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MASTER THESIS

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Universal Design of ICT

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Implementing Universal Design (UD) of learning materials among teachers in higher education

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OSLOMET

Preface

The accessibility and the universal design of ICT solutions have always been an interesting area of study for me since I started my bachelor's degree in information technology. Therefore, I decided to explore this area of study in a more systemic and academic prospective and took admission in a two-year master study program in universal design of ICT at OsloMet University.

The main target group for this master thesis that is of total 60 credits is teachers in higher education institutions in Norway. The aim to dig deeper into implementation of the universal design of learning materials among teachers in higher education institutions. The study involved different factors that have been under consideration during the period of this master thesis especially the issues that teachers face while practicing the universal design of ICT in their daily teaching activities. Furthermore, investigate different types of help that teachers need in order to make it easy for them to practice universal design of ICT.

The efforts regarding making this paper accessible for all types of user have been considered and adopted, such as the screen reader users.

First, I want to thank my supervisor from OsloMet University for her extraordinary supervision and support during the active period of this study. Especial thanks to her for interesting and productive advice and discussions regarding this study. I would like to also thanks to OsloMet that offers this master’s degree in universal design of ICT.

Many thanks to the participants that participated in the data collection for this study. Without them, it would not be possible to complete this study. I pay great attention to their contribution and participation which is the building block for this thesis.

Finally, I would like to thank my parents, friends, and family members who supported me in the stressful time especially in this pandemic situation of COVID-19. Finally, I would like to dedicate this master thesis to my late father Arif Hussain.

Adil Hussain

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Abstract

The universal design (UD) of information and communication technology (ICT) is an important principle that ensures the accessibility of ICT products, services, solutions, and anti-discrimination to provide equal access to the largest group of people possible. The digital learning materials in higher education institutions are also one of the types of ICT solutions, therefore, required to be universally designed by the different national and international regulations. However, until recently, the implantation of UD of ICT in higher education institutions is lacking.

This study aimed to extend the previous studies relevant to the universal design of learning materials, investigate the challenges that inhibit the teachers to practice UD in higher education institutions, and the role of these institutions in implementing the universal design of ICT. Through the use of individual interviews, online surveys, and observation as data collection methods and thematic analysis, this research briefly addressed multiple challenges that teachers face in practicing UD, the help teachers need from higher education institutions, and the role of these institutions in implementing UD of ICT. This will hopefully help the teachers in higher education institutions to practice the UD of ICT in making digital learning materials and the higher education institutions to implement the UD of ICT.

Keywords:

Implementation, universal design, accessibility, digital learning materials, higher education.

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List of Acronyms

AT	Assistive Technology
EAA	European Accessibility Act
EU	Europe
ICT	Information and Communication Technology
LMS	Learning Management System
NCSU	North Carolina State University
NSD	Norwegian Social Science Data Services
SDG	Sustainable Development Goals
TA	Thematic Analysis
U.S.	United States of America
UD	Universal Design
UDL	Universal Design for Learning
UN	United Nations
CRPD	Convention on the Rights of Persons with Disabilities
WAD	EU Web Accessibility Directive
WCAG	Web Content Accessibility Guideline
WHO	World Health Organisation

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1 Introduction

Equal access to education and training for all are prioritized goals in many parts of the world, including Norway, the EU, and the US. The importance of equal access to quality education is reflected in the UN Sustainable Development Goal no. 4. It is also reflected in legislation and strategies in many parts of the world, for example in the regulation connected to Section 18 in the Norwegian Equality and Anti-Discrimination Act ("Lov om likestilling og forbud mot diskriminering (The Norwegian Equality and Anti-Discrimination Act)," 2018), in the EU Disability Strategy 2010-2020 ("Europe 2020 strategy," 2018), and the US Higher Education Opportunity Act of 2008 ("Higher Education Opportunity Act," 2008) has included a set of guidelines for Universal Design for Learning (UDL).

De Marsico, Kimani, Mirabella, Norman, and Catarci (2006) mentioned that the proper use of technologies provides a unique platform for users with disabilities to access the information and participate equally which is easy for non-disabled users. Most of the considerations are given to the preparation and deployment of learning materials according to accessibility guidelines, but a few or no consideration is given to the students in the learning experience, for example, the students with disabilities and the teachers who prepare and develop the digital learning material.

The above-cited authors De Marsico et al. (2006) argue that the student with disabilities is a great source of direction on the most proficient method to address accessibility issues in the improvement and utilization of digital learning material and university policies & infrastructure. They provide the realization of individual information about their inabilities and insight knowledge into what has and has not worked for them in past learning environments. Then again, teachers/instructors are a specialist particularly on the decision of contents for the learning material or course contents. They likewise bring experiential information of what has or has not worked in their past educating of various courses and diverse population of students both including disabilities and no disabilities. Besides, it would be also helpful to include teachers/instructors with disabilities themselves. Hence, the teachers and universities should consider the students with disabilities as a great resource for their own improvement instead of their exclusion by ignoring the implementation of universal design (UD) while developing learning materials in higher education.

The authors De Marsico et al. (2006) also mentioned that of course every teacher has been a student and has a personal experience for choosing the right contents and strategies which making the digital learning materials. Though, the experience difference of a student with a disability and no disability is different. But only depending on this is not enough for the teacher to develop “good” accessible learning materials. To develop an adequate service or product, it is important to have a deep understanding of the needs of the target users. Deep understating of users’ needs is the basic building block of a successful design process. Therefore, the need arises to effectively include the disabilities in the preparation of digital learning materials so as to adequately address likewise accessibility issues. This will likewise give a controlled guideline for digital material accessibility for the teachers, so they can pick up from their instructive experience the most ideal approach to handle accessibility issues. Such a guide will help recognize the substance that influences dedicated accessibility and pick the correct design strategies which will be most appropriate to students with different kinds of disabilities.

The authors De Marsico et al. (2006), concluded that accessibility of digital learning material and the environment will have to expand significance later in the future as the population of students with disabilities toward education will increase because of countrywide implementation of UD legislation. As education will open new chances and interests for the individuals with disabilities both in personal and work life. It is improbable that future human resource (HR) will almost certainly fulfil the needs for preparing an instruction without digital learning materials improvements to the educational environment.

1.1 Problem statement

As it will be elaborated in the literature review the reason to ensure the motivation of making digital learning material accessible is that it is a right thing to do because of current laws and regulations related to it and required to provide equal opportune to all students especially with special needs for accessing learning resources. On the other hand, after the implementation of laws and regulations making digital learning materials is important now. The problem has two parts, the first part is related to teachers/faculty members in a higher education institution and the second part is related to the higher education institutions itself. Many efforts have been done before that for supporting accessibility of digital learning materials and guidelines were

purposed to address the learning barriers, issues, challenges related to making digital learning material accessible. However, little consideration has been given to the experts who are directly related to these learning resources that is, teachers/faculty member in higher education institutions. None the less, the guidelines provided by UD and Universal Design for Learning (UDL) does not ensure students learning needs are met, and the effectiveness of learning provide by the higher education institutions.

The part of the difficulty is not only related to teachers but also with the higher education institutions in Norway to fulfil the requirement of Anti-Discrimination Law 2018. After new law related to UD in Norway, according to Section 41 in the Norwegian Equality and Anti-Discrimination Act (2018), it is compulsory that existing information and communication technologies (ICT) solutions shall be UD as of 1st January 2021 ("Lov om likestilling og forbud mot diskriminering (likestillings- og diskrimineringsloven)," 2018). According to Section 27 Content of teaching aids and teaching, “Teaching aids and teaching provided by day-care facilities, schools and other educational institutions that provide training authorized by law shall reflect the purpose of this Act.”. This section required that all the resources, activities, training, and other facilities related to teaching should be universally designed. These facilities also including digital learning materials which are related to both of Section 27 and Section 41. However, the higher education institutions are slow and confused about how to implement these laws in their institution. A lot of teachers do not know about the UD and the teachers interested to know more about UD. So, it seems that the implementation of UD policy by the universities is lacking by the proper training of teachers and the attitude of teachers.

The literature review will show the need of implementation of UD for digital learning materials in higher education which is likely made possible by training and educating the higher education faculty about UD and on the other hand of course universities also required to contribute to this matter, is important. This master thesis will focus on the implementation of UD of digital learning materials which previously not have done. This master thesis will focus on what knowledge and practices teachers in higher education have when it comes to making the learning materials in their courses universally designed. This will be done with a qualitative approach. This may contribute towards making sure the implementation of UD of digital learning materials

in higher education institutions in Norway. It will hopefully improve the development of accessible digital learning materials so that all the students have the equal opportunity to participate in the same learning environment.

Teachers are positive towards the implementation of UD but there is a need to teach and train them about the UD while making the digital learning materials (Chen, Sanderson, & Kessel, 2018). So along with helping the teacher for implementation of UD of digital learning materials, this master thesis will also figure out the challenges related to the implementation of UD of digital learning materials in higher education institutions. These two parts of the problem that is, teachers/faculty member and higher education institutions are the issues and challenges which will be under consideration for this master thesis. This will hopefully contribute to benefits students, teachers, and higher education institutions that is, all students are having equal access to digital learning materials.

1.2 Research questions

The problem will be investigated through the following research questions:

- What kind of digital learning materials do the teachers in higher education institutions usually create?
- What are the issues related to digital learning materials teachers created or are using?
- What are the issues that teachers face while practicing universal design for learning materials in higher education?
- What would help the teachers to make it easy to practice universal design for digital learning materials in higher education?
- What do higher education institutions need to do to ensure that teachers are practicing universal design when preparing/creating digital learning materials?

This master thesis is planned to answer these above-mentioned research questions using the qualitative approach that is interviews, surveys, and observations.

1.3 Map of the Thesis report

This thesis report is consisting of six sections. Section 1 presented the identified background of this thesis including the problem statement, goals, and research questions. Section 2 presents the literature review that is the relevant research work

and the relationships between them. Section 3 presents the methods for data collection, why these methods selected in this context, and how the researcher used these methods in order to collect the right data relevant to answer the research questions of this thesis. Furthermore, this section also includes the ethical consideration related to these methods and data analysis method. Section 4 presents the results based on the data collection and analysis and the limitations related to the selection method. Section 5 presents the discussion on the findings and critical thinking in relation to the results with reference to theoretical arguments in the literature review. Section 6 presents concluding remarks and provides answers to the research questions, furthermore, it also presents useful areas for further research.

The list of references and appendices can be found in the last two sections of this thesis.

2 Literature Review

Design of products and environments include a variety of process and aspects, such as architecture, engineering, safety issues, standards, cost, users, and environmental issues. Mostly the “average” user is considered while designing any product or environment. On the contrary, “universal design” is different than traditional designing, according to the UD definition by The Centre of Universal Design at North Carolina State University, UD is “the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.” (Connell et al., 1997).

2.1 The concept of Universal design and Accessibility

The term universal design (UD) was first used by Ronald Mace in the 1970s, he is the founder of the Centre for Universal Design at North Carolina State University (NCSU). He was an architect and a wheelchair user proposed an idea of designed an environment proactively which allow the diverse group of people to get easy and equal access (Rice, 1996).

Hitchcock and Stahl (2003) argue that several research and efforts have been made to apply the seven UD principles to learning environments. However, they essentially are not a perfect match to requirement of learning environments. Like educational courses and curriculum that were planned without thought for the necessities of people in the light of disabilities, the main UD principles fitting for design and conceivably for PC equipment, programming, media, and specialized gadgets don't by and large function admirably when connected to learning. They were not created considering learning. It appears to be very likely that the essential UD standards should be reached out to apply to arts, expressions of the human experience, education, chose innovations, communication, and that is only the tip of the iceberg, UDL is one such exertion.

2.2 The diversity of students and disabilities

UDL provided teachers with a set of principles to accommodate the diversity of students. The "National Center on Universal Design for Learning" 2018) defined UDL, “a blueprint for creating instructional goals, methods, materials, and assessments that work for everyone—not a single, one-size-fits-all solution but rather flexible

approaches that can be customized and adjusted for individual needs". Hitchcock and Stahl (2003) stated that UDL expands the idea of traditional UD to the educational field. It indicates the way toward making the general educational module (counting the guidelines, materials, techniques, and appraisals of which they are contained) that are imagined, structured, created and approved to accomplish results for the vastest range of students, incorporating those with disabilities, without the requirement for ensuing adjustment or specific plan. UDL gives curricular adaptability to give suitable help and challenge to a normally various range of students.

The UDL structure provides unique importance to diversity through a dedicated framework of a comprehensive educational environment and helps to reduce the learning barriers to educational success. At first, proposed as a method for incorporating students with disabilities in the general classrooms, it is currently better comprehended as a general-education activity that improves results for all students including students with disabilities. The motivation behind UDL execution is to make students get equal access to educational curriculum, and digital learning material—students who can evaluate their very own adapting needs, screen their own advancement, and control and support their advantage, exertion, and constancy amid a learning task. Numerous students learn inside conventional classrooms with customary educational programs (Ralabate, 2011).

2.3 Definition of Disability

There is no proper definition of disability which is universally accepted. Some specialized organizations such as the "United Nations Convention on the Rights of Persons with Disabilities" 2011) and the "World Health Organization" 2011) defined disability in a well-understood manner. UN CRPD defined disabilities as *"people with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others" ("United Nations Convention on the Rights of Persons with Disabilities," 2011).* Where impairment refers to the way a person behaves and interact affected mental or physical functioning. Whereas, disability is created by the barriers created by society, which affect the equally and fully participation of an individual in society. These barriers could be non-accessible buildings, resources provided to the student, for instance,

digital learning materials, negative attitudes by teachers and institutions, and non-flexible procedures.

2.4 Disabilities and barriers for students in higher education

World Health Organization (WHO) provided a very clear and interesting definition of disability that is *"Disabilities is an umbrella term, covering impairments, activity limitations, and participation restrictions. An impairment is a problem in body function or structure; an activity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in involvement in life situations. Disability is thus not just a health problem. It is a complex phenomenon, reflecting the interaction between features of a person's body and features of the society in which he or she lives. Overcoming the difficulties faced by people with disabilities requires interventions to remove environmental and social barriers"* ("World Health Organization," 2011). According to definition disabilities could be invisible, so it is not possible to say a person is disabled or not.

