very well**. And I think that when you get when the lecturers get to choose which books to use, then they have a much better frame of reference, if they’re going to choose international books or older books.”

Excerpt 9. Perceptions of English learning materials

When asked about his experience in reading English and Norwegian learning materials, Nicolas answered that the formulation of ideas between the two languages differ, and that English learning materials are more systematic and effective. Nicolas explained this in detail in excerpt 10:

“It's a bit the same. I mean, the mathematical formulas are identical, but the formulation of what they mean is different. They're very different books in on how they approach the topics, but I'd say that **I much prefer the English literature. It feels more formal, it feels more like it's a systematic approach.** That is very subjective, but I feel the English texts that I have been reading now this semester are very systematic and not looking to explain more than what the topic means. **The Norwegian book usually tries to give explanation and frames of of comparison that I don't always find as effective as the English one.**”

Excerpt 10. Reading learning materials in English versus Norwegian

It appeared that Nicolas struggled with the understanding of terminologies in Norwegian as he hasn't been introduced to them, which is why he prefers English terms. According to Nicolas, using Norwegian terms would limit the learning material content, which is why English materials are more favorable to his benefit. He put this into words in excerpt 11 below:

“I suppose when it comes to terms, I haven't been introduced so much to the terms for that. In Norwegian books, I haven't been introduced through the names and it makes it a bit more difficult. **I would prefer English, and if I had to choose, I would always take English as it's more international.** And then I wouldn't have to put so much effort into trying to explain something just because the word is different. If I have an English text, **I wouldn't have to worry about having to understand the content in other languages.** Whilst in Norwegian, I would have to think of if I am to explain this to someone who doesn't speak Norwegian, which hopefully will be the case in the future, then I would have to translate it and find a translation for this term that I might only know in Norwegian. And if it's in English, then that barrier is smaller, I would imagine.”

Excerpt 11. Understanding terminologies in different languages

Comparable to Trond, Nicolas affirmed the advantageous nature of English learning materials. However, as Nicolas remarked, his choice of language very much depends on the approach of the author, rather than the language. Nicolas also said that he experienced a difficulty shift in the learning materials, and that he would often reflect on the learning materials.

4.1.4 Nora

Nora is a 20-year old second-year bachelor student enrolled in the Physics program. Like Nicolas, Nora is also multilingual and speaks four European languages. She went to an international high school and has had extensive exposure to English. She worked as a part-time teaching assistant in her department. Nora experienced a language adjustment from English to Norwegian. She said that “It was a little bit hard in the beginning, just because I wasn’t used to studying in Norwegian, so it took me some adjusting to do”. However, as she entered her second year, she had more exposure to Norwegian and has adapted well, although she might “confuse a lot of the teachers, but well, they get a bit of spice in their lives.”

When asked about her perception of English learning materials, Nora explained that she associated English learning materials with positive thoughts, as she was able to comprehend it better than the Norwegian ones. She further explained it in excerpt 12:

“I honestly have a very positive attitude towards it. I'm a big fan of English learning materials. I just think that it's more accessible. I feel like I can call **English as the universal language of science because everyone speaks it.** And it's just, you have maths and we communicate through maths or but also when it comes to verbal communication, and it's always English. And **I'm very happy every time I see any of my classes suggest it in English, because I know that I'm going to understand it a lot better than the Norwegian one,** just because I guess it has had more time to develop.”

Excerpt 12. Perception of English Learning Materials

Nora also mentioned the connection between language and internationalization of the study program. She believed that having an international outlook would enable students to broaden their horizons and to better utilize cross-cultural understanding in the increasingly multicultural classroom. She also mentioned that the majority of the learning materials that she encounters are in English, as seen from excerpt 13:

“I think that it is very important in terms of becoming more international- and to be open minded as well. And I feel like I have come across a lot of students that are not as open minded to people who speak English instead of Norwegian. And I think that **having English material really helps to globalize us,** and also, help us to have a whole international mindset.

So you need to English well to understand both people that are from other backgrounds, but also be able to read important literature that's in English because most of the things are going to be in English, whether you like it or not. So I think that it's very important to have English literature included in regardless of the level. Regardless.”

Excerpt 13. Perception of Internationalization through Language

Nora further described that she was more concerned about the way a book explains the transition from a point to another point. This finding is similar to Nicolas, who was also more interested in the systematic and effective approach of a learning material. Nora appreciated a learning material in English as she found it easier to clarify meaning and to look things up on the internet in English rather than Norwegian. This is illustrated in excerpt 14 below:

“What's more important for me is how well they explain the transition, so how you get from point A to point B. How do you get from this equation to that equation? What do you assume? What kind of stuff you go through? Those kinds of things are a lot more important to me... **So it's a lot easier to Google things when you know what it is in English rather than Norwegian because then you have to go through the whole process of translating things.** And it's often that the Norwegian terms used for a concept are just, they don't have an intuitive translation.”

Excerpt 14. Perception of Learning Materials

Nora then gave an example of specific terminologies used in her program that she found a little bit complicated, namely “moment of inertia” in English/*treghetsmoment* in Norwegian. Nora explained this in excerpt 15 below:

“For example, what word was it? It was something in mechanics that we learned. I think it was torque in English... and I think that was *treghetsmoment* in Norwegian. And it took me way too long to figure out what like *treghetsmoment* was in English, because I just I knew what the concept was, but I only learned about the concept in Norwegian so it wasn't as easy for me to link it to the English concept I might have heard of before. Those kinds of things they can be a bit hard, so that's why I also appreciate English a lot better. Oh, it was moment of inertia in English, not torque! **I don't see a logical connection between those words.** See, it's the small things that make life a little more complicated.”

Excerpt 15. Example of terminologies in mechanics

Nora asserted that she prefers English learning materials over Norwegian because they have gone through an editorial process, which makes English learning materials more refined than Norwegian ones. This also resonates with what Trond suggests. Nora and Trond believed that content weighs the most in STEM learning materials. Nora portrayed this in excerpt 16 below:

“I prefer my literature in English, unless it's very well written in Norwegian. Again, **the reason why I prefer in English is because I know that it is well written because there have been many editions of that book and it has been edited many times, and I know that it has been worked on for a very long time.** I think that if I had the same level of literature in Norwegian, I would have been just as happy. It's more of the content. And because English is such a global and international language, more people can work on the same book, and more people can edit the book and revise the book rather than Norwegian. So contrary, contrary to Norwegian versions. **I really hope that in the future, Norwegian books are catching up with the English books in terms of quality.**”

Excerpt 16. Content quality in STEM learning materials

4.1.5 Astrid

Astrid is a 20-year old first-year bachelor student enrolled in Life Sciences program. She has always been interested in life and figuring out how the world works. She chose Life Sciences because of its work relevance and is looking forward to become a scientist. She has had English since elementary, but she felt that her English is “really decaying”, and that she struggled with Academic English. Astrid likes to play football in her spare time, and has played with English-speaking people in this sport. Out of all participants, Astrid most often switched from English to Norwegian during the interview.

It appeared that Astrid has mixed feelings about English use in her program. She reported that switching from English to Norwegian was just “not working in my head”. She also mentioned that she “tried to make notes in English first, but then it was really difficult with having the group conversations in Norwegian. So I just take them in Norwegian”. She understood that most of her learning materials happen to be in English, and that “there’s no mercy about the English bits in the book”.