The Eurostat presented explained statistics on the individual with disabilities, which refer to The Europe 2020 strategy indicators on education: early leavers from education and training. According to which The Europe 2020 strategy calls for efforts to reduce the number of individuals aged 18-24 who leave education and training to less than 10 % by 2020 and at least 40% of the individuals aged 30-34 must complete their higher education by 2020 ("Europe 2020 strategy," 2018).

According to Eurostat individuals with disabilities are far from the objective of 40% in tertiary education completion, only 15% of people with disabilities attain higher education. The most interesting part is once these people enrolled in a higher education institution, it becomes more difficult for them to graduate. In Europe, only 24% of people aged 30-34 and have disabilities are graduated. Many young individuals with disabilities mostly leave the education earlier than the individual with no disabilities mentioned by the Eurostat (Hauschildt, Vogtle, & Gwosć, 2018).

Many barriers keep the students with disabilities from accessing and completing higher education. Mariaud (2018) mentioned the diverse barriers which created a gap between the students with disabilities and the completion of higher education:

- Inaccessible higher education institutions buildings.
- Inaccessible teaching (When teaching methodology does not include all the students, that is a wide variety of needs is not taking under consideration when making digital leering materials and lessons).
- Lack of training of teachers, academic staff, and other higher education staff members.
- Lack of understating of possible student disabilities by the teachers.
- Lack of accessible student activities including digital learning materials.

2.5 National and international regulations on UD of ICT

2.5.1 Norwegian national regulations on UD of ICT

2.5.1.1 Norwegian Act related to universities and university colleges 2005

According to Section 4-3(2) of the "Norwegian Act related to Universities and University Colleges " 2005), particularly Section 4-3(2) i) about ensuring “that the learning environment is designed according to the principles of universal design”.

2.5.1.2 Norwegian Regulations on Universal Design of ICT solutions 2013

As digital learning materials are part of ICT solutions. In addition to other ICT solutions, Section 2 of Norwegian Regulations on universal design of ICT solutions specifically stated that the regulations of UD of ICT apply to solutions in the education and training sector. The law also stated that the “digital learning materials” should be universally designed ("Regulations on universal design of ICT solutions," 2013).

Furthermore, Section 2 of Norwegian Regulations requires that electronic learning platforms and digital learning materials used in education in Norway must be universally designed.

2.5.1.3 Equality and Anti-Discrimination Act Norway 2018

According to Section 21. Right to individual accommodation of pupils and students of Equality and Anti-Discrimination Act Norway 2018, *“Pupils and students with disabilities who attend a school or educational institution have a right to suitable individual accommodation in respect of the place of learning, teaching, teaching aids and examinations, to ensure equal training and education opportunities.”.* This section refers to the learning materials, teachers' abilities to accommodate all students, learning environment, and assessment should be universally designed to

ensure the equal educational and training opportunities ("Lov om likestilling og forbud mot diskriminering (likestillings- og diskrimineringsloven)," 2018).

2.5.2 International standards on accessibility

2.5.2.1 European regulations on Accessibility

2.5.2.1.1 European Web Accessibility Directive (WAD)

European commission have also put extraordinary efforts in the improvement of the accessibility of products and services in Europe. The European Web Accessibility Directive (WAD)[1] is a directive on the accessibility of the websites and mobile applications of public sector bodies. The directive aimed to make sure that the web solutions including mobile application are accessibilities designed in the public sector of member states. Furthermore, the directive also includes the accessibility monitoring activities toward the ICT solutions in member states which include the electronic downloadable documents. The digital learning materials in higher education institutions are one of the forms of electronic documents which are part of European efforts on universal design and accessibility of ICT products and solutions.

2.5.2.1.2 European Accessibility Act (EAA)

European Accessibility Act (EAA)[2], the Act is a Directive, that set minimum accessibility requirements in the member states around the EU for a wide range of ICT products and services. According the EAA directive, around 80 million people are affected by some degree of a disability in EU. The directive is ratified the Article 9 – Accessibility of the "United Nations Convention on the Rights of Persons with Disabilities" 2011) to make sure that the accessibility is a precondition in order to ensure the full and equal participation in the society across the EU. The Act also cover the electronic documents, whereas the Act specially mentioned e-books to be covered by this Act.

[1] Fullname: Directive (Eu) 2016/2102 of the European Parliament and of the Council of 26 October 2016 on the accessibility of the websites and mobile applications of public sector bodies (Text with EEA relevance)

[2] Fullname: Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services (Text with EEA relevance)

2.5.2.2 U.S. Legislation on Higher Education

According U.S. Legislation on Higher Education ("Higher Education Opportunity Act," 2008), UDL is a scientific framework of guidelines which assure the educational practices in a way that all educational activities and materials provides the flexible presentation of information so that student can determine the knowledge, skills, and their engagement in the education environment. It also includes the eliminate the barriers while instructing and provide significant support, assistance, and assure the higher level of success of all students especially students with disabilities. UDL accommodate all the students whether with disabilities or without disabilities, these students can be from diverse cultural, languages and countries. It is stated that nowadays all learning framework whether these learning frameworks are universally designed or not, involved technology. For example, digital learning materials, the size text in these kinds of learning material can be a barrier for students with learning and/or visual disabilities. So these documents can be easy for students reading or learning disability to access (King-Sears, 2014).

The IMS Global Learning Consortium presents why implementation of accessibility specifications are important "IMS Global Learning Consortium - Accessibility" 2009). The consortium mentioned that “Authors and web developers need to be aware of a myriad of parts when it comes to accessibility” and proposed different specification constructs for digital content creation:

- It is in legal requirements and International standards to make the digital contents accessible. Accessibility legislations required to remove the barriers to the learning experience. This legislation is based on World Wide Web Consortium Web Content Accessibility Guidelines 2.0 (W3C WCAG2.0) principles and guidelines which are developed by International standards experts.
- Accessibility Settings and Assistive Technologies (AT) required access to all users who use assistive technology devices (e.g., screen readers) through both internal and external digital settings.
- EPUB™ Personal Needs and Preferences provide each user with an ability to customize the personal accessibility needs and preferences. So, the user can control the appearance of digital contents within the same system.

- According to UD principles, services, and products that fulfil the requirements of inclusive design are more accessible by all user without special design or customization.
- The authors who prepare and develop the digital contents can support the accessibility by removing learning barriers that eliminate the student's abilities to equally participate in the education if authors choose the accessibility enhances learning strategies and authoring tools.

The Learning Federation, which ensures the creation of accessible digital learning contents, presented another study on accessible digital learning materials ("The Learning Federation," 2012). Proposed accessibility specification of The Learning Federation reflected the importance of creating learning material accessible because it is important for digital learning material must comply with legislation, appropriate learning standards, support for authoring tools for accessible contents, independent access to assistive technology devices, customization of contents according to user needs and preferences.

2.5.2.3 UN Sustainable Development Goals (SDG) – Quality Education

According to United Nations (UN) Sustainable Development Goals (SDG), Quality Education is the 4th goal of 17 Global Goals that are part of 2030 Agenda for Suitable Development, this goal ensures that all the students both girls and boys have right to complete free, equitable, and quality education. According to Goal 4 targets, it is stated that "By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university" ("Education - United Nations Sustainable Development," 2015). The SDG Fund response refers to the promotion of digital education stated that "Affordable, reliable and context-sensitive digital education, can promote equal opportunities for girls and boys and reduce inequalities by ensuring every child has access to high-quality content. Digital education technologies improve fundamental skills such as collaboration, problem-solving and global awareness. It can easily connect boys and girls from different parts of the world with the possibility of sharing their content with peers living kilometres away." ("Sustainable Development Goals Fund - Goal 4: Quality education," 2018). The aim of SDG is to achieve universal access to quality higher education. Whereas, when it comes to digital education technologies which can be used to sharing the educational content to many people who live kilometres. It

is possible these people may have disabilities if the digital education contents are not universally designed it will be difficult for them to access these contents. So, SDG also required to ensure the implementation of UD of learning materials in higher education to benefit the largest extent of people possible.

2.6 Social aspects of UD and accessibility

2.6.1 Digital divide

Generally, the accessibility is considered as a set of principles and features of a physical or digital product that ensure the access of information and benefits of that product to a large group of users. The term accessibility is defined as “it implies the global requirement for access to information by individuals with different abilities, requirements, and preferences, in a variety of context of use” (Stephanidis, Akoumianakis, Sfyrakis, & Paramythis, 1998). The main goal of designing learning material accessible is to reduce the digital divide. Whereas, the term digital divide refers to “The gap between those who have access to digital technologies and those who do not, or the gap between those who use digital technologies and those who do not, understood in binary terms distinguishing the “have” from the “have nots” (Hargittai, 2003).

2.6.2 Difficulties in implementing UD of ICT

E. J. Moore, Smith, Hollingshead, and Wojcik (2018) conducted a qualitative study to look at the degree of success by implementing UDL after the increasing pressure on higher education institutions in the United States to meet the learning needs of all students. The authors found difficulties when implementing UDL in higher education institutions. Limitation of administrative support and cultural isolation that is a teacher stated that “I don’t know if anyone else is using UDL. I have one colleague teaching a class on UDL and it is a small class for special education.”. Implementation of UDL is rarely addressed in the teacher education program and the lack of collaboration of different departments in the higher education institutions.

King-Sears (2014) mentioned that there is a need of student engagement when the teacher uses the different way to present the educational content in learning material, what exactly the students know for what purpose of presenting the material in different formats, and what are the benefits these contents are being developed. For example, through regular feedback of students, after the class. Applying UDL inside a

traditional classroom or for a diversity of students begins with three introductory advances: characterize proper objectives that take into account different methods for the fulfilment, deeply understand the student needs, and obstructions that may exist inside the present educational modules and learning materials (Ralabate, 2011).

2.6.3 Teaching every student in the digital age

In the text, *Teaching Every Student in the Digital Age*, Rose and Meyer (2002) stated that "...barriers to learning are not, in fact, inherent in the capacities of learners, but instead arise in learners' interactions with inflexible educational materials and methods" (p. vi). The authors argue that according to the brain research it has been affirmed to the world that how different students and the same teaching approaches will not work for all students, whether a student with disability or not. They also argue about the possibility of UDL in this digital age and stated that new technologies now make it possible to develop learning material and environment universally designed to accommodate the more diverse students. Although they provide a positive signal toward the technology while making learning materials according to UDL is not enough to conquer the existing barriers in learning systems but also the implementation of UD culture in both teachers' daily practices and the design of learning environment to eliminate the barriers in the beginning.

2.6.4 Teaching using universal design for learning

In the text, *Design and deliver: Planning and teaching using universal design for learning*, Nelson and Rose (2014) described how to implement UDL to ensure that every newly created curriculum, digital learning material, course program, and assessment should include the content/information which is accessible for all. The first component of implementing the UD of learning is designed, designing the digital learning material and the environment has required the knowledge of the framework of UDL and get familiar with it by the designers. For higher education, the design is a teacher who has to full control to choose the contents for the digital learning material. The learning environment is, on the other hand, is an important space in which the students learning needs, and it could be done by the involvement of higher education institutions. Most of the time teachers think that the lesson they designed is likely accessible for all, but UD is not one size fit all. The author also stated that why UD required to change the traditional way the teacher used to develop the digital learning

material. There are multiple eras behind it that is the teacher required to reach out to more students, and the UDL is a framework that addresses a diverse group of students. Sometimes the teachers are confused that there are several tools, strategies, resources, and guidelines available but which one they should choose? The UDL framework is key to decision making and helps the teachers to choose the best tools, strategies, resources, and guidelines to make the digital learning material accessible.

2.6.5 Digital learning materials – teachers and students

In Chapter 2 of text *Design and deliver: Planning and teaching using universal design for learning*, Nelson and Rose (2014) described the barriers to students if digital learning materials are not developed according to the principle of UDL. The author stated that barriers are situations that prohibit the individual to fully involve, learn, and express them self in a specific environment. It could be a student's physical separation from the involvement of the lesson in the classroom or the digital learning material provided by the teachers. Of course, if a student is denied or excluded to get access to a learning environment is also known as a barrier. UDL framework allows the teachers to design and develop the digital learning material and learning environment in a way so that the teachers can discover and overcome the barriers related to students learning needs. The authors mentioned that it is important for every teacher to first understand and know the UDL and then it will be easy for them to practice UD in their daily practice. This master thesis is also focused on the same aspect of UD to help the teachers and higher educational institutions to overcome this fear and the myths teachers develop against UD which are as mentioned earlier that is, "universal design required time", "it's hard to implement", "we don't have reward from university" (Chen et al., 2018).

2.7 Organisational aspects of UD and accessibility

The UDL framework allows the teachers to choose an appropriate learning environment and classroom which address a variety of students. Teachers argue that to implement UD for digital learning material required more time than the traditional way of developing digital learning materials (Chen et al., 2018). The UDL framework only takes time to learn and adjust your daily practices of making digital learning materials but once you learn and understand how to implement UDL then it will be

easy and less time taking for you to implement UD of digital learning materials (Nelson & Rose, 2014). In the second part, the author mentioned in the text is “The Act of Teaching” that is the implementing of UDL in digital learning materials. Although the teacher designs the digital learning material universally designed and have a lesson plan, required resources, tools, and the curriculum. But UDL framework required more than that, it required you to be flexible and understand the learning needs of your students. The term flexible refers to the teachers allow the students to use the learning resource according to their own learning needs instead of using these resources in a specific way. For example, if the teacher defined an activity such as students must arrange the tiles in a specific manner, then it will ignore the flexibility of resources.

2.7.1 Information society

The principle of representation collaborates the recognition networks together. These networks allow the human being to identify and interpret the things which we see, hear, touch, smell, and taste through the senses. The way our body and brain interact with senses and inputs of senses affects our learning (Meyer, Rose, & Gordon, 2014). The guidelines under the principle of Representation explain what are the learning needs of students which they want to learn by identifying, defining, and explain through language, syntax, and numbers (Meyer et al., 2014).

The principal of Action and Expression deals with strategic networks. Strategic networks help the human being to strategies the actions both mental and physical process that the human perform. It affects how we want to listen and how we communicate with others to understand the specific thing. The guidelines under the principle of Action and Expression suggest the students to fully communicate what they already know about the action they are going to perform and what are their expectorations towards learning which only be possible when student allows the students express themselves.

Nelson and Rose (2014) suggested a set of steps easy to practice once the teachers get familiar with UDL framework. These steps are as followings:

1. “Identify the practice you are currently using or would like to use in your classroom.
2. Identify whether that practice connects directly to one or more of the UDL

guidelines.

3. Identify how that practice supports your goal.
4. Identify how you can measure the success of that practice in relation to your goal.
5. Implement the proactive and look at those data produced in relation to your goal.
6. Implement the practice and look at those data produced in relation to your goal.
7. Examine those data to find evidence that your students are moving towards becoming resourceful, knowledgeable, strategic, goal-directed, purposeful, and/or motivated learners."

In Chapter 3, Rose and Meyer (2002) mentioned that new digital media help to support more universal designed learning materials and environments than traditional media such as textbooks and lectures. This is because of the flexibility provided by the new digital media. They defined four major features of new digital media which exceptionally helpful for the classroom environment. According to these features new digital media are: "versatile", "can be marked", "transformable", and "can be networked". Absolutely these features new digital media are vital for learning material and environments which are originally arbitrated by technology. Anyhow, these features are not inheriting features of the technology and the technology itself is not accessible or flexible, these are the human who builds these kinds of environments only with the help of UD and accessibility principles.

2.7.2 Failure to learn

S. L. Moore (2007) argue that "failure to learn" is not a measuring characterize of students/learners, but it is a contemplation of the learning framework, for example, learning materials, institutional policies & strategies or environment is the main factor fail to accommodate the demand of all students. From strategies to prizes and motivation for both teachers and students, resources, and review/ feedback system, for example, specialized foundations, every one of these frameworks level highlights assumes a huge job in whether a school or student or government substance will accomplish an all-around planned condition. Without thoughtfulness regarding these parts of frameworks, UD basically will not achieve what it generally can. UD principles connected at these dimensions could mitigate a great part of the worry at

the student level and classroom environment in schools and associations. For sure, if we set a smart thought against an existing traditional educational framework, the framework will at present win without fail. The author stated that it is our responsibility being professional to make sure the UD standards in learning material, environment, and system that what we are developing do not create any barrier by design for anyone.

Bedrossian (2018) emphasized the understanding and promotion of UDL in higher education and stated that digital technologies for learning such as online course curriculum, presentations, digital learning materials can fulfil the demand to access for all students can be achieved through the implementation of UDL in higher education institutions. Bedrossian (2018) suggested the engagement of faculty, academic chairs, and deans to arrange the faculty training and consider the implementation of UDL as a common goal, both institutions and students will get the benefit of it.

2.7.3 Attitudes among teachers in higher education toward UD

Chen et al. (2018) conducted a thematic analysis to understand the attitudes among teachers in higher education toward making learning materials universally design in Poland and Norway. Poland does not have national law/legislation related to UD or accessibility, so mostly the teachers did not know about the UD. Therefore, the teachers from Poland were asked about whether they would like to have these kinds of legislation in their country or not. On the other hand, Norway has law and legislation, the teachers from Norway were asked about the usefulness of existing law and legislation. Chen et al. (2018) identified that the teachers were found positive against assisting students with disabilities and making the learning material universally designed only if it is important and compulsory.

The authors found that many of the teachers have inadequate knowledge and experience to assistant the diverse students and identified their “conditional willingness” because of inadequate knowledge, experience, and policy of their universities. Accordingly, there is a possibility that the exclusion of diverse students especially students with disabilities from learning materials and courses is not because of discrimination from teachers, but inadequate knowledge, the experience of teachers and university infrastructure and/or policy about accommodating the

diversity of students. Students that cannot access the learning materials and/or courses experience that they are hindered, which affects their possibilities to succeed/achieve good academic performance. But When it comes to implementation of UDL material it is likely that to consider the attitude of teachers toward it is highly probable.

Chen et al. (2018) identified the challenges related to implementation and compliance of UD when making digital learning material in higher education. The authors stated that there are some teachers who express challenging concerns related to the implementation of laws and regulations related to UD on Information and Communication Technologies. Some teachers argue that the UD guidelines and regulations are hard to fulfil, some of the teachers clearly mentioned that the individual may found it hard or show an unwillingness to follow these kinds of laws and maybe is close to impossible. Some teachers do not know about the UD guidelines related to learning and show unwillingness to justify. One of the interesting things the authors found that implementation of UD guidelines, law and regulations required additional work and time to make the digital learning materials universally designed especially online contents.

2.7.4 Effectiveness of UD

Griful-Freixenet, Struyven, Verstichele, and Andries (2017) conducted a qualitative study to explore the effectiveness of UDL for the learning needs of students with disabilities. The authors found that students learning abilities well aligned with the principle of UDL principles especially with the principle of Engagement. Griful-Freixenet et al. (2017) concluded that the traditional model of accommodating students with disability in higher education is not enough. There was a sufficient match found between the UDL and the students learning needs to enhance learning activities in higher education institutions. Anyways, many countries including Norway has already implemented UD in all fields including education which focus to uncover and overcome the learning barriers to students learning. This study identified the potential barriers if UDL is implemented only curricula and learning environment. Hence, the authors argue that teachers should be responsive to fulfil the students learning needs and overcome the learning barriers by implementing UDL in a flexible way. The teachers and higher education institutions should consider UDL as an ongoing process of enhancement instead of a destination.

Gradel and Edson (2009) mentioned that students with diversity are increasing gradually in higher education institutions who may face possible learning issues such as learning disabilities, language barriers, teacher emotion/ attitude, less motivation/ engagement, physical and sensory disabilities. This is teachers/ faculty responsibility to identify and manage the barriers related to learning materials, teaching methods, and students learning assessments.

2.7.5 Challenges for teacher toward UD

Lieberman (2017) also explain the challenges that teachers face while practicing UD, one of the important aspects of difficulties for teachers is that many of them do not receive training about UD to support all students in their own educational period. Teacher are directed about how to include all student in the beginning. The author also mentioned that there is still no overlooking in the field of education to ensure that every resource especially digital learning material are accessible for every student. In the implementation of UD of digital learning materials, higher education institutions are slow to motivate and enforce the teachers to implement UD of digital learning materials. On the other hand, many students do not like to have a special treatment, they do not like to stand out differently.

Fenrich, Carson, and Overgaard (2018) found that most of the teachers have a common problem, lake of knowledge and experience about how to design and make the inclusiveness and accessibility of learning materials. There was a significantly better response by students on newly designed materials according to UDL principles. The new learning material content was broken down into different sections with headings and subheadings structure in PowerPoint which make the PowerPoint well organized. As the newly designed contents were well organized than the original contents which provided a simple and easy way to learn from it. The text size of content was sufficiently large than the original contents which fulfil “Web Content Accessibility Guidelines (WCAG 2.0)” of the World Wide Web Consortium. These guidelines were excluded in the previous contents, so the student was found satisfied and stated that “The size of the text on the PowerPoint was large enough for me to easily read it”. The original content has excluded the description of video clips but in new contents, the description of all videos was provided which concluded them strongly supported learning contents.

3 Methodology

The main context of this study is primarily related to implementation of universal design of ICT on digital learning material in higher education institutions. Therefore, it is required that the data collection process will be circumscribed to the teachers from higher education institutions.

According to Lazar, Feng, and Hochheiser (2017), HCI researchers recommend using more qualitative methods of research in this field to deliver effective research results according to HCI needs. In HCI research our discussions, observations, and interviews introduce a different kind of data associated with research questions that are not so clear-cut. Instead of finding numerical calculations and manipulations, the qualitative studies involve study texts, interviews, observations, artifacts, and questionnaires to understand the complex situations. Sometimes we do not know what exactly the “truth” is as different researchers often do have different perceptions of the same situation which cannot be done with quantitative measurements and manipulations.

Richard (2013) stated that the qualitative method of research provides a deeper understanding of a problem which is impossible through a quantitative method of research or statistically based investigations. Furthermore, the author also reported that the qualitative method centralises and provides primary value to complete understandings, people's understanding, their experience, and how they operate in their social foundation and structure. While comparing qualitative and quantitative methods it was stated by the author that the quantitative research method is a more “scientific” approach of research.

The surveys with open-ended questions are a very common research method that is not just being used only in human-computer interaction (HCI) but in all other fields of research. Although surveys are a well-defined set of questions typically presented to the individuals without the presence of the researcher itself, it gives an opportunity for individuals to think freely and deeply to respond to the survey questions. Lazar et al. (2017) stated that surveys provide an opportunity to the researcher to get answer relatively quickly about how individual use different technologies, what kind of challenges they face while using these technologies, and how they overcome these challenges.

Therefore, this research used a combination of qualitative online surveys and individual interviews to find the answers to research questions. In addition, I participated in an introduction seminar on UD and workshop as a student research assistant in a project titled “Implementing universal design of ICT in OsloMet” to further learn how the teaching and administrative staff develop digital documents in their everyday life.

All teachers as a group from same profession somehow share similar interest and patterns of behaviour towards creating learning materials. To learn and understand these patterns of behaviour it is crucial to observe the teachers and conduct the individual interviews, it helps to explore teachers views and experiences towards the universal design of digital learning material and how it can be implemented in an effective and efficient way.

3.1 Data collection methods

The data in this research study is collected from the faculty members from higher education which require a deep understanding of their behaviour and attitude. It is also important to consider how the teacher uses different tools to make digital learning materials and what is their behaviour when making learning materials universally design. In addition, it will also be helpful to observe and understand what kind of digital learning material they usually create and the issues that come along the process of creating and developing these documents. Therefore, to answer the research questions I participated in a workshop on how to develop digital documents universally design to gather the necessary data to answer the research questions. Furthermore, it gave me an opportunity to deeply observe and understand the teachers while practicing universally design of ICT in the development of digital documents.

For the individual interviews the semi-structured interview method is used for further collection of data for this research. It provides an opportunity to delve into topics more deeply that would be difficult to accomplish by structured interviews. It leads the interviewees to answer to a discussion that the interviewer might be overlooked to do, and it also helps to understand interviewee’s interest and aspects into a broader trend. Semi-structured interviews are more relevant when the researcher wants to go deeper to find important responses and other intuitions (Lazar et al., 2017).

Chen et al. (2018) stated that semi-structured interview method lets the researcher ask more unrestricted and generic questions that allow teachers to provide their experiences in their own words. In addition, Chen et al. (2018) reported that teachers' comments and responses are more to reflect their own understanding, judgment, experiences, and challenges.

The online surveys with open-ended questions were selected for the data collection from more individuals in addition to the individual interviews. For many teachers, it was hard to find time to participate in the individual interview because of the high level of burden of online class due to the pandemic COVID-19. Therefore, an online survey with open-ended questions research method is arranged as an alternative for the teachers who cannot participate in the individual interviews.

Shinohara, Kawas, Ko, and Ladner (2018) have conducted online surveys on faculty members from computing and information sciences in the United States about knowledge of the higher education teachers about teaching accessibility. The authors reported that teachers are more likely to respond the online surveys and consider it timesaving.

3.1.1 Selection and recruitment of participants

3.1.1.1 For individual interviews

For the individual interviews, interview participants were contacted through emails sent to the 23 different heads of department from 8 different universities of Norway. The criteria for selection and recruitment of participants were primarily teachers (both with and without disabilities) from higher education institutions at bachelor (3 or 4 years), master (2 years), Ph.D. level (3 years to 5 years). The scope of the population targeted instructors and professors only in Norway.

The context of higher education institution in Norway is followed by the international survey done by Eurostudent and Statistics Norway. According to "Eurostudent VI Database (Data Reporting Module)" 2018), 23% of all students in higher education institutions in Norway have impairment such as long-standing health problems, learning disabilities, and functional limitations. According to an article published by "Statistics Norway" 2018), every fourth student in Norway has disabilities which are 25 percent of the total population of students in higher education in Norway. Finland

and Sweden have even more students with disabilities than Norway reported by the Statistics Norway that is 28 and 27 percent, respectively.

To contact the heads of the departments, it was important to collect their contact information. For this purpose, the manual internet search method had been chosen where a list of different universities in Norway along with their website's links was gathered. From the university websites following department was selected and information about their head of departments was gathered from the department webpage:

- Department of Computer Science and Information Technology
- Department of Art, Design and Drama
- Department of Electrical Engineering and Science
- Department of Civil Engineering and Energy Technology
- Department of Public Health and Nursing
- Department of Teacher Education
- Department of Mathematics
- Department of Special Needs Education
- Department of Business and Finance
- Department of Social Sciences
- Department of Chemistry, Biotechnology and Food Science

There are several parameters that have been considered for the selection of the above-mentioned departments for participants. The most important parameter among others is based on work done by another researcher on the attitude of the teachers from different faculty toward the universal design of ICT for digital learning materials and students with disabilities. In addition, the type of learning materials developed by the teachers in different field of studies such as some of the studies contain simple text content whereas others contain mathematical formulas, charts and graphs, graphics and animations, and other non-text contents.

It is also considered while recruiting participants for interviews and an online survey that there might be students with disability in the class and/or the teacher as a participant might have disabilities. Therefore, all the type of functional performance statements (fps) mention in chapter 4 of the European (EU) standard "EN 301 549 v2.1.2 – Accessibility requirements for ICT products and services have been

considered during the recruitment process ("Harmonised European Standard EN 301 549 v2.1.2 – Accessibility requirements for ICT products and services," 2018). The following type of disabilities have been considered according to different user accessibility needs mentioned in the EU standard:

- Usage without vision
- Usage with limited vision
- Usage without perception of colour
- Usage without hearing
- Usage with limited hearing
- Usage without local capability
- Usage with limited manipulation or strength
- Usage with limited reach
- Minimise photosensitive seizure triggers
- Usage with limited cognition

Furthermore, the teacher's recruitment and selection criteria also include that the teachers that teach students from bachelor to Ph.D. level were considered. This information was collected from each university's website and the biography about the teachers mentioned by the university on their websites. The reason considering these levels of classes assumed that the bachelor students have more technical knowledge in a practical manner. However, the master and Ph.D. students are mostly research students, therefore, they interpret knowledge and experience more systematically in a research context than other students (Tehranineshat & Rakhshan, 2018).