Astrid mentioned that she experienced language shock from Norwegian-based to English-based literature in the beginning of her studies. Astrid wished that she could have more learning materials in Norwegian. She explained this in excerpt 17 below:

“All the written books are in English, and I, I'm not used to using that much of an English in my studies. **I can, I understand English, and I can use it, but sometimes it's like processing a little bit slower than Norwegian, all the writing and reading all it's a little bit slower.** So preferably, I would have everything in Norwegian, but I understand that we have to had something in English as well. I feel like now that I've gotten more into it, it's a bit better, but **I still wish that we had books in Norwegian.**”

Excerpt 17. Language preference

When asked about her attitude towards English, Astrid responded that she has to work harder on comprehending Academic English and English terminologies as science research are written in English and her future work will depend on her language skill. Astrid described this in excerpt 18:

“Most of the research that is done, is being done abroad. So, every time we study others' research, research is always written in English. And most of the science that is done today, it's a collaboration of many places and different thoughts. **So, I understand that I see myself in the future will be using English, most definitely, because of the collaboration between different fields.** I can't do my job perfectly if I'm just sitting by myself, I have to communicate with others. I know that I'm going to use English in my work, so **I have to learn how to use it and I know that my work will be depending on it.**”

Excerpt 18. Language and work relevance

Furthermore, Astrid explained that there is a language gap between the main learning materials and other learning sources. She reported that she found biochemistry to be most challenging because she had to read a big book in English while other learning sources (i.e presentations, lectures, lecture notes) are in Norwegian. Astrid clarified this through excerpt 19 below:

“**There is a big difference between what you're reading and what you're learning in other ways, really two-sided.** And, yeah, almost all of the colloquia

this is going on Norwegian, the lab course is going on Norwegian, we write our reports in Norwegian. So everything except the book is in Norwegian. So and say. I find that quite hard because **I struggle to see the connection when I read something in an English book and when I've learned something from somewhere else in Norwegian.**"

Excerpt 19. Language gap between the main material and other materials

Then, Astrid gave an example of how different the terminologies can be between English and Norwegian. According to her, this difference is so great that it hinders her comprehension of the terminologies. The examples that she referred to were citrate cycle/*krepssiklus* and pyruvate/*pyrodruesyre*. As Astrid demonstrated in excerpt 20:

"Some words are really different. For example, the citrate cycle that can be named the *krepssiklus* in Norwegian. And **that's quite different**. Most of the words are Norwegian words of the English, but yeah, it's quite hard. Simple chemistry words can be quite difficult. Pyruvate in English would be *pyrodruesyre* in Norwegian. If you directly translate that to English, I think it would be pyro grape acid. **Like, what? These new words, I really find it difficult to learn.**"

Excerpt 20. Examples of terminologies in English and Norwegian

However, in contradiction to Nora, who found the terminologies between English and Norwegian to be complicated and appreciates learning materials in English, Astrid exhibited a stronger inclination to Norwegian learning materials. Astrid also affirmed the issue of high-quality learning materials in Norwegian, which Aksel, Trond, and Nora touched upon earlier. Astrid's description can be found in excerpt 21 below:

"We don't have that much Norwegian literature. It's often written by some of the teachers who just written like a simple book for it. So for example, the chemistry book was just a Norwegian simple version of the English textbook. So it's often in essay form, because the most complex books are always in English. **It's hard to find good and complex literature in Norwegian. Maybe Norwegian books are too bad to be written because they're not the same quality. The content is not as complex and diverse as these English books.**"

Excerpt 21. Quality of learning materials

Interestingly, Astrid reported that she would rather write reports in English instead of Norwegian. She linked the reports to future work relevance and reflection of what she has learned from the learning materials and other activities. Astrid explained this in excerpt 22 below:

“So the work that I will be doing when I'm graduated will be happening in English. I need to do them perfectly, because the reports is really a direct link to the work that I will be doing and the reports is not about learning, is just about writing down what you've learned. It's not processing in the head, it's just writing down what you have done and what the results were. **I will gladly write in English, because it gives a similar practice to the work that I will be doing. I can see that as a work practice. Directly linked.**”

Excerpt 22. Language preference in writing reports

Additionally, Astrid reflected that she would have spent less time and would have benefitted more from learning materials if they were available in Norwegian, her L1. This is seen from excerpt 23:

“I think that I would learned a lot more if the literature was in Norwegian, especially in the first months, I just struggled a lot with the transition. **So if I've gotten opportunity to have a Norwegian book, I would definitely have used it.** I would have learned a lot more, because I've used all my energy and learning and understanding the English bit and not using that time and energy on the learning materials.”

Excerpt 23. Inclination towards Norwegian learning materials

4.1.6 Oscar

Oscar is a 28-year old second-year student enrolled in the Electronics program. He is passionate about electronics and looks forward to applying electronics in his job. Oscar runs and works at a music production studio. When asked about his experience of English learning materials, Oscar explained that he experienced an inconsistency in terms of the terminologies in the learning materials. He elaborated this in excerpt 24 below:

“I like it better when we have consistency in the terminology at least, so that we know what we're talking about. **Even though if they use the same language, they switch up the terminology, and so it might not be 100%, no matter what.** Especially in electronics, we have differences in terminologies in Norwegian and English, which can be a little bit confusing. A lot of synonyms for a lot of words, which some professors aren't as good as in sticking to one type, or one word for one thing. **Having a consistent and clear language is important.**”

Excerpt 24. Terminologies in English Learning Materials

Oscar mentioned a specific characteristic of his study program, which is categorized as hard-applied in Biglan & Becher's disciplinary typology. Oscar affirmed that the learning objectives in Electronics are aimed towards the basic knowledge of physics, informatics and mathematics, and that one of the distinctive traits of hard-applied is factual-based knowledge. He also touched a little bit upon the issue of domain loss due to translation, especially in terminologies. Oscar made this clear in excerpt 25:

“Electronics has a curriculum for ages, and is actually a very **factually-based** subject, and there are **a lot of directness in physics and maths**, so having an English curriculum helps, because all the information is there. And if it's Norwegian, I mean. Norwegian written textbook, by a Norwegian author, and it's still based upon a lot of English texts from before, or other foreign texts, they still have to be translated and things get lost. As long as something doesn't get lost in translation, it should be fine, because you have to understand what the author really means behind the words. **The more something gets translated... well, then we all play the whisper game. Things do get lost in translation.**”

Excerpt 25. Domain loss in factual-based subject

Much the same as Astrid, Oscar also reported the time-consuming and inconvenient aspects of the parallelingualism implementation in his program. He noted a shift in terminology use and gave an example of a certain terminology in Electronics that has developed over time, which could lead to a misidentification of terminology and impede learning. This can be seen from excerpt 26 below:

“So there is this conflicting term that is easy to misidentify, one electronics part that is called *capacitor* in English, which is *condensator* or *condenser* in Norwegian. If you put a *condenser* into Google, you get something entirely different, another electrical components. I think it used to be called *condenser* in English as well, but they switched at some point. In microphones, they still use that component more or less, the one called *diaphragm*, which is the part that vibrates. So that is basically a *capacitor*, but now that's called a *condenser* microphone. **The translation is not clear, then it takes extra time of googling before getting on with the work. And this is a point - no matter with which kind of language we will use, terminology suddenly shifts.**”

Excerpt 26. Shift of terminology use in learning materials

When asked about his perception of English learning materials, Oscar answered that he often thinks in English as he is more exposed to English learning materials. Similar to Trond, Nicolas, and Nora, Oscar remarked that he favors English due to its usefulness in finding extra learning sources on the internet, as well as its vocabulary richness. Oscar's response can be found in excerpt 27 below:

“Most of the time we are dealing in English books and everything is in English. If I read something in English and try to think of the Norwegian word, it doesn't pop to the forefront of my mind all the time. If I, then, I need to find sources and stuff and was trying to reference them, I would have to tap into Google and translate them, because I know what the word means, but what would the correct word be. **I prefer English more than Norwegian just because it is easier to find other learning resources of the same material and double-check and get other methods to similar problem on the internet, asking somebody on the forum or something.** I also think that English is a lot more of a rich language, so it is a lot easier to be able to vary the language, which makes it easier to read.”