Kawas, Vonessen, and Ko (2019) conducted 18 semi-structured interviews with the teachers from the Faculty of Computer Science and found that only 4 of them have been reported as knowledgeable about accessibility. Although computer science faculty are considered as experts in computer and IT service even then there is a lack of accessibility knowledge among them. Chen et al. (2018) also reported similar findings where Computer Science faculty being found inclusive toward diverse students. However, many of them have limited knowledge and experiences regarding accessibility terminology when it comes to students with disabilities.

The teachers in the Faculty of Education Sciences showed a positive attitude toward students with disabilities and consider that the personality of students with disabilities

has a balance with any other student. The teachers from this faculty received the highest score on personal involvement with the students with disabilities and do not mind working for them. Furthermore, the number of students with disabilities in the Faculty of Education is comparatively higher than other faculties (Polo Sánchez, Fernández-Jiménez, & Fernández Cabezas, 2018).

The information about potential accessibility is provided to students with disabilities in all learning materials modules. However, there are general accessibility issues found related to subjects, such as scientific equations and numerical formulas in mathematics, engineering, science, and technology (Slater, Pearson, Warren, & Forbes, 2015). Numerical formulas also include in learning materials provided by the Business and Finance faculty such as excel sheets and long financial reports.

Faculty members from arts, public health, social are considerably less technical and use different complex graphical illustrations in their learning material which might have accessibility issues. Therefore, it is important to consider faculty members from these departments for individual interviews participants.

After finalising the departments, a manual method was chosen to send invitation emails to each head of the department. In the invitation email, the heads of the department were requested to further send the email to their faculty members from his/her department. The introduction to the research study has been provided to them along with the information about how, where, and when the interviews are planned to be conducted. In addition, the head of departments and teachers have been informed about the ethical consideration during the interviews in the invitation email.

There were several heads of departments that were agreed on forwarding the invitation email to their faculty members to participate in the individual interviews. However, there were few who rejected to forward the invitation further to their faculty member. The reason that they provided was, the busy schedule of the teachers because of the pandemic COVID-19 situation as most of the teachers are working from home and do not have time because of their online teaching method.

More specially, of 23 head of departments, five rejected to forward the invitation to their faculty members due to lack of time, interest, and teachers already have several scheduled research interviews and surveys. Of the remaining 18, 7 of them did not respond even after sending reminders, it might be possible that they have forwarded

the invitation to their faculty and faculty have similar reasons as mentioned in the last paragraph to participate in the interviews.

The recruitment process of participants for interviews were stopped when the faculty did not further respond, as the goal was to spark the reactions and interest, but not add any pressure. The invitation email that was sent to these departments is presented in the chapter Appendix A.

Finally, the 7 teachers were interested to participate in the interviews that have been recruited for the individual interviews based on the reason that they want to participate in the interviews. The teaching background of these teachers was from Computer and Information Technology, Social and Political Sciences, and Public Health and Nursing.

Furthermore, two teachers with expertise in the universal design (UD) of ICT have also been recruited for the individual interviews. It is important to consider the UD experts who are teachers as well to deeply understand what do the teachers generally develop for their students, how the situation handled during the pandemic by the teachers and higher education institutions. Furthermore, it is also crucial to get their opinion of what kind of measures do higher education institutions need to do in order to ensure that the teachers as actually practicing universal design when developing digital learning materials for students.

In the initial plan for this study, the individual interviews were planned to be held physically. However, due to the pandemic COVID-19 all the institutions were closed, and teachers were advised to work from home. Therefore, a digital mode of communication is used for the interviews where Zoom – virtual digital meeting is used as a communication tool for the interviews.

3.1.1.2 For online survey

For the online survey, the same 25 faculties from different universities in Norway that have been considered for individual interviews have also been considered as the target population for the online surveys. The survey was opened for responses for 4 weeks. Several of the contacted departments refused to further send the invitation to their teachers and stated that the teachers are already overburdened and do not have time to participate in the online surveys or interviews. One of them stated our

faculty is already having a high burden of teaching because of school closure due to COVID-19. The respondent also stated that the teachers are busy in different courses related to learning new digital tools and technologies that will support their online teaching skills. This makes it even more important in the light of the urgency for teachers that how to make their lectures and teaching materials accessible due to the digital teaching with the COVID-19 pandemic.

After sending reminders twice, 5 teachers with an educational background from the department of statistics, data science, and artificial intelligence, political science, public administration, and biology participated in the online survey questions. In addition to the above-mentioned challenges in recruiting participants for online surveys, there might be several other reasons that the 5 teachers participated in the online survey instead of the interviews. These reasons among others include lack of time and interest, overburden, higher education teacher population in Norway (as Norway is a country with a small population).

3.1.2 Individual interviews

For the interviews, a comprehensive interview guide was developed to answer the research questions. The aim of this interview guide was to initiate the discussion on a certain context or topic to get a deeper understanding and response from the interviewees. The interview guide starts with the general questions about the area of the study field, years of working experiences as a teacher in the related field of study, and age group. The rest of the interview guide was based on the research questions of the study. All the questions were related to their everyday teaching routine on developing digital learning material and universal design of ICT, the complete interview guide is attached in the chapter Appendix E.

As mentioned earlier, a semi-structured interview guide has been developed for the individual online interviews. A set of pilot interviews were conducted with two different interviewees (teachers) to subsequently adapt this method. The pilot helped to find out the clarity of the questions and the overall duration of the interview. As a result of this pilot, the interview guide was updated, and the total duration of the interview was gauged to about 45 minutes.

After the acceptance by the participants to participate in the interviews, the calendar invitation in outlook sent to each participant along with the letter of consent. In the

calendar invitation, the participants were informed about the interview procedures. The complete calendar invitation email is attached in the chapter Appendix C.

All participants that were interested and agreed to participate in the interviews received a letter of consent for signature. However, the personal signature is sensitive data, therefore, a four-digit code (X497, X here is variable) series was used for signing the letter of consent instead of personal signatures. All the participants instructed to write a four-digital code in a blank space specified in the letter of consent.

In addition, the participants were requested to provide some of the digital learning material as a sample learning material for further analysis to find what kind of accessibility errors do these learning materials have.

3.1.3 Online Surveys

For the participants who were unable to participate in the individual interviews, the online survey was designed based on the open-ended questions which reflect a similar context as the interview questions. The online surveys were designed using the online tool offered by the "The University of Oslo, Norway" 2020), Norway, this tool is known as “Nettskjema” ("Nettskjema – Online Survey Tool offered by University of Oslo, Norway," 2020). The “Nettskjema” tool is an online survey tool used for simple questionaries, sign up and registration forms and multiple-choice with a high degree of privacy and security.

The survey was available for four weeks, whereas the survey link was shared through the faculty’s heads of departments.

When the online survey was selected as a method for data collection because of the lack of teachers’ availability to participate in the interviews. The teachers had a busy teaching schedule due to pandemic and a sudden change of teaching mode from physical classes to digital classes. It was considered that there might be less quality of data collected in the online survey but in the formulation of survey questions, this risk of fewer quality data has been considered. Therefore, the question for the survey was formulated with more description in the survey form. For example, during the interviews, several teachers had questions about what is required by the law when it

comes to the text of video such as does live video require to be text? Furthermore, what is the difference between caption and texting of video?

Among other the above-mentioned queries were considered while formulating the online survey question to minimize the risk of fewer quality data.

3.1.4 Participation in introduction seminar on UD and workshop

I have participated in a one-year duration the project titled “Implementing of the universal design of ICT in OsloMet” (actual title of the project in the Norwegian language is “Implementering av uu-ikt i OsloMet”) as a student assistant with other UD researchers from Oslomet - Oslo Metropolitan University, Norway. The project leader was Weiqin Chen ("Weiqin Chen – Professor at OsloMet – Oslo Metropolitan University, Norway," 2020), who is a universal design expert and research scientist at the same university. The project was funded by the "Universell" 2020) that is commissioned by the Ministry of Education and Research to work for knowledge and collaboration about the learning environment, universal design in higher education.

The project was a pilot project for training the teachers, professionals, and administrative staff about the universal design of digital documents at Oslomet - Oslo Metropolitan University, Norway. The aim of this training was to increase the competence of teachers and administrative staff on how to develop the digital documents universally designed. Furthermore, those who will receive training can thus be able to impart knowledge and help their colleagues in the development of digital documents universally designed which hopefully aid the teaching.

The project organised an introduction seminar on UD with a hands-on workshop on how to develop Microsoft Word, PowerPoint, Excel, and PDF documents universally designed at Oslomet - Oslo Metropolitan University, Norway. I participated in that introduction seminar on UD and workshop as a student research assistant to observe and help the participants with different tasks regarding the universal design of these documents. The participants were contacted and selected by the other researchers whereas 20 participants were recruited for the workshop from both teaching and administrative staff. It is important to note here that the introduction seminar on UD of learning materials and tasks for the participants, as well as notes, were taken care of by the other researchers in the project.

A room with enough capacity for 20 participants and researchers was arranged for the workshop. The workshop room was equipped with multimedia devices, such as a projector, computer screen, and sound system. In the workshop, two sign language interpreters were also arranged so that participants with hearing disabilities can get good communication of what been discusses and presented in the workshop.

In addition to the above-mentioned facilities, different assistive technology and simulation equipment was also arranged for participants so that they can experience different kind of impairments that the user might have while reading their digital documents. This assistive technology includes screen reader speech, eye mask, and simulation glasses for people with vision impairment. Other simulators to create an imagery simulation environment to experience different impairments such as vision, deaf or hard of hearing, cognitive, motor, physical, and intellectual disabilities were also arranged for the participants.

The workshop was based on both theory and practical parts, where four researchers from OsloMet University and three student assistants were responsible for administrative and arrangements. Whereas one researcher from the four researchers presented the theoretical part of the workshop and practical tasks. In the theoretical part of the workshop, a a comprehensive introduction to the different type of digital documents was provided such as Microsoft Word, PDF (Portable Document Format), PowerPoint, Excel, Outlook, and ePUB (for electronic publication).

The participants have also been provided the information about the different user accessibility needs, situations, and equipment. Universal Design was one of the topics of the theoretical presentation where the participants have been provided with descriptive information about what exactly the universal design means, what does the Norwegian Regulation on Universal Design say about the accessibility of digital documents and the relationship between Web Content Accessibility Guidelines (WCAG) 2.0 and digital documents.

In the practical part of the workshop, there were several different tasks were designed and a document has been developed for each type of document list in the previous paragraph. One of the tasks was based on accessibility simulators where the goal was to allow participants to experience the accessibility barriers in different scenarios while solving the task. The participants were divided into a group of two

participants and the task was to open a Microsoft word document or outlook email and write a little birthday greeting and simulate other different scenarios while solving this task.

For scenario simulations, the participants were instructed to use simulation gloves, balance board, simulation goggles, mouthpiece, bright light, and disturbances such as light, sound, movements, and touch. These simulation tasks provide the participants with a hands-on practical experience on what kind of challenges people with different disabilities and impairments face if digital documents are not universally designed.

The rest of the tasks in the workshop was based on practical activities on how to develop Microsoft Word, PDF, PowerPoint, and Excel documents. For the word document, the participants were instructed to develop a document of their wish and the accessibility check of this document with a zooming tool and screen reader, in addition, the participant received a checklist to evaluate their work. The checklist (for word documents) is documented in chapter Appendices under the heading “Accessibility checklist for different documents in the workshop”.

The participants had also been trained on how to make universally designed PDF documents and PowerPoint presentations. The checklist (for PDF documents and PowerPoint) is documented in chapter Appendices under the heading “Accessibility checklist for different documents in the workshop”.

The last task was designed on Microsoft Excel, pre-developed Excel sheets were provided to the participants. The participants were training on how to develop a universally designed Excel document. A checklist was provided to the participant for further evaluation of their work on this task. The checklist (for Excel document) is documented in chapter Appendices under the heading “Accessibility checklist for different documents in the workshop”.

It is important to note here that the content of the presentation, training guidelines, and workshop contents related to the universal design of ICT was based on the Norwegian Standard NS 11021:2013 – Universal design – Accessible electronic text documents - Requirements for design, mark-up, and file formats ("The Norwegian Standard NS 11021:2013 – Universal design - Accessible electronic text documents - Requirements for design, mark-up and file formats," 2013).

At the end of the workshop, the questions from the participants were served and feedback from them was reported by the other researchers. The student assistants help the participant in accomplishing these tasks in a proper way and the two of the researchers observe them and took the notes.

The role in participating in the introduction seminar on UD was very important and especially played an interesting role in finding answer regarding research question about what the issues are related to digital learning materials or documents. The documents that were considered in the introduction seminar on UD was Microsoft word, excel, PowerPoint, and PDF that teachers and administrative staff create or use in everyday working routine.

It is worth mentioning here that the members of administrative staff from OsloMet – Oslo Metropolitan University also participated in the introductory seminar on UD.

3.2 Ethical consideration

The participants were contacted through their head of the department and the contact information about the heads of departments were collected directly from the university's websites. After the interviews are done, the email data along with the calendar invitation has been deleted and a series of four-digit code is used for the interviews data to separate the data per participant. Furthermore, there is no key linking the code to the individual participant, so that this is completely anonymous.

3.2.1 Approval for data collection methods

The research study was planned not to collect or store any personal information about the participants or any sensitive data that might identify the participant. Therefore, the report has not been submitted to the Norwegian Centre for Research Data (NSD).

As mentioned earlier, all participants received a written letter of consent by email, and they signed it using a four-digit code series for the interviews. In addition, to the written letter of consent, all participants were also informed that their participation in these interviews are voluntary, and the data collected in the interview shall be only used for the academic purpose of this research study. The participants were given an opportunity to skip the question that they do not want to answer or can also withdraw from the interview at any time. The participants were also instructed that they can

hide their names and use imaginary names or codes during the interview call on Zoom.

3.2.2 Confidentiality declaration

The participants were informed about the interview procedure at the start of the interview and an assurance was given to them that only the hand notes were taken during the interview on a word documents, no audio or video data recording. The participant identity and personal information is kept private and anonymised during the data collection and in the data analysis.

For the sample learning materials collected during the interviews, the participant was instructed to remove all the information in the learning material that might identify them such as name, contact details, course name, department, university, etc.

The online survey form was set up with anonymous submissions functionality offered by the tool vendor. This functionality is specially designed for anonymous submissions of data that do not need to be reported to NSD. The forms set up with anonymous submissions do not store data neither the personal information about the participant nor the time of submission.

There were two ethical considerations that are important to mention that one of the participants voluntarily mentioned in the interviews without being asked that the participant has been blind for the last two years. In the online surveys, one of the respondents provided an email address because of the participant's interest to receive the survey response. This data has been deleted after the survey ended.

Finally, after collecting all the data, it was made sure that there is not any information stored that might identify any of the participants both in the interviews and online surveys.

3.3 Data analysis method

The data collected using qualitative methods are habitually unstructured and massive cumbersome. It is highly based on detailed text containing both verbal and written notes during the data collection. Furthermore, the content of the data is in microform such as data based on someone's experience, knowledge, observation, or interactions, etc. Therefore, the researcher needs to do some consistency and

structure to this unwieldy data while keeping the original context by which the data is derived (Ritchie & Spencer, 2002).

According to Ritchie and Spencer (2002), qualitative data analysis is “necessarily related to detection, and the tasks of defining, categorising, theorising, explaining, exploring, and mapping are fundamental to the analyst’s role”. The qualitative data analysis is based on three stages, that is it starts with a set of data related to information about the actual problem of interest. In the second stage, each data component of explored to find out relevant dimensions and properties descriptively. In the third stage, the researcher better understands the nature of the original substance using knowledge gain through studying each data component and also how they related to each other (Corbin & Strauss, 2014). In this research study, thematic data analysis is chosen to use for data analysis.

The thematic data analysis is chosen because of the nature of the data collected in this research. This method is used by the several other research that conducted the similar research such as Chen et al. (2018) used thematic analysis on data collection from 35 semi-structured interviews to understand the attitude of technology faculty members towards making digital learning materials universally designed.

Furthermore, Clarke, Braun, and Hayfield (2015) consider thematic analysis as a flexible data analysis method from research questions, participants, and collection of data to meaning generation from the collected data.

3.3.1 Thematic Analysis

Clarke et al. (2015) stated that the thematic analysis (TA) is a method “for identifying, analysing, and interpreting patterns of meaning (‘themes’) within qualitative data”. TA is essential for coding the collected qualitative data into the smallest units possible for the analysis relevant to the research questions. The codes are considered as the backbone for the themes and underpinned the central concept of the problem under consideration. Finally, the teams give a framework for further organising and reporting the analysis results.

Lazar et al. (2017) however, suggested that the limitation to the qualitative data analysis is that the results are subjectively based on the interpretations of the content of the data by the researcher may develop biases in the results and it would be

potentially valuable that it should be review by the other researcher in order to secure the validity of the results.

This study followed the Braun and Clarke (2006) thematic analysis approach in order to perform data analysis which focuses on finding the patterns of meanings according to the data. A bottom-up approach for coding the data and the analysis is used in the data analysis that is an inductive way of codes and categories to give meaning to the data collected. The inductive way of approach is selected as the codes were mainly derived from the data itself based on participants' responses and experiences instead of deriving codes and themes by the existing ideas or concepts.

The six phases approach developed by Braun and Clarke (2006) has been used in order to perform the data analysis which provided deeper insights into the dataset. In addition to deeper insights into data, this approach provided a quicker and easier process to code the data and generate themes at a conceptual level instead of paraphrasing or quoting the participants' responses. However, the notes taken during the interviews and data collected through the online survey were quite clear but later transcript into a more understandable manner in order to perform effective data analysis. Finally, the transcription files have been developed for the whole dataset before start performing the data analysis.

The data collection in interviews, online surveys, and notes made from the introduction seminar on UD that is observational data from on-site observation in the introduction seminar on UD were coded and themed in the same manner. As the raw data was the only introduction seminar on UD and workshop participation, therefore raw data was probably less data for analysis than expected. Some of the data from observation in the introduction seminar on UD was out of the scope of this study such as participation of administrative staff in the introductory seminar on UD, which was therefore obsoleted.

Although this six-phase approach is sequential which is presented below, it is used as a recursive abstraction process:

1. **Familiarisation with the data:** In this phase, the recursive process of reading and rereading data transcripts actively and critically was involved in order to become immersed and familiar with the content of the data. The notes on the data were made while reading and rereading the dataset in order to highlight the

quotes in data potentially interested and relevant to research questions and triggers for coding and data analysis.

2. **Coding:** In this phase, the actual systemic analysis started through coding and labelling the data potentially relevant to the research question. As the data collected in the interviews and online surveys were fully transcribed, but it might come out to be a time-consuming process. The open coding approach to the data was therefore used, it also helped to clear the data such as the chunks of data not relevant to research questions and/or repeated chunks in the data. The coding did not revolve around tagging of the dataset but provided a way to describe and interpret the content of data and participants' meanings.
1. **Generating themes:** After all the data were coded comprehensively, the data were examined in order to generate the initial themes, that are capturing the chunks that are important about the data especially in relation to the research questions. The potential themes were generated in order to a significantly broad perspective of meaning within the dataset. This approach has also been proved to be an effective approach when analysing such data, such as Polkinghorne and Arnold (2014) also mentioned that "By compacting the data using themes and codes, it becomes possible to identify patterns that otherwise are not apparent".
2. **Reviewing potential themes:** After generating the initial themes, a recursive process of reviewing the themes and continuously cross-checked to the coded data and entire dataset in order to secure the quality of the summarised meaning pattern derived from the data. The potential themes were then selected according to the participants' answers and relevant to the research questions after three iterations of continuous reviewing the themes.

   Furthermore, it helped to ensure that the themes and summarisation of data in form of themes still consistent and work with the participants' responses. This phase not just help to discard the codes from the interview and survey data that were out of the scope of this study but also help to discard the data from the observation in the introduction seminar on UD. In simple words, this phase is a quality checking phase to capture the most important and highly relevant component of the data to research questions.
3. **Defining and naming themes:** The codes are then further used in the development of concepts by grouping codes that were unique and specific about each theme generated in the last phase. After the development of concepts,

these were deeply analysed and then structuring the story of the data for each theme with these concepts. Finally, the themes named were defined based on the factor informativeness and conciseness that provide a vivid sense of what a theme is all about and close to the concepts.

It is important to mention here that the data collected in the data analysis was large in volume, therefore, subthemes have also been developed which are presented and explained in section 4 results.

4. **Producing the report:** Although this phase is the final stage of the data analysis but writing and analysis are closely interwoven process. Therefore, reporting the findings and results was a continuous process in the data analysis of this study for example it started with the making notes while reading and rereading the data transcriptions from the beginning of the data analysis process. Furthermore, in the final description reporting the arguments have been provided while answering the research questions based on the data analysis. The report writing also includes the structure of themes in a coherent and logical manner so that each theme is logical next step for the coming theme which is closely related to research questions.

3.3.1.1 Limitation of the method

It would be important to mention, that there were two limitations were experienced from the interview method the first, in online interviews, there were often technical issues and noise. Second, in the interview guideline, there were some technical terms that were new for some participants such as video caption and the universal design itself. It might not be the most appropriate method to investigate the knowledgeability of participants' regarding universal design and captioning the videos.

Another term "ICT" abbreviation for "Information and communication technology" was used in the interview guide. Especially for the online surveys, a few of the participants did not understand it until they search it on the internet. These terms would have been described before the actual individual interviews and online surveys. In the online survey, several participants have had spelling and grammatical errors that made it a bit hard to understand the intention of the participants. However, some errors were easy to understand such as the participant wrote "Life recording" instead

of “Live recording”. Furthermore, in some cases, the participants answered questions with only one word such as “Yes”, “No”, and/or “I do not know” rather than providing more description in addition to their answer. A few participants did not understand a few questions in the online survey.

However, this did not affect the data analysis and did not reflect any negative impact towards investigating the knowledgeability of the participants.

It is important to mention here that the sample learning materials collected in data collection were aimed to perform a heuristic evaluation in order to find the frequent issues with the digital learning material. However, only four teachers shared the learning materials in word, PowerPoint and PDF formats are insufficient to perform heuristic evaluation and data analysis. Therefore, due to the lack of sample data for learning materials, it is impossible to conclude anything on this research question, thus it remains unanswered. Therefore, this part of the study is considered as future work.

In addition, due to COVID-19, the teacher was extremely busy in the teaching activities, therefore, it was challenging to recruit the interview participants. However, the data need required for the data analysis was then fulfilled by the online surveys, which did not reflect any significant limitations in term of finding answers to research questions.

4 Results

In this chapter, the general findings during the data collection and analysis phase are presented. At the start of this chapter, Section 4.1 presents the general findings from the data collection method such as how the individual interviews and online surveys have been performed to collect the necessary data in order to perform data analysis. Furthermore, the demography and the context of the teaching of participants are presented.

The main results based on the data analysis in order to find the answer to the research questions of this study is presented in two sections. Section 4.2, the results based on data analysis performed on data collected in individual interviews and online survey are presented. Section 4.3, the results from the participation introduction seminar on UD as observational data is presented along with the summary of these results.

4.1 General findings

4.1.1 Individual interviews

The teachers (both males (2) and females (5)) recruited for the individual interviews, age group from 36 to 66 years old, had teaching experience 5 to 26 years of role from associate professor to professor, including three research scientists. Their main duties include teaching (7), administration (2), and software development (1). In addition to teaching, all the teachers are involved in the research work at their department.

Three of the teachers reported being knowledgeable, one with some knowledge, and one reported no knowledge of the universal design of ICT or accessibility. Two of the teachers reported as the universal design of ICT experts. The teachers had expertise in 11 different subjects, from academic areas to research and development. They teach courses ranges from bachelor’s level to Ph.D. level students.

The final recruited teachers, therefore, selected based on diversity of area of subjects, knowledge of the universal design of ICT, accessibility, and expertise in different faculties. The detailed demographics of interviews’ participants are presented in Table 4.1 below.

Table 4.1 Demographics of participants for individual interviews

Gender	Male (2), Female (5)
Age range	35-50 (3), 51-65 (2), 65+ (1), do not want to answer (1)
Department	Computer and Information Technology (3), Social and Political Sciences (2), and Public Health and Nursing (2)
Role (some with multiple roles)	Professor (3), Associate Professor (4), Research Scientist (3)
Teaching experience (in years)	5-20 (2), 20+ (5)
Use of computer and IT services experience (in years)	20-35 (5), 36+ (2)
Digital learning material development experience (in years)	5-15 (3), 16-25 (3), 26+ (1)
UD and accessibility knowledge	Expert (2), Knowledgeable (3), Some knowledge (1), No knowledge (1)
Main Role (some with multiple)	Teaching (7), Research (7), Software development (1), administration (2)
Area of subject (some with multiple)	Climate Change and Global Health (1), Health Care and Nursing (2), Research Methodology (3), Interprofessional Communication and Collaboration (1), Universal Design of ICT (2), Human Computer Interaction (1), Technology and Society (1), Software Engineering (1), Artificial Intelligence (1), Social and Political Sciences (2), and Theory About Disabilities (1)
Course level (some with multiple)	Undergraduate level (4), Master's level (7), and Ph.D. level (3)

The interviews were held in four weeks using a virtual communication tool known as Zoom virtual communication. The interviews started with the introduction of the study and research, in addition, information about the research ethics had been provided to the participants before starting the formal interview. The interaction duration in the interviews with participants was ranged from 40 to 60 minutes.

The interviews went very well except some of the interviews were interrupted due to technical issues with the tool used for the interview, such as weak internet connection and audio-related issues. However, with the corporation of interviewees these issues were solved in a matter of very short time. All the interviews held during the office timing range from 11:00 to 15:00. The sample learning materials collected during the interviews are downloaded and stored in a password-protected online drive.

4.1.2 Online surveys

The online survey contained 20 open-ended questions and on average it took 20 minutes for each respondent to complete the survey form.

In total, 5 teachers responded to the survey and the data collected is useful for further data analysis. I sent a reminder to the heads of department to further follow up with the teachers. Some of them responded that they cannot forward this survey to the teachers as they are already overburdened with many other surveys and interviews. Some of them mentioned that our faculty is busy with the academic session due to an overnight change of education mode to digital. Although the data collected in the online survey was small scaled, it hopefully will help to find the relevant answers that will contribute in a positive way to the results of this study.

The data collected in the online survey is saved on university OneDrive in a password-protected drive in an excel sheet for further data analysis. The detailed demographics of online surveys' respondents are presented in Table 4.2 below.

Table 4.2 Demographics of online survey respondents

Gender	No such data collected
Age range	35-50 (4), 51-65 (1)
Department	Data Science (1), Public administration (1), Political Sciences (1), and Statistics (2)

Role (some with multiple roles)	No such data collected
Teaching experience (in years)	3-10 (4), 10+ (1)
Use of computer and IT services experience (in years)	20-30 (3), 30+ (2)
Digital learning material development experience (in years)	2-10 (3), 10+ (2)
UD and accessibility knowledge	Expert (1), Knowledgeable (1), Some knowledge (0), No knowledge (3)
Main Role (some with multiple)	No such data collected
Area of subject (some with multiple)	Statistics (2), research methods (3), data analysis (1), public policy (1), quality improvement (1)
Course level (some with multiple)	No such data collected

In the workshop I participated, a total of 20 participants were participated. Participants were from different departments at OsloMet – Oslo Metropolitan University. The participants were ranged from teaching to administrative staff and were very excited about the hands-on workshop on how to develop digital documents universally design.

During the seminar, participants felt uncomfortable while practicing the guidelines for universal design but after receiving the training they were very confident about developing documents universally design.

The findings are presented according to the different data collection methods. In section 4.2 the findings from individual interviews and online surveys are present. It is important to mention here as a reminder that the data is analysed using the same

data analysis methods and in a similar manner. Finally, section 4.3 presents findings from participation in introduction seminar on UD and workshop in a project "Implementing the universal design of ICT in OsloMet" at OsloMet – Oslo Metropolitan University, Norway.