Excerpt 27. Preference for English learning materials

4.1.7 Elin

Elin is a 21-year old third-year student enrolled in the Mathematics program. She has worked as an international student buddy last year and now works part-time as an engineer in a Norwegian company. Additionally, she went into an international high school and wanted to continue to a master's degree after finishing her bachelor's degree. When asked about her attitude towards English, Elin shared a similar perspective as Astrid, who also favors Norwegian. Both Elin and Astrid mentioned the word "perfect" when describing their motivation in becoming competent in their subjects. Elin explained her attitude towards English in excerpt 29:

"At English academic level, I have been struggling a little bit, because I'm used to using Norwegian. So when I started learning in English, because of the books, I was struggling with even the basic stuff, I don't know what is multiplication, I'm still struggling with those terms. So I think it was kind of hard, I had to Google a lot of stuff in different languages. So I'm comfortable with Norwegian, but not English in the mathematics subject. Also, in our lectures that are in English, I feel it harder to follow when I'm in the lecture. **I use more time because I kind of want them to be perfect, so then I use more time searching some words and terms.**"

Excerpt 29. Attitude towards English

In terms of her experience with the subjects in her program, Elin said that she has learned some hard theoretical mathematics, statistics, and programming so far. She also commented that she experienced a "language crash" in grasping her learning materials due to new terminologies in English and Norwegian. Thus, she would often use Norwegian-English dictionary to accommodate her needs in understanding the learning materials in Mathematics program. Elin explained her "language crash" as well as her preference for language consistency in excerpt 30 below:

"I did experience language crash when I was in the first lecture and the slides were in English. There was this lecturer speaking in Norwegian and teaching in Norwegian, I think it was really weird. I always look for language consistency. I think it is better to have it either all English or all Norwegian, because if not, then I get confused, especially if they are sometimes Norwegian and sometimes English.

I find it hard to follow up with the terms that I'm learning in the course. **There's language crash when the book is in English, and then everything else is in Norwegian. So yeah, I really like language consistency and prefer to have that kind of language stability.**"

Excerpt 30. Language consistency in learning materials

Furthermore, Elin revealed that she would rely on Google and her American friends to understand some aspects of her learning materials. She explained this in excerpt 31:

"Sometimes, I learned something in English, but then I don't know what it is in Norwegian, or vice versa. And I feel like I use time to learn the same term in both languages. And that's really a waste of time, because when you're studying, you just want to get through reading, but then you have to Google every single word. **Sometimes I, I didn't even understand how the sentence was built.** The book in statistics was really hard, especially on the English level as well. **I had to ask my American friends for help, like, what did it mean here, because the sentence is so long, you know?** So many different phrases, and that kind of stuff. And on top of it, statistics in general is not really easy."

Excerpt 31. Help from the internet and peers

Other than the internet and her American friends, apparently Elin also contacted her lecturers. Seeing that there is a need for a comprehensive translation of terminologies from English to Norwegian, Elin reached out to her lecturers. She would send them an e-mail asking for a dictionary for some courses. Afterwards, a list of words that are frequently used in the class with their corresponding translations was made.

Elin gave some examples of terms that would confuse her in comprehending terminologies in her materials, such as "neighbourhood" or *nabolag/omegn* in Norwegian, as well as the "Banach space"/*banachrom*. She presented these examples in excerpt 32 below:

"And if I look at some of these words... I mean, like neighbourhood, I would directly link it to *nabolag*, but then he (the lecturer) said *omegn*, so, I was confused. Terms like this, it's really hard to think about it in mathematical way. I struggle a lot, it was really difficult. Also the Banach space in English, in Norwegian is *banachrom*. **This is really a language crash**, because when I think about *rom* in Norwegian, I would think about room first, and not space."

Excerpt 32. Examples of some terms in Mathematics

Lastly, Elin concluded her point of view of learning materials with a concrete suggestion for the teaching staff and the institution by recommending the construction of a dictionary or list of words that would help to reduce misunderstanding in excerpt 33:

“Having both of languages, English book plus Norwegian lectures, is confusing and time-consuming. If they can’t go all English or all Norwegian, they should pay more attention and give extra sources like a course dictionary or something else, so that there are less confusions and misunderstandings among students.

Excerpt 33. Suggestion to build a dictionary

4.1.8 Erlend

Erlend is a 24-year old third-year student enrolled in the Informatics program. He never wrote any code in his life prior to his study in Robotics & AI, yet he was determined to pursue a career in informatics and computer science. Similar to Trond and Elin, Erlend plans to take a master’s degree after he finishes his bachelor’s degree. When asked about the subjects in his program, Erlend reported that his program combines mathematics, informatics, and physics. He also mentioned that he didn’t depend solely on the curriculum, but also on the practical experience and online forums more, as the nature of knowledge of his program is hard-applied. He explained this in excerpt 34 below:

“I don't necessarily read a lot of curriculum or stuff like that. **I just sit and code.** If I encounter a problem, I usually just google it and see if anyone else has encountered the same problem. I have had a couple of maths courses, where I used curriculum more actively. But when I work, I usually have my tasks in front of me and some slides from the lectures that are necessary to finish the task. I usually don't have a pen, paper and book and taking notes and stuff. I don't do that a lot. So yeah, it's pretty much just sitting on a computer and writing programs. **More of doing instead of writing and reading.**”

Excerpt 34. Way of learning

Erlend mentioned that most of his learning materials are available in English, which he found to be quite helpful. He also connected the use of English with career relevance

and transferable skills that would enable anyone, anywhere in the world, who also majored in the same program to collaborate. Erlend explained this in excerpt 35 below:

“I think it's good to have a lot of English materials, because it prepares us very well to going and studying abroad, especially when it comes to programming, which is a field that everyone in the world knows what you're talking about. So it shouldn't be a problem if you want to study abroad in Africa or Asia or anywhere else in the world, you can still talk about object-oriented programming and don't have to look up words in Norwegian. It also makes cooperation between different nationalities a lot easier, **even if we don't necessarily speak the same language, we have a common “language” in the programming language.**”

Excerpt 35. Transferable skills and future work relevance

Regarding his preference for language in learning materials, Erlend had a neutral stance. As he was not exposed to many Norwegian learning materials in his Informatics program, he considered Norwegian to be unnatural for him in some courses, whereas in a specific course, such as mathematics, he remarked an inclination to Norwegian because he has a deeper conceptual understanding of mathematics in Norwegian. Erlend added details to this matter in excerpt 36 below:

“I think it's quite natural that the language of the material is English and not Norwegian. If it was Norwegian, I might have a bit more trouble, strangely enough, just because it's unnatural. **I use English all the time when I write my code, and so if someone suddenly starts explaining things in Norwegian, it would be a bit more difficult to understand.** So yeah, I would have preferred English in some courses, but because all my math courses are in Norwegian, I have a better understanding of the Norwegian words for different concepts rather than the English ones. I guess you can say that I'm rather neutral.”

Excerpt 36. Neutral language preference

Erlend mentioned that one of the issues that he encountered in material comprehension is the pronunciation of some of his lecturers. Since they have different L1 and L2, this might lead to trouble in understanding the materials due to difficulty in comprehending the lecturer's pronunciation. Erlend explained this in excerpt 37:

“The lectures, I prefer that they are in Norwegian, because **I had a couple of lecturers that aren't really comfortable with English, so it's a bit distracting, it is hard to really understand what they mean, because their English isn't that good.** There are mainly two Norwegian lecturers in this course. One of them

has worked in the US for a couple of years, so he's really fluent in English, so when he's the lecturer, it works fine, but when the other guy has the lecture, it's a bit more difficult. **Really, their English speaking qualities are quite different.**"

Excerpt 37. Pronunciation issues

Lastly, Erlend gave an example of terminologies that he found to be troublesome, that is, linear transformation/*lineær avbildning*. He extended this in excerpt 38 below:

"So for example *lineær avbildning*, or linear transformation in English. The confusing part is that there is another Norwegian term for that, *transformasjon*, but they just used *avbildning* for that, so **I didn't know that they were the same thing. They could have been making it easier for me, but no.**"

Excerpt 38. Examples of terminologies

4.1.9 Maja

Maja is a 20-year old second-year student enrolled in the Informatics program. Similar to Erlend, Maja has never had experience with IT prior to her studies in informatics. However, she was eager to learn about informatics and is optimistic about the job opportunities that lie ahead. Maja has lived in the USA and England when she was small. Consequently, she has both Norwegian and English as her L1. Maja mentioned that her English speaking skill "doesn't come as natural as it did before." Maja's thoughts about English learning materials were similar to other participants. She appreciated the bigger scope of English learning materials, as well as the user-friendly trait of using English, as it is easier to look things up online. Maja further explained it in excerpt 39:

"A lot of research has been done a different way, on a different bigger scale for making the material. And I think that there are more English good professors in the world rather than the Norwegian ones in a way. However, I've also had some Norwegian books as well. I think they have been relevant when they're speaking about Norway, or speaking about things that happen in Europe or Norway. **But when it comes to informatics, I prefer the English ones because it's easier to search up some words sometimes when I heard something new.**"

Excerpt 39. Inclination for English learning materials

Moreover, Maja also talked about her learning material preference and the economical matter in acquiring them. According to her, she had a greater liking for more accessible and cost-efficient learning materials. This can be seen from excerpt 40 below:

“I like books about a subject with a lot of different theories. **It's nice to have the book, because you can read exactly what you need to learn, while if you search online, then you'll find a lot of different stuff that you probably don't need to learn. So, I think the books are really helpful in those type of subjects, but in programming, I don't find it helpful at all.** I'd say the book is better than to go online. The reason why I don't buy the book is because it's cost money and I could find it online easily, so if I don't have to buy it, I don't. ”

Excerpt 40. Accessibility of learning materials

When asked about her perception of English learning materials in her program, Maja shared an identical view with Trond, Nicolas, Nora, and Oscar. Maja commented that familiarizing herself with English terms would be beneficial for her future career, and that the parallelingualism policy that the program followed could create a terminology confusion since some English terminologies are not translatable to Norwegian. Therefore, Maja struggled with linking the words and matching their meaning. Her detailed response can be seen from excerpt 41 below:

“I prefer English materials, because the textbook I use is in English, and **it felt more natural.** It also has **a better vocabulary,** which makes explaining things easier. And often **many things in informatics are in English.** So it's important, especially in work life later, because they use the English terms. Still, I couldn't just depend on the lectures alone. I have to figure out what term goes with Norwegian, and that makes it hard sometimes. Often, there's not a Norwegian word for it, and then I would just use the English terms, which is easier, but **sometimes it's hard to connect the words immediately to the lecture.**”

Excerpt 41. English as a beneficial tool to future career and word clarity

Additionally, Maja gave some examples of the terminologies that she encountered in her materials. In some of her notes, she would note some English words that have no Norwegian equivalence. These words include *persuasive technology*, *moral machines*, and *double-barreled questions*.

Interestingly, she would write up the explanation of the English word in Norwegian, as suggested by excerpt 42 below:

“So, here I have my Norwegian notes. Let’s see... I can see that there's a mix of Norwegian and English. This is a good example actually. We learned about the types of questions, in which one of them are *double-barreled* questions. Here I wrote *double-barreled* questions in English, but then **I wrote the explanation of the word in Norwegian because ... because there’s no Norwegian word for it.** It’s just, so much easier like that, so I just did it that way.”

Excerpt 42. Example of English terminology in Informatics

4.1.10 Hilde

Hilde is a 21-year old first-year bachelor student enrolled in the Life Sciences program. She has always been interested in medicine and science. She had previously studied in Denmark and volunteered in Asia. Hilde aspired to continue with a master’s degree upon her graduation later. Despite being quite new to the subject, Hilde has taken a lot of courses. She also commented that she enjoy learning about cells and molecular biology in particular, as she would like to pursue a career in bioinformatics.

In a dialogue about her relationship with the use of English in her study program, Hilde responded that it took some time for her to adjust from Norwegian to English. However, she enclosed that she is now well-adjusted to the parallelingualism reality and is ready to prepare herself for future work. This is visible from excerpt 43:

“It took some time to get used to in the beginning, because I had to use some time to translate some words, but it's okay now. **It can also be a bit confusing at times, because the books are in English while lectures and the exams are in Norwegian, so I have to learn everything in both.** But I suppose when we’re working, then most things are going to be in English, so it's nice to get used to it. The world is really international now, and if I'm gonna have a job in biomedical sciences, then I'm probably going to be working with English.”

Excerpt 43. Attitude towards English use

Hilde’s remark resonated with the majority of participants concerning usefulness of a higher education degree. When asked about the learning materials in her program, she

revealed that “in the beginning, I had to get used to the fact that it was in English, and always translating it in my head. So, at least it makes me have to work with the material more”. Hilde also enclosed that the language of the learning materials vary in her courses, as most well-written materials are available in English. Furthermore, she mentioned that in some courses, she mostly did assignments and hands-on experience instead of using books or other written materials.