4.2 Results from individual interviews and survey

4.2.1 Overview of themes

The codes developed in the coding phase and initial themes were then placed into the structure of the matrix suggested by Polkinghorne and Arnold (2014). An extract from this matrix is presented in the Table 4.3 below.

Table 4.3 An extract of the matrix with themes and codes from the interview and online survey data

Themes	**Data ID-1**	**…**	**Data ID-12**
Type of learning materials	- PowerPoint - Word - PDFs - Videos and texting - Always use digital way - Learning management system - Online teaching …	…	- PowerPoint - Videos in the PowerPoint - Podcast lectures - Online lectures - Now a day I do lectures digitally - I cannot develop learning material myself - I have an assistant for developing digital learning material for me. …
Issues to implementing universal design of ICT	- Fairly easy most of the time - not expert in all areas - know requirements of universal design	…	- Before I lost my sight, it was very easy for me to use digital technology. - After I lost my sight, it is hard for me to use

	- Legibility of learning material - caption of video is important for accessibility - UD is hard to practice - Lack of time for UD …		- Digital technology does not create for me and I did not get education on it - Do not use the technology by choice but with necessity. - Know requirement of UD very well - My sectary does most of the technical work. - Always develop accessibility documents …
Teachers needs and role of higher education institutions	- No students' complaint on accessibility - A firm tone at the top requiring universal design - Easily accessible learning material - Online courses/FAQs	…	- No, never complaint me. - For the first three years I ask university for help, but they did not help me, so I learnt everything self - UD Expert at school - Every project has to apply NSD in Norway. - NSD for UD in the Norway with an area especially for higher education - There is not time in my arbeidsplann

			(workplan) for universal design - The university should add UD in the arbeidsplann (workplan) …

Furthermore, these themes along with subthemes are the driving force in order to answer the research questions, that is, type of digital learning materials, issues to implementing the universal design of ICT, and teachers needs and role of higher education institutions. The theme “type of digital learning materials” emerge through the aspects related to digital learning materials and participants’ routine on types of digital learning materials, they develop for their students, how they develop and use learning materials in teaching, lecture, communication, and collaboration. The theme “Issues to implementing the universal design of ICT” emerge through the participants’ knowledge and universal design awareness aspects and is related to what do the participants know about the universal design of ICT, accessibility, and Norwegian national regulations and the like. Furthermore, this theme also emerges through the aspect related to participants’ experience with digital technology and tools, how they feel using these technologies, digital barriers and how accessibility these technologies are for them and the like. The theme “teachers needs and role of higher education institutions in the implementation of UD” has a broad scope and emerge through the organisational aspect and related to organisational and technical barriers that teachers face. Such as, what kind of help do they need, how the higher education institution take part in the implementation of universal design of ICT, institutions internal policies, and the like.

4.2.2 Summary of findings from individual interviews and survey

The findings from the data analysis performed on the dataset from individual interviews and online surveys suggest that the teachers in higher education institutions generally develop similar types of documents. There are several teachers that are also developing and teaching through online courses which include videos lecture developed using Zoom or PowerPoint. The texting of the video is also part of

their daily work but most of the teachers are significantly unfamiliar with how to do texting of videos. There were a few that have assistants or third-party help that do this task for them.

Data analysis found that the teachers are overworking during the pandemic COVID-19 than pre-COVID-19 time. However, it was interesting to mention here that the majority of the teachers has adopted the new way of teaching method that is digital classes. When it comes to the online way of teaching and videos, most of the teachers were interested to provide live auto-texting but they found that online texting/caption of videos only work effectively for English text, but not Norwegian text. Suggested by this research and supported the previous research conducted by Chen et al. (2018), the time is a big factor to do texting of the videos especially when you have many classes and workload because of the pandemic.

An interesting finding regarding recorded videos as digital learning material, is that the university don't recommend and/or ask the teachers to do texting of the recorded videos even this is required by the Norwegian national "Regulations on universal design of ICT solutions" 2013), and is a part of national discrimination act that is "Lov om likestilling og forbud mot diskriminering (The Norwegian Equality and Anti-Discrimination Act)" 2018).

The research suggests that the participants have quite high experience with the use of digital technologies and tools, majority of the participants are familiar or have heard about the universal design of ICT as a concept. There were few teachers that mentioned it is hard to practice the universal design of ICT in making digital learning materials. However, most of them do not take any measure to practice universal design to increase the accessibility of their learning materials. Many suggested that if we know that there are students with disabilities then they are very flexible and open toward helping them and universal design.

It is also interesting to mention here that the majority of the teachers are unfamiliar with the national "Regulations on universal design of ICT solutions" 2013) that is what is actually required by the regulations. Furthermore, findings suggest that several the teachers do not aware of neither internal nor external guidelines toward universal design and accessibility. However, all the teachers reflected that universal design is

an important aspect to be consider in higher education institutions. The majority of them found suggesting, it will be beneficial not to students with or without disability.

The findings further suggest that the higher education institutions as organisation do not have formal guidelines, internal policies, and/or routines that address or consider universal design. Especially, majority of the teachers found reflecting that if the university have such guidelines, but they never heard about these guidelines or they are unfamiliar with that. It is also interesting to mention here that many universities have learning or media centre to help the teachers with different teaching aspects. However, the institutions do not have any section or media centre that could help the teacher toward universal design or accessibility of learning materials.

Furthermore, the findings suggest that the students do not complaint about the accessibility issues with the learning materials except a few. The universal design (UD) experts reported that *"I do not think students think about accessibility unless they have disabilities"*. This is also supported by De Marsico et al. (2006) that the students with disabilities are great resources to learn and consider the accessibility of learning materials. However, in this case students seems to be uncertain to provide feedback on the accessibility of learning materials. The participant further suggested that even the students specialised in UD often do not check the accessibility of their documents.

This research suggests and also evidenced by Moriña and Orozco (2020), most of the teachers have access to all possible help from higher education institutions. The institutions are open to providing all necessary support and actions but there is lack of internal policy on UD, information sharing, and awareness on universal design in the general population is low.

The findings suggest that the higher education institutions have an important role in the implementation of the universal design of ICT especially regarding internal policies and routines on universal design of ICT. This not just suggested by this research but also supported previous research conducted by Moriña and Orozco (2020). The higher education institutions can take several measures founded in this research in order to help the teachers to practice universal design while making digital learning materials.

The findings are presented in three sections, group by the themes developed in the data analysis. in order to ensure anonymity, the participants are being referred based on the order in which they were interviewed or responded to the online survey instead of using codes that were used to get consent from the participants. Further, these findings are explained in detail in section 4.2.3, 4.2.4, and 4.2.5.

4.2.3 Type of digital learning materials

4.2.3.1 Type of learning materials

The majority of participants reported that they are developing learning materials by using Microsoft (MS) PowerPoint, Word, PDFs, Videos, Zoom and/or MS Teams, and posts in the learning management system. This is an interesting aspect that the participants in different universities in Norway has something common that they use to teach the students, that is the way they develop digital learning materials using common tools. It might be possible that the participant is developing other types of documents, but these are the most frequent documents participant used to develop in everyday teaching routine.

The two participants mentioned that the development of interactive assignments using excel as learning material.

Furthermore, the fourth participant defined the types of learning materials that the participant used to develop into two different categories, that are “written materials” and “film”. In written materials, the participant somehow mentioned a similar answer as the previously mentioned participants. However, the participants also develop handwritten notes and word documents about various topics. The assumption here shows that there are still some teachers in higher education that develop handwritten materials which are hard to make accessible.

Further, scanning these handwritten notes and make them available to the students in learning management as an accessible document required extra time. Cliffe (2009) also reported that the standard print learning materials in mathematical subjects still have a technology gap for students in higher education. Especially the large mathematical and statical formulas are hard to make accessibility in the standard prints and require time stated by the author. Further, Cliffe (2009) stated that due to lack of time to make the standard prints accessibility, the learning materials often did not accessible.

The participant also reported that the mathematical exercises, detailed solutions to these exercises, and RStudio scripts are also part of learning materials. It is interesting to consider for further work on how the learning management system handle the accessibility of the mathematical exercise especially in online quizzes. However, this have not been considered due to scope of this research.

Other types of learning material that participants used to develop in addition to videos, are “screencasts”. The participant use office as a studio to develop these videos instead of a media studio. This makes it clear that the environment for developing these videos might be of poor quality and can be inaccessible for many students. Similarly, the participant stated that *“I teach a course with up to 400 students, and the probability is high, that someone is disabled.”*. So, when there are many students in a class like this, there is a high chance that there are students with disabilities in the class who might needs accessible learning materials.

The fifth participant reported using programmatically generated Canvas (LMS) quizzes developed using R programming language and Canvas APIs. For other documents, participants use Google Docs, which includes visualisation and analysing the quiz results in addition to other notes. The participant reported being used Google docs because it is easy to use, and users have more control over the structure of the document. The participant did not mention anything about the accessibility of this tool.

In addition, other similar types of learning materials, the rest of the participants reported using Zoom and MS Teams for live lectures and video recordings including screencasts. Further, one of the participants stated the video lectures are an important resource as a participant teach students from all around the world and these lectures help in different time zone.

The seventh participant mentioned the use of Prezi as a tool for presentational documents for lectures. The three of the remaining participants mentioned using video lecture and have a professional video producer who works with the technical part of the learning materials; however, all contents and scripts are done by the participant. Therefore, participants use media centre at the university to film the video lectures.

As mentioned earlier, there has been a participant, were interviewed and voluntarily reported being blind since a few years ago. The participant reported that before becoming blind used to develop learning materials in PowerPoint and videos in the PowerPoint. Currently because of blindness, the participant stated that *"I cannot develop learning material myself, but I have an assistant with master's in education who developed digital learning material for me.".* Further, the participant stated that *"I cannot use new technologies because these technologies are not accessible for me.".* This actually shows an interesting factor that is even if the technologies have become very advanced but still there exist digital divide.

The participant also reported use of discussion forums as one of the learning resources that participant uses for teaching a large group of students. This phenomenon is very interesting, that is the idea of decentralisation of learning and teaching processes from top-down learning approach to bottom-up approach. It let the students raise and ask questions by their own self.

Collectively, it seems that all the participants somehow are developing similar learning materials for their students. However, the focus to develop these learning materials is teaching but not the technology itself.

4.2.3.2 Digital mode of teaching

Since 2020, the outbreak of COVID-19 pandemic hit all the aspects of life for human being. This also includes the education sector ("Coronavirus disease (COVID-19) Pandemic," 2020). These are not just students that are highly affected by this pandemic but also the teachers. Due to the pandemic, the mode of teaching has been transformed from the traditional way of physical classes to the digital mode of teaching. It is mentioned in the literature review that the one the issues teachers are not practicing the universal design while making digital learning material is "lack of time" (Chen et al., 2018). However, the digital mode of teaching makes it even more hard for teachers to use their time effectively to fulfil the students' learning needs. Therefore, it was important to further explore how the teacher handling this overnight change of teaching mode, especially further analysis with respect to the universal design efforts in making digital learning materials.

It seems, almost all the participants being teachers reported that they have adopted the new situation quite well but there are participants who mentioned that they are

still struggling to adapt to the new situation. All the participants nowadays using the digital mode of teaching as most of the universities in Norway are closed. The participants mentioned that they are using video conferencing tools such as Zoom and MS Teams as a digital channel to teach their students. However, they did not mention the accessibility of these tools except for three participants who reported that these tools are not completely accessible.

Two of the twelve participants reported that they adopted the new situation, but they are overworked than before the COVID-19 period. Three of the participants reported that it is more challenging to teach using Zoom because of lack of interactions with the students and audience is more passive in online classes than the physical classes. This makes sense that teachers generally are flexible and are open to adopting the new situation to fulfil the learning needs of their students.

All the participants reported that being digital and digital mode of teaching is not difficult. The higher education institutions are very active in helping the teachers with online courses, which was not the case before COVID-19. Furthermore, the colleagues are flexible and collaboration oriented.

More interestingly, one of the participants reported that COVID-19 opens new ways of teaching and provides more freedom. It seems that the teachers have more freedom in online teaching but for many teachers, the physical interaction with students is very important. The body language can tell a lot by the students turn off videos and it is hard to get feedback from them.

The texting of recorded video is a very important aspect when it comes to universal design and accessibility of the learning materials. However, eight of the twelve participants the teachers mentioned that they do not know how to do texting to videos. One of the participants prefers not to do, however, must do as a part of teaching. The sixth participant reported that *"it is hard to do texting for large video lectures, we cannot do it as it takes time. It seems to be impossible to do text for every word."*. Another seems completely unfamiliar with the UD requirements and stated that *"I do not know if it is a requirement for texting of recorded video".*

Two of the participants reported adding written and detailed content descriptions of the videos in Canvas but have not added time tags of subtitles. One of them stated that if I know there is a student with disabilities, I will do it. One of the participants

personally likes to watch the videos with texting, therefore, always do the texting to videos.

Another participant reported that we do not get help from the university regarding texting the videos as it required expertise and we do not have such an expert at the university. Further, five of the twelve participants reported that the big problem is communication with the students through Canvas LMS which is not perfectly universally designed. One of the participants spent a lot of time with the assistant to learn to use the canvas with screen reader.

4.2.3.3 Recommendations by the higher education institutions

All the participants except one participant reported that their universities do not recommend doing the texting to video and most of them mentioned that there is a lack of guidelines and resources to perform this task. One of the participants stated that *"if they ask me, it will break all my teaching capability. If they ask me to text in the video it will take a lot of time and it 200% capability, I might need a separate assistant for that"*.

The eleventh participant personally developed a community along with other teachers in this area. The participant mentioned that we must do everything universally designed even we know if there is a student with a disability or not. There might be students who have hidden disabilities and most of the students hide this information because they shy to talk about their disabilities. This seems a great motivation and strong argument to make the learning materials universally designed.

Further, three of the participants reported that the UD is above the technology and people do not think about it as they use to say I never have a student with disabilities. This is a very interesting response as one of the objectives of universal design is to provide users freedom instead of dependability.