In terms of her perception of English learning materials, Hilde answered that she is indifferent to the language of the learning materials, and that “the language, it depends on the course, and also what books are available for specific courses.” Hilde’s point of view corresponds highly with Aksel and Erlend’s, who also shared a neutral view. Hilde gave some examples of some terminologies from physiology that she found to be difficult, such as thyroid gland/*skjoldbruskkjertelen*, nodes of Ranvier/*Ranvierske innsnøringer*, pancreas/*bukspyttkjertel*. She also enclosed some words in chemistry that “almost cannot be recognized”, such as sodium/*natrium*, potassium/*kalium*, and solute/*oppløste stoffer*. As she suggested in excerpt 44 below:

“So when I heard the word in Norwegian and then when I read it in the English book, sometimes I don't recognize it. For example, when we were working with the hormonal systems. I had to look up the word for thyroid gland, which in Norwegian would be *skjoldbruskkjertelen*. **That's quite different, I don't know why. And so I had to take a look at that, because I have heard the wording in Norwegian, but I didn't recognize it when I read it in English.**”

Excerpt 44. Example of a terminology in Physiology

Apparently this matter became a greater concern during the exam period for Hilde, who stated that “it is hard to write a good answer in Norwegian when you are used to having your curriculum and science words in English”. Further, Hilde described the similarities and differences between learning materials in English and Norwegian. She believed that both learning materials have their advantages and disadvantages, according to the subject that they take. Hilde described this in excerpt 45:

“I think that they are similar, it's mostly the same way. At least the books on chemistry were really similar. Except one was in Norwegian and the other one is in English. **They are similar in the way they were set up, from the things that they went through. All of themes in the books were pretty much the same.** Yeah, these books are pretty similar in that way, and I think the Norwegian one was written a bit simpler. **It depends on the topic, I think. Sometimes the English one would be better, and sometimes the Norwegian one is better, I guess I can use both.** Also, the words are also similar in chemistry, the Norwegian words are directly translated from English. I could just look up everything in both books and **read it from two different perspectives, or different ways to phrase it.**”

Excerpt 45. Similarities and differences in learning materials

4.2 Answering the Research Questions

The first research question focuses on Norwegian STEM students' perceptions of English learning materials. From the semi-structured interviews, it can be seen that the majority of Norwegian STEM students seem to prefer English over Norwegian learning materials, while the rest of students are divided in their perceptions. From a positive inclination, Erlend demonstrated his preference of English learning materials by emphasizing on the universality of English and his tendency of using English in his study program. Erlend explained that *“I use English all the time when I write my code, and so if someone suddenly starts explaining things in Norwegian, it would be a bit more difficult to understand”*. However, Astrid contradicted Erlend, as she demonstrated a rather negative inclination to English learning materials. Astrid was in favour of Norwegian learning materials. Astrid mentioned that *“I still wish that we had books in Norwegian”*. From a rather neutral perception of English learning materials, Hilde contributed in balancing the overall perceptions. Hilde clarified that *“It depends on the topic, I think. Sometimes the English one would be better, and sometimes the Norwegian one is better, I guess I can use both... I could read it from two different perspectives, or different ways to phrase it”*.

The second research question revolves around the organization of English learning materials in undergraduate STEM courses at UiO. Based on the semi-structured interviews, it appears that English learning materials are organized differently in five different STEM undergraduate programs. There were some overlapping courses between the study programs, and all participants had English learning materials in varying degrees and forms (i.e books, lecture notes, videos, podcasts, online resources). One particular subject that many students brought up during the interviews is the issue of language mismatch between the language of the learning materials (English) with the language of the exam (Norwegian). For instance, Aksel and Elin voiced this clearly in their responses. When talking about a course in his study program, Aksel reported that he experienced language confusion when a compulsory book was changed from Norwegian to English. Aksel articulated that “... *if you’re trying to learn a whole new language, then you also relate to a new information and abstract concepts in many ways*”. Similarly, Elin also talked about the same issue, namely language mismatch that lead to language confusion. Elin expressed that “*There’s language crash when the book is in English, and then everything else is in Norwegian. So yeah, I really like language consistency and prefer to have that kind of language stability.*”

The third research question relates to the similarities, differences, and factors affecting students’ perceptions of English learning materials. There are several influential factors which could affect how students perceive English learning materials in undergraduate STEM programs. Future career relevance, experience abroad, and L2 mastery could play significant roles in shaping students’ perceptions of English learning materials. Based from the interviews, it appears that the majority of students have had experience abroad and exposure to English from elementary to upper secondary school. Most students also voiced their ambition to pursue master’s degrees upon graduation, which explains why their motivation to become competent in Academic English at university level. Some students voiced their future work in their respective disciplines, which would also explain why they would need to improve their English skills.

4.3 Summary of Findings

In conclusion, one primary issue that arose from the interviews is that having different terminologies in English learning materials could create language confusion and terminology disconnection. Most of the students reported that they had to use extra time to look up and understand unfamiliar terminologies in both English and Norwegian learning materials. It is rather common for students to benefit from other learning sources, which are often available in English rather than Norwegian. Some students linked English learning materials with affirmative words. Oscar, Erlend, and Maja associated English learning materials with “natural”, “better vocabulary”, and “richer”. Nora, Erlend, and Maja also explained that looking for deeper explanation of a concept or a terminology is more accessible in English. Yet, some of the students were still in the transitioning process, either from a Norwegian to an English learning environment, or from an English to Norwegian learning environment.

From looking at the findings, a stability in the practice of parallelingualism is necessary. Aksel, Trond, and Oscar believed that language consistency is beneficial in order to gain knowledge from the materials. Moreover, most students recognized that more research is done in English, and that they had to cope with it. Oscar also mentioned the issue of terminology shift, where a term in one language could be different in another. It is also evident from the interviews that most of the students perceived that they were not prepared for Academic English for higher education, apart from those who attended international high school which employed English as the language of instruction. Some participants asserted that their general English proficiency is adequate, but they needed more assistance in Academic English. Elin, Astrid, and Hilde encountered difficulties in navigating between the language of the learning materials (English) and the language of the exam (Norwegian).

From examining the findings, it appeared that the L1 of the teaching staff also played a significant role for the students in understanding their learning materials. Aksel, Trond, Nora, Oscar, and Erlend conveyed that their lecturers' L1 and pronunciation is crucial to material comprehension, especially in the STEM subjects where clarity is required. Conclusively, 50% of the participants had a positive view of English learning materials, and 30% had a neutral view. Only 20% had an inclination for Norwegian learning materials. Figure 9 below visualizes the findings of this study.