Further, one of the participants reported that *"the system that is available for me, I cannot get the education to learn it how I can use it. University has the tutorial that only helps the sighted teacher but not disabled teachers."*. This is the case where universities must take responsibility and make sure that the information that the made available through all their channels must be accessible for all.

The two of the twelve participants reported that to text the video as learning material takes a lot of time than the other types of learning materials. Further, teachers neither have the time nor skill to do it. This is the fact that was suggested by many researchers in the literature review. Another participant stated that *"the university has a website with recommendations about UD, but I have not read it"*. However, did not get information from the administration that *"I should or not"*. It seems to be the time as a factor because of which participants do not consider learning it.

4.2.3.4 UD support in learning management systems

Two of the participants mentioned that they receive feedback or evaluation report from the learning management system regarding the accessibility of the learning materials that they are uploading. The learning management system that participants mentioned here is Blackboard, however, it has not been evaluated in this thesis because of the scope of the study.

Participants stated that if there are accessibility issues in the learning material that is being uploaded to LMS, the LMS provide an evaluation report on what is exactly the error is and how the user can correct this error before uploading it again on the LMS. This seems to be a very interesting point that the LMSs can itself help the teacher in order to ensure that the learning material that they are uploading for students is universally designed and accessible for all.

4.2.4 Issues to implementing universal design of ICT

4.2.4.1 Use of digital technologies

All the participants reported that they are using digital tools and technology as a tool for teaching except one of the participants also using handwritten notes.

Majority of the participants found comfortable with the use of digital technologies except for the two participants. It is interesting to mention here that one of the participants stated that it was very easy for me to use these digital technologies but after I became blind, it is very hard for me to use them. The participant further reported that *"I did not use the technology by choice but with necessity"* and the participant reported not getting training on UD of ICT. This makes it clearer that there is a lack of training at the higher education institutions toward the universal design of ICT especially learning materials.

Collectively, it seems that the participants with higher experience with the technologies feel more comfortable, however, majority of them do not know the requirement of UD of ICT.

4.2.4.2 Familiarity and knowledge of UD and consideration

Three of the twelve participants reported not to be familiar or do not know the universal design of ICT. One of the participants reported that there was a lecture about “universal design of university” which was one of the enlightening lectures for the participant. Further, the participant reported that *“I am familiar with the term "Universal design"*. However, when receiving your mail, I had to google the abbreviation "ICT". Found in this research and suggested by the Moriña and Orozco (2020), it seems that the participant is familiar with universal design as a term but only physical aspects of universal design such as buildings.

Furthermore, another participant mentioned that *“until I read your mail, I had never heard of this that is implemented part of the universal design ICT in higher education”*. One participant reported some knowledge of UD defined universal design as “accessibility of learning materials means that there are alternative ways of accessing the content”. The participant also presented some examples to reflect the understanding of accessibility that is *“reading text aloud for the blind or dyslexic, "alt text" descriptions of images, shortcut keys or menus for those who can't use a mouse, captioning of movies for the hard of hearing, adjustable font size and contrast for the visually impaired, colour-blind-proof colour schemes, simple language wherever possible, use of common, open standards for interchange of learning materials facilitates, and the conversion to alternative media or forms of expression”*. This definition is interesting in a way instead of being a legal requirement, increase the accessibility by providing alternatives.

Rest of the eight participants have partial or full knowledge of UD. All these participants reported considering universal design somehow while making learning materials. However, one of these participants stated that “I do have it in the mind, but I am not that active implementation it.”. It might be possible the participant has a different interpretation of what universal design is and what are the requirement that the participant be required to meet. The participant recommended that “everything digitally should have to be universal design”.

Four of the nine participants who have knowledge about the UD reported that the UD is hard to practice. One of the participants reported that the master students assistant help to make the learning materials including the evaluation of these learning materials according to students learning needs and accessibility, Further, the participant mentioned that *"You should know early and aware is very important"*. It has also been suggested by the other research that awareness is very important such as Chen et al. (2018) and Moriña and Orozco (2020).

One of the participants reported that UD is difficult unless the technology becomes simple. Further, the participant reported that *"I am a bit disappointed even though technology becomes more advanced but not accessible for all"*. Another participant reported that it is easy to practice universal design, but the technical part of the UD is hard as there are several requirements that must be considered.

The twelfth participant stated that people should not think it is hard, if many people think that it is hard then, it will increase the level of difficulty. The participant also reported that it is only videos as learning materials, that take more time than other learning materials.

Further, all the participants regardless they know UD or not reflected their behaviour towards UD as it is an important aspect that must be considered and implemented within the frames of the relevant subject. One of participants reflects a positive view about the implementation of UD that is it is perfectly possible, but the universities need more people with UD capabilities and skills.

The participant further reported that *"If I have universally designed learning material, then I do not need to ask students what kind of disabilities you have."*. This is another interesting argument for making universal design regardless thinking of having students with disabilities or not in the class.

4.2.4.3 Barriers

There are several barriers that teachers reported in the individual interviews and online surveys. These barriers are categories into three categories in the data analysis that is, technical barriers, awareness barriers, and organisational barriers.

4.2.4.3.1 Technical barriers

Three of the participants mentioned that the main challenge is that they are tired of learning new things. However, participants seem interesting to learn more about the technical part of UD of tools and learning materials. Two of the participants mention that the integration issues with the videos with text files and learning management systems. One of the participants mentioned that the technical information is overloaded, and we have a lot of courses that we can take but do not have time to learning all technical aspects to support teaching.

Furthermore, five of the twelve participants reported that most of the digital tools are not universally designed. One of the participants reported it seems that tools are only universally designed for students but not for the teachers. This was also reported by another participant that not all the tools are universally designed. These participants reported uncertainty about the accessibility of the tools being used by the teachers in higher education institutions.

4.2.4.3.2 Awareness barriers

Participants with no knowledge of universal design reported not considering universal design while developing learning materials because of a lack of UD awareness. The fourth participant mentioned that *"without the awareness that it actually is just a label "universal design""*. It reflects that it is not possible for a person to consider something if the person does not have awareness about it. Another participant reported that it is easy to consider UD as I know about it, however, usually do not think about it if I do not have students with disabilities.

Eight of the participants reported that they have never been offered courses on universal design of any training regarding the accessibility or the universal design of learning materials. The remaining participants did not explicitly state that the universities offer them a course on UD or training, but they personally learned and adopted UD.

4.2.4.3.3 Organisational barriers

The two of twelve-participant reported that all the tools that teachers use must be universally designed. It is the university's public procurement responsible for that, but

they do not have expertise in that, or it comes to knowledge as they may not have the expertise to judge.

All the participants reported that the time is a big issue that is they do not get extra time from universities in order to learn and practice the universal design.

4.2.5 Teachers needs and role of higher education institutions

4.2.5.1 Students feedback on UD of learning materials

Majority of the participants except two reported that they did not receive complaints regarding the accessibility of their learning materials. One participant reported students with reading and writing disabilities that is Asperger's diagnosis complained about the about of text and difficulties regarding identifying wrong and correct answers. Another participant mentioned receiving comments from the students if they do not understand the content in the learning materials. Participants consider it worst if the student does not raise questions and feedback if they do not understand. It is also suggested by De Marsico et al. (2006) that the students are a great resource to learn if they provide feedback.

Three of the participants mentioned that they never received any complaint about the accessibility of learning materials as they reported that they always develop universally designed learning materials. However, one of these participants reported that a very few students complain that your learning materials are not accessible, furthermore, students do not think about it unless they have disabilities.

Further, the two participants reported even if the students have disabilities, but they do not want to share this information – Whether you do it or not it is on you, students do not complain and for many, it does not matter. Correctively, it seems that the feedback from students is consider as important factor as reported by the participants.

4.2.5.2 Online UD courses with practical example

Four of the twelve participants were reported being in the favour of an online crash course on UD with practical examples related to learning materials and how to practice UD in everything routine. One of the participants stated that something truly universal design is tough, however, if teachers learn and have active practical knowledge of universal design then, it would not be tough. It seems that the

participants are interested to learning but they need online course with practical example, for example, a course on how to make a universally designed PowerPoint with examples and tips on how to do it would be enough.

Another participant suggested that all universities in Norway should arrange such courses for teacher and make it mandatory that all the learning material should be universally designed.

4.2.5.3 Awareness and information sharing

Majority of the participant reported that the awareness and information sharing about UD is very important in the first hand. However, it is not a practice for them to consider all the requirements in the legislation. Therefore, universities and/or authorities of universal design must provide a checklist to the point of what is required and what is not required based on the interpretation of legislation.

Two participants reported an interesting fact about the discussion forums and one of them stated that *"my university already uses standards-compliant systems that support accessibility."*. It shows that the cooperation and discussion between colleagues are also very useful. The participant has developed a small community in the university about the universal design of learning materials which helps the teachers with the accessibility of learning materials.

Another participant express views on automatic testing of learning materials if possible, to obtain a UD evaluation report on learning materials. The participant also reported that their university is using Blackboard as a learning management system that provides accessibility evaluation on the learning materials. Participants assume that it is very useful as it also provides a solution proposal on how to fix the errors reported by the learning management system.

4.2.5.4 Higher education institutions internal policies

In addition to the individual level, they should learn how the do UD. However, two participant reported very interesting argument, that is there is no bottom-up approach, and the implementation of the UD should be based on the top-down. The higher education institutions should have action plan and resources so that teacher has time to do it at that level. It should an integral part of pedagogy, the higher

education institutions should have UD as a part of pedagogy so that the teachers can learn and consider it from the beginning.

Five of twelve participants reported that it seems that there is a lack of internal policies in universities about the universal design of learning materials. One participant suggested that there should be a meeting about universal design internally in the department. Another participant reported that *"so far there has not been a special initiative that has been done from the university management for where I teach. Even though teachers have provided university recommendations and suggestions about UD policies"*. It seems that several universities itself has not priorities the universal design as an internal policy.

The participant also mentions that there seems the lack of collaboration between the higher education institution on universal design. It seems that there must be an inter universities collaboration group from different universities on the implementation of the universal design of ICT.

Two of the twelve participants reported that although Norwegian national regulations on universal design of ICT require that the Norwegian Authority for Universal Design of ICT should monitor the learning materials. However, the participants never heard that there will be schedule monitoring of their learning materials towards universal design requirements. Furthermore, the participants suggested that at least, higher education institutions should have responsibility to monitor check that whether UD requirements are met. The universities should have the policy to make sure that their faculty members have knowledge about UD and practicing it regularly as teachers are not directly listening to the Authority for universal design of ICT.

Furthermore, in addition four participants suggested that the higher education institutions should have UD expert at school where you can ask them for information about UD and how to make the learning materials universally designed. Many universities do not have universal design expert, someone to help them as teachers.

4.2.5.5 UD and teachers' workplan

Five of the twelve participants reported that many teachers at higher education institutions in Norway have a full work plan called "arbeidsplann" in Norwegian. However, the participants reported that there is no time for universal design in their

teaching work plan. Therefore, the participants suggested that the universities should add UD in the work plan so that they can use this time to learn and consider UD in everyday teaching. The most important needs that several participants report in the interviews are categories into two categories related to the time that is “training and time for training” and “time for practicing UD” in the teachers' work plan.

4.2.5.5.1 Training and time for training

Several teachers mention that higher education institutions offered them all kinds of help - that is not the problem. The actual problem is to get enough time to learn and develop learning material universally designed.

Furthermore, ten of the twelve participants suggested the need for UD training and time for training. It is important that all the teachers should have this UD training at least once a year maybe in a departmental meeting.

All the participants reported that the big issue is the time that is the teacher do not have time to learn and practice universally design. Further, if people have time, they can priorities the subject matter but not the UD unless the university says this. Therefore, universities must provide frequent awareness and must have a routine on following up to ensure that universal design is being practiced.

Two of the participants suggested that the time is important especially only in the beginning for learning UD, once they got training with the practical example then, it would be easy for them to practice it without using much time on it.

The participants supported this argument by reporting the pandemic situation and adoption of the new way of teaching modes by the teachers in higher education institutions. The participants reported that now teachers have learned to use the digital mode of teaching and accepted it. Similarly, the teachers can learn and accept the universal design by a top-down approach that is if universities prioritise it and make internal policies on UD.

4.2.5.6 Media centre for UD

Five of the participants reported that they have media centre at their universities that help teachers with teaching resources and provide support to their teaching. The

participants consider it as a useful initiative and one of them suggested that someone who could do the video captioning would be a great help.

Two of the participants stated that their universities have a contract with a third-party company that provides these services especially help with texting of video materials. The participants are suggested that possibly get feedback on learning materials from someone in university would be helpful.

4.3 Results from participation in introduction seminar on UD and workshop

4.3.1 Summary of findings from observation

During the introduction seminar on UD of digital learning materials, the participants were continuously under observation and the notes were collected as data by the other research. The focus was to find what kind of digital learning materials both administrative and academic staff at OsloMet use to develop for students and issue with these learning materials. Furthermore, an instructional course based on both theoretical presentation of universal design, regulations on UD, principles, different UD requirements, and a hand-on practical examples as exercise or tasks. Results are concluded based on the data analysis of observational data. Therefore, this section presents participant's routines regarding the development of electronic documents (e-documents) before and after the seminar that was observed in the introduction seminar.

Collectively, all participants seemed very positive at the end of the introduction seminar. Six participants mentioned that they never imagined how frustrated is it for people with disabilities if the document is not accessible. Five of the participants reported that the practical examples, hands-on experiences with different types of documents with errors, and checklist to evaluate the document were very useful and to the point. Therefore, it is timesaving and let us practice UD easily without extra burden.

Furthermore, more the research found that the participant reported that there is a lack of UD routine that they can follow to develop universally design documents.

After the information seminar, participants were asked to participate in the online quiz with different tasks and questions about accessibility of documents. Most of the

participants score more than 90%. The other researcher in the seminar also reported that this is a great achievement and higher education institutions should arrange these seminars at least once yearly for students, teachers, and administrative staffs. The results are presented in detail in section 4.3.2 below.

4.3.2 Things that are common to UD of e-documents

Participants were provided a list of a common set of instructions to make an e-document universally design. All participants seem very interested in these instructions and after the presentation of these instructions and their feedback was observed which is presented in the section according to each instruction.