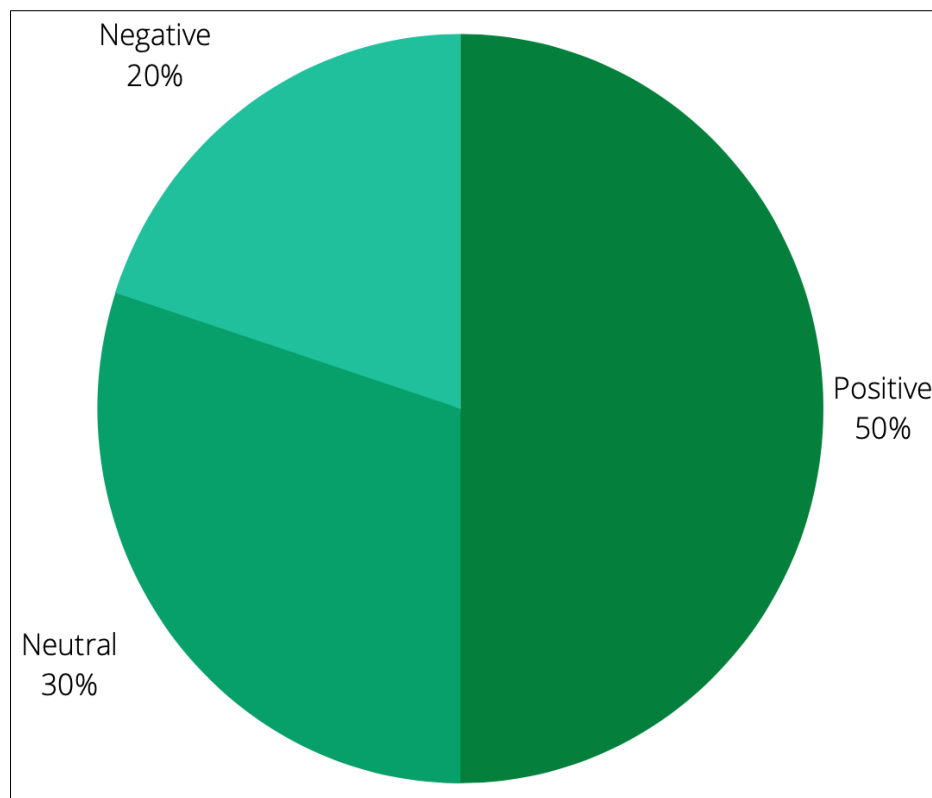


Figure 9. Norwegian STEM Undergraduates' Perceptions of English Learning Materials

5 Discussion

This chapter will discuss the findings of this study and bring the preceding chapters together. The literature review from chapter 2, as well as the results from chapter 4 will be revisited in order to answer the research questions that this thesis asked regarding how do Norwegian STEM students perceive English learning materials. Questions about the similarities, differences, and factors affecting students' perceptions were also posed to find out about their language choices and perceptions of learning materials. The following sections are found below: Perceptions of English Learning Materials (5.1), Organization of English Learning Materials in STEM Courses (5.2), and Factors Affecting Students' Perceptions (5.3).

5.1 Perceptions of English Learning Materials

The global status of English, parallelingualism and internationalization were discussed to provide an overview of the role of language in Norwegian higher education. A better awareness and understanding of English as a lingua franca might help bridge the gap between General English and Academic English, as world Englishes are not in the hands of native speakers (Galloway & Rose, 2015; Rindal, 2014). Even though the global status of English would not account for why some students perceived English learning materials as challenging, it is admittedly the cause of the role that English has in higher education. Most students perceive English to be highly relevant to their future career due to several reasons (i.e accessibility and international research collaboration, to name a few). This corroborates HEIs' aspiration to accommodate the international learning community by incorporating international perspectives through English learning materials (Søvik & Tungesvik, 2019, p.14; Belhiah & Elhami, 2014).

Based on the findings presented, the present study cannot conclude whether Norwegian STEM undergraduates indicate notable disinclination towards English learning materials. Nevertheless, this study can bring forth indicators of where students situate themselves with regards to these approaches. A limitation of this study is the learning materials from the undergraduate courses. As different programs have different coverage approaches to English and Norwegian learning materials, some courses were left out from the study. It is more likely that upper-secondary school could affect students' English proficiency, as seen from the findings. Some students had more exposure to English than others, which entails more aversion to English learning materials. In comparing the perceptions of English learning materials, there is substantial variation, as half of the participants are inclined toward English learning materials, other students are indifferent to the language of the materials, and some are inclined toward Norwegian learning materials. Since all participants are in the age range of 20-28, they can be considered relatively young and possibly do not bother themselves with the issue at hand, unlike the elderly (Jensen & Thørgersen, 2011). In other words, the students seem to possess ownership of the language as a result of them growing up with the language through popular culture and exposure to English-intensive environments, such as international upper secondary schools or workplaces.

5.2 Organization of English Learning Materials in STEM Courses

The first encounter with an advanced text in a higher education setting could be experienced as challenging and grueling to some. In this study, the extent of EMI measured is within a series of courses on how much English is organized in the learning materials in selected STEM programs within Electronics, Mathematics, Physics, Informatics and Life Sciences. Therefore, one suggestion could be the creation of optional introductory courses in both Academic English and *akademisk norsk* to ensure

comprehensible input from the learning materials and to link learning with future work relevance. Some collaboration schemes with relevant instances, such as Innovation Norway, and incentive schemes for HEIs to concretize language work related to the technical terminology, development of teaching resources, journal, encyclopedia, and articles in Norwegian could also be relevant, considering that many of the long-term priorities in the plan for Norwegian research and higher education are focused at strengthening research efforts in STEM (DIKU, 2020). Another recommendation is to initiate an excellence program for exceptional teaching. Since STEM students are highly sought-after for future value creation and welfare levels in Norway (DIKU, 2020), it is important to consider solid language measures with concrete results that would boost STEM students' learning and benefit the welfare of the society at large.

Another aspect in the organization of learning materials is the preservation and protection of Norwegian language. Findings suggest that some students show an inclination for Norwegian learning materials as domain learning in the local language is pertinent to future jobs in Norway. This is perhaps not surprising, as most of the students intend to further develop their skills by continuing to master's degrees upon graduation. The increasingly dominant position that English has acquired in higher education and research might jeopardize Norwegian, as suggested by the Language Council (Språkrådet, 2007). In the light of a recent paper on language use in Norwegian HEIs (St.meld nr. 7, 2020-2021), the university could have raised more awareness of Norwegian as a socially relevant language, and emphasized their responsibility to contribute to this matter. Furthermore, the fact that individual faculties and disciplines have varying degrees of learning materials and a diverse extent of language in learning materials indicates that despite the university's endeavour with the strategy documents and guidelines on learning materials, the institution can provide greater awareness and better anchoring with clearer action plans and concrete measures to reflect how internationalization has seeped into curricula and learning materials.

5.3 Factors Affecting Students' Perceptions

The participants also voiced several difficulties in material comprehension with regards to the parallel language structure that the institution follows. Language mismatch between the language of instruction and the exam language is one of the barriers found in EMI implementation in five STEM undergraduate programs. Students' obstacles can be broken down into several parts, namely difficulties encountered in following the lectures, taking notes from Academic English, understanding lecturers' pronunciation, and understanding new terminologies caused by lack of vocabulary. That said, teachers' language proficiency also plays a significant role in EMI implementation, as reported by several participants. Three items were described by the participants: lower quality and depth of academic materials, teachers' inability to explain a concept/terminology, and the gap between teachers' actual English proficiency and the English proficiency needed to teach STEM subjects at the higher education level. This complements DIKU's finding in their latest working note, which implies that both language and pedagogical training for academic staff and the inclusion of specific goals and outcomes related to language skills in the study programs are crucial.

When it comes to discipline-specific terminologies, the findings reveal that the participants' preference for clear and consistent language is evident in regards to STEM learning materials. Indicatively, stability in the learning materials are highly regarded by most students, as they encountered differences in vocabulary, translation, and discipline-specific terminologies. Another reason might be the language mismatch between the language of the learning materials and the exam language, which would create a gap in understanding the materials. Based on this finding, the parallelingualism policy might be reviewed accordingly to accomplish the intended learning goals. As English technical terminologies are more commonly used in STEM fields, one needs to question the right balance of English and Norwegian coverage in learning materials, and whether it is beneficial to use Norwegian terminologies in two different written forms (i.e. *bokmål* and *nynorsk*).

6 Conclusion

This final chapter concludes the thesis with a brief summary of the study, where the three research questions are revisited and discussed based on the findings from the data analysis. Afterwards, this chapter reflects on the limitations and possible contributions of this study, along with suggestions for future research. The main objective of this study was to explore Norwegian STEM students' perceptions of English learning materials, and the similarities, differences, and other factors that influence their perceptions. Upon an extensive review of literature on related themes, an analytical framework was developed by drawing on disciplinary differences and language experiences as essential factors which determine students' perceptions of English learning materials. Ten semi-structured interviews were carried out, guided by the three research questions, the analytical framework, and the interview guide. The findings of this study revealed both similarities and differences between learning materials in English and Norwegian, as well as some notable aspects about language use in Norwegian higher education and STEM undergraduates' perceptions. The following sections are found below: Addressing the Research Questions (6.1) and Limitations and Suggestions (6.2).

6.1 Addressing the Research Questions

The first research question relates to Norwegian STEM students' perceptions of English learning materials. It is evident from the semi-structured interviews that Norwegian STEM students seem to prefer English over Norwegian learning materials. It appears that the students also found the learning materials to be demanding in both languages. Moreover, students reported that they perceive technical terminologies in Norwegian to be more difficult than the English ones, as some terminologies are structured in an unfamiliar way. This could be linked with students' Academic English skills, particularly vocabulary and reading, as well as lecturers' English proficiency. All students mentioned

that they spent more time when they encountered an English text and relied on the use of other learning aids from the internet. As most learning aids are available in English, students emphasized the accessibility and affordability traits of these additional resources. Thus, language training for students and lecturers, as well as pedagogical training for academic staff could improve the teaching and learning processes.

The second research question focuses on the organization of English learning materials in undergraduate STEM courses at UiO. In this case, all participants had English learning materials in most of their courses to varying degrees and forms. One interesting observation is the language mismatch between the language of the learning materials (English) with the language of the exam (Norwegian). Although the majority of students mentioned that they experienced language confusion in navigating courses and exams, it appeared that some were not bothered by this issue. Furthermore, guidelines from UiO, the Language Council and UHR were employed as a frame of reference in determining the ways in which English learning materials are organized in STEM programs. It is observable from the findings that the institution can provide a clearer action plan and concrete measures to reflect on how internationalization is realized through the learning materials in STEM programs.

The third research question revolves around the similarities, differences, and factors affecting students' perceptions of English learning materials. There are several determining factors which could influence how the students perceive English learning materials in their study programs. Future career relevance, experience abroad, and L2 mastery have significant roles in shaping students' perceptions of English learning materials. Most students seemed to favour English due to its advantage as a universality and utility in securing jobs after graduation. There is a need to question the right balance of English and Norwegian in learning materials, and whether it is beneficial to use Norwegian terminologies in two different written forms (i.e. *bokmål* and *nynorsk*), besides English technical terminologies that are more common in STEM fields, and the consequences that HEIs, faculties, lecturers, and students will bear.

6.2 Limitations and Suggestions

This study started out as a curiosity to explore students' perceptions of language use in higher education. In line with the findings of Arnsby (2013), this study revealed notable differences between EMI implementation and students' Academic English in STEM fields. Furthermore, this study shed light on some aspects of the relationship between internationalization and language use in higher education in the context of Norwegian higher education. However, there are several limitations in this study. First, the scope of this study represents only a relatively isolated discipline (STEM), and therefore limits the possibility of deeper interpretation in terms of how language policies influence students' perceptions. Future studies could consider conducting a longitudinal analysis that includes observation, survey, questionnaire, or focus group discussions in order to study students' learning and development over time and link it to developments in language policies pertaining higher education in the same period.

Second, the use of semi-structured interviews alone, despite their centrality in qualitative research, does not allow for the interpretation of any correlation between students' perceptions of English learning materials and students' actual language proficiency. Thus, a larger sample would allow generalization, provide stronger indications, and a better understanding of the relationship between IELTS scores, subject scores, and students' learning. Third, future research could also look into the perspectives from various layers of stakeholders in higher education, such as lecturers, faculty members, DIKU, UHR, the Language Council, and investigate how they approach the realities of parallelingualism in Norwegian higher education context. Additionally, studies with a focus on linguistic themes, such as lexical borrowing, code-switching, and/or discourse analysis could also be considered to explore language interaction and blended learning interaction in higher education.

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Appendices

Appendix A: NSD Approval Letter

Meldeskjema for behandling av personopplysninger

05/02/2021, 10:26



NSD's assessment

Project title

Norwegian Undergraduates' Perceptions of English Curricular Literature

Reference number

828778

Registered

19.01.2021 av Adryani Gloriana Landum - adryanil@uio.no

Data controller (institution responsible for the project)

Universitetet i Oslo / Det utdanningsvitenskapelige fakultet / Institutt for pedagogikk

Project leader (academic employee/supervisor or PhD candidate)

Joshua Lawrence, joshua.lawrence@iped.uio.no, tlf: +4722858153

Type of project

Student project, Master's thesis

Contact information, student

Adryani Gloriana Landum, adryanil@student.uv.uio.no, tlf: 48674724

Project period

16.10.2020 - 31.07.2021

Status

05.02.2021 - Assessed

Assessment (1)

05.02.2021 - Assessed

Our assessment is that the processing of personal data in this project will comply with data protection legislation, so long as it is carried out in accordance with what is documented in the Notification Form and attachments, dated 05.02.21, as well as in correspondence with NSD. Everything is in place for the

processing to begin.

SHARE THE PROJECT WITH THE PROJECT LEADER

For students it is mandatory to share the Notification form with the project leader (your supervisor). You can do this by clicking on "Share project" in the upper left corner of the Notification form.

NOTIFY CHANGES

If you intend to make changes to the processing of personal data in this project it may be necessary to notify NSD. This is done by updating the information registered in the Notification Form. On our website we explain which changes must be notified. Wait until you receive an answer from us before you carry out the changes.

TYPE OF DATA AND DURATION

The project will be processing general categories of personal data until 31.07.21.

LEGAL BASIS

The project will gain consent from data subjects to process their personal data. We find that consent will meet the necessary requirements under art. 4 (11) and 7, in that it will be a freely given, specific, informed and unambiguous statement or action, which will be documented and can be withdrawn. The legal basis for processing general categories of personal data is therefore consent given by the data subject, cf. the General Data Protection Regulation art. 6.1 a).

PRINCIPLES RELATING TO PROCESSING PERSONAL DATA

NSD finds that the planned processing of personal data will be in accordance with the principles under the General Data Protection Regulation regarding:

- lawfulness, fairness and transparency (art. 5.1 a), in that data subjects will receive sufficient information about the processing and will give their consent
- purpose limitation (art. 5.1 b), in that personal data will be collected for specified, explicit and legitimate purposes, and will not be processed for new, incompatible purposes
- data minimisation (art. 5.1 c), in that only personal data which are adequate, relevant and necessary for the purpose of the project will be processed
- storage limitation (art. 5.1 e), in that personal data will not be stored for longer than is necessary to fulfil the project's purpose

THE RIGHTS OF DATA SUBJECTS

NSD finds that the information that will be given to data subjects about the processing of their personal data will meet the legal requirements for form and content, cf. art. 12.1 and art. 13.

Data subjects will have the following rights in this project: access (art. 15), rectification (art. 16), erasure (art. 17), restriction of processing (art. 18), data portability (art. 20). These rights apply so long as the data subject can be identified in the collected data. We remind you that if a data subject contacts you about their rights, the data controller has a duty to reply within a month.

FOLLOW YOUR INSTITUTION'S GUIDELINES

NSD presupposes that the project will meet the requirements of accuracy (art. 5.1 d), integrity and confidentiality (art. 5.1 f) and security (art. 32) when processing personal data.

To ensure that these requirements are met you must follow your institution's internal guidelines and/or consult with your institution (i.e. the institution responsible for the project).

FOLLOW-UP OF THE PROJECT

NSD will follow up the progress of the project at the planned end date in order to determine whether the processing of personal data has been concluded.

Good luck with the project!

Data Protection Services for Research: +47 55 58 21 17 (press 1)

Appendix B: Information Letter and Consent Form

Are you interested in taking part in the following research project?

Students' Perceptions of English Learning Materials

A case study among STEM undergraduates at the University of Oslo

This is an inquiry about participation in a research project in which the main purpose is to find out how Norwegian Science, Technology, Engineering and Mathematics undergraduates view the use of English in their learning materials. In this letter, I will give you information about the purpose of the project and what your participation will involve.

Purpose of the project

My master's thesis, which will be completed at the University of Oslo (UiO), will look into how Norwegian students in STEM majors perceive English in their learning materials in detail. The sample will be ten Norwegian undergraduates who are enrolled in 3-year bachelor STEM programs and studying at the Faculty of Mathematics and Natural Sciences, UiO. The samples will engage in semi-structured interviews. Information collected will be valuable for understanding how English is perceived in Norwegian higher education. The interview will be conducted in English.

Who is responsible for the research project?

The University of Oslo is the institution responsible for the project.

Why are you being asked to participate?

You are being asked to participate because you are enrolled in STEM bachelor programs at the University of Oslo. This study seeks information about STEM students' perceptions of English in learning materials.

What does participation involve for you?

If you choose to take part in this project, you will participate in an individual interview. It will take approximately 30-60 minutes. The interview will include open-ended questions which would allow you to describe your perceptions of English learning materials. The questions will be related to your experience and educational background. The interview will be recorded using digital recording tool and later transcribed for research purposes.

Participation is voluntary

Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data

I will only use your personal data for the purposes specified in this information letter. I will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

- You can choose whether to participate anonymously, or to give your name as a contributor to the research. If you want to be anonymous, your name will not be given on the recordings and in any reports from the project. If you want your name to be given as a contributor to the research, the recordings in the archive will say who the person speaking is.
- In addition to the researcher, the supervisor, Prof. Joshua Lawrence (Department of Education, UiO) will also have access to the data gathered in this research project.
- The interview will be recorded using the audio recording audio app. I will personally transcribe the interviews and replace your name with a code. The list of names and codes will be stored separately from the rest of data. Information will be stored on UiO's protected server and deleted upon the end of the study. No personal information will be published and participants will not be recognized in the thesis.

What will happen to your personal data at the end of the research project?

The project is scheduled to end in July 2021. The personal data including recordings will be deleted at the end of the project.

Your rights

So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?

I will process your personal data based on your consent. Based on an agreement with the University of Oslo, NSD – The Norwegian Centre for Research Data has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can I find out more?

If you have questions about the project, or want to exercise your rights, contact:

- University of Oslo via Adryani Landum (email: adryanil@student.uv.uio.no, +47 48674724), Prof. Joshua Lawrence (joshua.lawrence@iped.uio.no, tlf: +47 22858153)
- Our Data Protection Officer: Roger Markgraf-Bye (email: personvernombud@uio.no)
- NSD – The Norwegian Centre for Research Data AS, by email: (personvertjenester@nsd.no, +47 55582117)

Yours sincerely,

Adryani Landum/Prof. Joshua Lawrence

Consent form

I have received and understood information about the project *Students' Perceptions of English Learning Materials: A case study among Science, Technology, Engineering and Mathematics (STEM) undergraduates at the University of Oslo* and have been given the opportunity to ask questions.

I give consent:

- to participate in an interview
- for information about me/myself to be published in a way that I cannot be recognized

I give consent for my personal data to be processed until the end date of the project, approximately until July 2021.

(Participant's name, signature and date)

Appendix C: Interview Guide

Outline

The purpose of this interview is to hear from you about your experience as a Norwegian bachelor student studying Science, Technology, Engineering and Mathematics (STEM) programs at the University of Oslo. The main goal of this research is to explore students' perceptions of English learning materials. This interview will be recorded and transcribed for research purposes. The interview takes place on Zoom and will take about 30-60 minutes.

Part A. Warm-up

1. Can you tell me a little bit about yourself? (batch year, study program)
2. How would you describe your English knowledge?
 - How was your English experience from school?
 - In your private life, how often do you interact with others using English?
 - Do you have any experience being abroad (study, volunteer, trips)?
3. Can you tell me about your studying experience in your study program?
 - Why did you choose to study this program?
 - What subject areas have you been studying so far?

Part B. The use of English learning materials in a specific course

4. What comes to your mind when you think of English learning materials?
5. English learning materials are said to be important in higher education today.
How would you associate yourself with this statement?
 - In what ways do you think English learning materials are important? Why?
6. Let's take a look at one specific course in your program.
 - Which specific course do you want to focus on? (choose one course)
 - How are English learning materials used in that course? (scroll through course)
 - Can you give me some examples of how the learning materials look like?
 - Do you notice any differences between Norwegian and English learning materials? (Examples)

Part C. Students' perceptions of English learning materials

8. What do you think of English learning materials in course X?

9. How do you think the fact that the learning materials are written in English may influence your understanding of the content? (Examples)

-How has your understanding of English learning materials developed during these semesters?

10. Can you describe similarities and differences of having your learning materials in English and Norwegian? (Examples)

-Can you share any specific moment or experience related to this?

11. Do you often reflect what you have learnt or experienced from the materials?

- What do you plan to do with English learning materials in the future?

12. What types of support do you get from your department/faculty to help you with English learning materials?

13. Do you have any suggestion on how the university and teaching staff could help students to improve their understanding of English learning materials?

Part D. Wrap-up

13. Is there anything you may be forgetting during our discussion or would you like to add something?

Appendix D: Codes and Sub-Codes

Research Questions	Codes and sub-codes
1. How do Norwegian STEM students perceive the use of English learning materials?	Language Experience
	Perceptions of Learning Materials in NO and ENG (positive, negative, neutral)
	Examples of NO and ENG terms
	Difficulties (in pronunciation, reading and vocabulary)
	Students' Reflection (easeness of use, future career relevance)
	Suggestion for HEIs
2. How are English learning materials organized in STEM courses at UiO?	Parallelingualism
	Provision of Support
	Other learning materials
3. What are the similarities, differences and factors affecting students' perceptions?	Abroad Experience
	Attitudes towards ENG
	L2 Mastery
	Disciplinary Differences
	Similarities between LM in NO and ENG
	Differences between LM in NO and ENG

Appendix E: Cluster Analysis