4.3.2.1 Good file names

Most of the participants observed as they are already considering this instruction while making documents. However, one of the participants asked a question about what a good name for a file is. A good file name is a name that reflects the content of the document in a perceivable and understandable manner. After the participants testing different file names with a screen reader, they reported that how it is important to provide good file names that not just help the person with disabilities but others such as searching a correct file from a large archive.

4.3.2.2 Good structure

The structure of the document was a very important aspect in the seminar, where the majority of the participants reported not considering while making documents. Five of the participants reported using bold text and large font size instead of using built-in headings in MS Word or other similar tools. The research uncovered that after testing different unstructured documents with keyboard navigation, most of the participants reported that we never think about it before. Moreover, ten of the total participants reported the use of spaces, enters, and tab spaces for adding spacing between words and lines in the documents.

4.3.2.3 Good contrast (minimum 3:1 / 4.5:1 – preferably more)

The research observed that the participants were unaware of measuring colour contrast of the text and background of their documents. The research observed, but the reason for this case and the reason for that cases was lack of awareness about

the requirement such as WCAG 2.0 – 1.4.1 – Use of Colour and the tools required to measure the colour contrast. The research also uncovered the importance of the need for training of the administrative and academic staff of the higher education institutions.

4.3.2.4 Alternative to colours that convey information

The participants were asked to read a document in which different parts of the document were referred using the colours only such as, for more information read the text in the blue box below. The participants were provided the simulation glasses that simulated different effects of visual impairments and screen readers. After the exercise, none of the participants felt comfortable or easy to find the referenced part of the document. The documents were then marked with other indicators in addition to colours such as the more information is presented in blue colour, in addition, there is an asterisk character * at the start of this paragraph. The participants were asked to test the document again with the screen reader. The research uncovered that all the participants were able to identify the reference information and read it using a screen reader.

4.3.2.5 Clear and large enough fonts

All participants were familiar with the use of correct font style and large enough size for a different part of documents such as ten of participants reported the use of font style Arial and Times New Roman with font size 12 for body text. It increases the readability of the documents and user with different accessibility needs can read the documents in an effective way.

4.3.2.6 Avoid images of text

The observation revealed that most of the participants using images of text in the documents. Five of the participants reported being used scanned images of documents in e-documents such as word, PowerPoint, and PDFs. The findings suggest that this affects the accessibility of the documents and will strongly affect the person with visual disabilities.

4.3.2.7 Alternative text for images

The research uncovered that only seven of the participants considered using alternative text for the images in the e-documents. The participants were asked to test an image in a document with a screen reader in addition to the use of simulated glasses. The image did not contain alternative text, due to which the screen reader did not read the image. However, the image again tested with this screen reader but this time the image had alternative text in a word document which was read by the screen reader.

Among others, one of the participants expressed uncertainty about what is a good description or alternative text to an image. This shows that the participant knows about the alternative text but not what exactly the alternative text to an image should be. The suggested were given to all the participants in form of a checklist that is a text alternative can be a short sentence that explains the purposes that image reflect visually so that the person with disabilities can easily perceive and understand the purpose of the image.

4.3.2.8 Good link texts and clear markings

The participants were asked to add links to a word document and provide link text. The observation revealed that the participant was comfortable with providing the text to the links. However, two of the participants struggled with providing good link text that provides user purpose of the link.

4.3.2.9 Audio and video texts (possibly visual / sign language-interpreted)

The observation revealed that thirteen of the total participants did not use to add description text in the form of the transcript to audio or video content. Overall, the participant expressed uncertainty towards audio and video texts as participants stated that it takes a lot of time and they do not have time in their work plan to do that.

4.3.2.10 Provide language

The observation shows that nine of the participants were familiar with selecting the correct language of the documents. However, they were uncertain about the document which contains text in multiple languages. The suggestion was provided as

an answer to this uncertainty that the language can be selected by selecting the part of the document and a built-in function in the tools.

4.3.2.11 Run accessibility check

The participants expressed uncertain knowledge about the built-in accessibility checker in different tools such as MS Word, PowerPoint, PDFs, and Excel. The research reveals that this is an important function that quickly helps the user to check the accessibility of their document along with solution suggestions on how to fix the error. The observation ended after the exercises are given to the participants and their feedback was documented.

5 Discussion

The results from this research uncovered that in addition to UD awareness barriers, time for UD (both for training and practice) in teachers' teaching work plan and lack of higher education internal policies on UD, inhibit the implementation of universal design practice in higher education institutions. More specifically, the presented findings in the results section show the insufficient awareness of teachers toward National regulations on UD of ICT and related guidelines of UD for digital learning materials. The research also uncovered that the UD experts, who by profession are teachers as well, presented suggestions and proposals to universities but there seems to be a lack of prioritisation of UD in institutions' internal policies.

This research uncovered that the majority of teacher do not think that the guidelines are hard to follow if they have awareness and information about the part of regulations related to learning materials. However, findings suggested by Chen et al. (2018), the teachers are positive toward learning and implementing UD and reported the regulations of the universal design of ICT is hard to fulfil.

The higher education institutions lacking the routines for monitoring the learning materials against the universal design requirements, as well as the authority for universal design of ICT. Therefore, based on the suggestion by Kawas et al. (2019), this research suggests that the collaboration between different institutions facilitate to promote the universal design in general population.

The findings of this research also suggests that the teacher in higher education institutions somehow develop similar types of learning materials for students. This contrasts the findings in a study conducted by Rose and Meyer (2002) on teaching every student in the digital age, the same teaching approaches do not help the students with different abilities, implementing UD in learning materials does not eliminate the digital barriers but it is also important to implement the UD culture at higher education institutions.

This research revealed several issues and challenges that the teachers in higher education institutions in Norway are facing in order to practice the universal design. The participants reported that the time is a big issue that inhibits the practice of universal design, especially in the current situation of a pandemic where most of the teachers reported to be overworked and work from home. These findings extend the

findings reported by Nelson and Rose (2014).

The research shows that participants do not have additional time so that they can use to learn UD and practice it in everyday teaching routines. The research conducted by Chen et al. (2018) also suggested lack of time is a big challenge for teachers in order to practice the UD in learning materials. However, in addition to that, this research suggested that the pandemic, an overnight change highly hit the teachers' everyday working routines and adoption capabilities.

Furthermore, the research suggests that UD only takes time to learn and adjust in teaching routines, once the person learning and understand how to practice UD in learning materials then it do not take a lot of time (Nelson & Rose, 2014). However, it is the video as a learning material that takes much more time than other time of learning materials.

Based on the findings of this research, the teachers seem to be adopted towards new situations such as the digital mode of teaching due to pandemic. However, in this situation, the higher education institutions also took a greater part which not just include the online courses and training for new situations but also the extra time compensation. Thereby, the UD experts interviewed in this research suggested that in the similar way if the universities help them regrading UD, it will make it easy for them to adopt the UD which will help all. In the study conducted by Hitchcock and Stahl (2003) on universal design of learning, universal design gives a flexible and adaptive approach that is suitable to help and overcome the challenges related to the learning needs of various ranges of students. It is also suggested by King-Sears (2014) the accessibility documents ensure the high level of the success of all students especially students with disabilities.

In addition to the findings in the research conducted by Hargittai (2003), this research significantly suggests that not all the tools provided to teachers are completely accessible. The findings of this research show that teachers in Norway are using different learning management systems in different universities. Reported by the participants, this research uncovered that the tools procured by the public procurement are not accessible on the teachers' side. It might be possible that these tools are accessible on students' side, however, this was not in the scope of this study, therefore, the UD evaluation of these tools is considered as future work.

It should be noted that participants in this research revealed that the public procurement at universities do not have UD experts or expertise. It is universities' responsibility to ensure that the tools that they are offering to teachers and students must be ensured that tools are universally designed and accessible. Furthermore, teachers reported that they need someone at universities who can help them with the UD of learning materials such as a UD expert at universities' media centres.

The findings of this research suggest that the teachers need crash courses with practical examples and training on UD of learning materials. However, Griful-Freixenet et al. (2017) explored the effectiveness of the UDL in a study and found that the effectiveness of UD of learning materials is based on the ongoing process of enhancement instead of a destination. Correspondingly, this research suggests that the UD training for teachers should be frequent at least once yearly such as at the departmental meeting. Furthermore, the teachers should be offered courses on the universal design of ICT at the beginning of their career and/or education in pedagogy. In addition to training, it is also likely important that the teacher should provide time for training in the teaching work plan.

The data collected, and suggestion taken from this research gives a significant confirmation on the assumptions made from the theories in the literature review. Furthermore, it further extends it to other areas of this field that have not been explored in this research such as implementing UD culture and evaluation of tools that are being offered to teachers and students at higher education institutions.

The results from this research suggest top-down approach for implementing UD of learning materials in higher education institutions. Therefore, higher education institutions and authority for universal design are important actors in order to promote UD in learning materials and help the teachers in practicing UD while making learning materials. This can be done by taking initiative both in universities' internal policy and practically to promote and ensure that the UD is being practiced at higher education institutions.

Finally, this research not just present the importance of universal design of ICT in higher education institution but also presents the valuable findings that will hopefully help the higher education institution to effectively prevent the user description by adoption and implementing the regulations on universal design of ICT. It will hopefully help the teachers to proactively working to increase the accessibility and universal

design of learning material that will help the students with diverse abilities.

6 Conclusion

In this research, the implementation of universal design of ICT have been under investigation to gain insights on what kind of learning materials teachers in higher education institutions used to develop for their students. By use thematic analysis method on the data collected in the data collection phase, the research attempt to explore and explain issues that teachers face to practice UD in their learning materials. Furthermore, the research uncovered the help that teacher needs from higher education institution to make it easy for them to practice universal design while developing digital learning materials. The research aimed that this will hopefully contribute to benefit not just the students with disabilities, teachers, and higher education institutions, but let all students have equal access to digital learning materials regardless of their abilities or disabilities (Ralabate, 2011).

In the introduction of this thesis, it is stated that the following research questions have been under investigation:

- What kind of digital learning materials do the teachers in higher education institutions usually create?
- What are the issues related to digital learning materials teachers created or are using?
- What are the issues that teachers face while practicing universal design for learning materials in higher education?
- What would help the teachers to make it easy to practice universal design for digital learning materials in higher education?
- What do higher education institutions need to do to ensure that teachers are practicing universal design when preparing/creating digital learning materials?

Three aims have been defined in this research, first of all, to extend the previous findings in the studies conducted by (Chen et al., 2018). Second, to investigate the issues and challenges that inhibit teachers in higher education institutions to practice the universal design of ICT in digital learning materials. Third, what can help teachers need from higher education institutions in order to practice the universal design, promote, ensure the UD practice.

In order to answer the research questions, the findings were categorised into three: Issues to implementing the universal design of ICT, familiarity, and knowledge of UD

and consideration, and teachers' needs and role of higher education institutions. These answers also include the suggestions that can be considered as recommendations for higher education institutions in order to ensure that UD is being practiced by the teachers.

The findings of this research showed that the teachers in higher education institution develop similar kind of digital learning materials that are PowerPoint, Word, PDF, online Quizzes, Videos, and LMS posts. It reported likely challenges that teachers face towards practicing universal design of ICT including the awareness and organisation barriers revealed by this research.

The teachers are positive toward learning and practicing the universal design; however, higher education institutions have a very important role in prioritising the UD in internal policies and providing training, time for training, and practicing the UD. The research uncovered that the teacher does feel that the practicing of universal design is easy, and they are comfortable to adopt regulations on UD of ICT. This significantly leads to the universal design culture for not just implementation but collaboration between teachers and different institutions.

The research suggests that the higher education institutions should priorities universal design of ICT in internal policies and ensure that the teachers are practicing UD in learning materials. Furthermore, take initiatives to reform the public procurement at university in order to secure the values by making sure that the tools that are being offered to teachers are universally designed.

The UD evaluation of tools that universities offered to both teachers and students would be an important factor that has not been yet explored in this research. This evaluation can help the universities to procure the tools that meet not just the needs of teachers and students but also prevent the user discrimination according to "Lov om likestilling og forbud mot diskriminering (The Norwegian Equality and Anti-Discrimination Act)" 2018) and Norwegian National "Regulations on universal design of ICT solutions" 2013).

Based on the results of this research, it would be interesting to look further into how to practically achieve the universal design of ICT in higher education institutions which this research could not do within the scope of this master thesis.

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Appendices

Appendix A: Invitation email for individual interviews (to heads of departments)

Dear XYZ,

I am Adil Hussain, master student in Universal Design of ICT at department of computer science at the faculty of Technology, Art and Design, Oslo Metropolitan University (OsloMet), Oslo, Norway.

As a part of my master study's final thesis, I am working on research project with subject to "Implementing universal design of ICT of learning materials among teachers in higher education". Equal access to education and training for all prioritized goal in many parts of world, including Norway, the EU, and US as well as the equal access to quality education is reflected in the UN sustainable development goal no. 4.

As Norway has had universal design of ICT solutions since 2014 which according to Section 2 of Norwegian Regulations on universal design of ICT solutions specifically state that the regulation of universal design of ICT apply to solutions in education and training sector. The law also stated that the "digital learning materials" should be universally designed.

The Norwegian authority responsible for implementation of universal design of ICT have been working hard to provide information and guideline past several years. However, little considerations have been given to the actual actor who develop the digital learning materials that is teacher in higher education institutions. On the other hand, the part of difficulty is not only related to the teachers but also with the higher education institutions in Norway to fulfil the requirements of regulation on universal design of ICT.

In this master study is planned to figure out the challenges related to the implementation of universal design of digital learning materials in higher education institution. The study is based on online surveys and individual interviews with the teachers from different departments and education programs. This master project is in connection with a research project looking into training teachers in making their digital learning materials universally designed.

Specifically, for individual interview, I have planned to conduct interviews with one or more teacher from your department. I request you to please forward my email to your faculty and request them to participate in the interviews. In addition, I want to mention here that the information related to the participants will be completely anonymous and only hand notes will be taken during the interviews.

The channel for interview will be digital (Zoom, MS Teams, Skype) and a consent form will be distributed to the participant digitally (Email). The Interviews are planned to take place between 10.10.20 to 06.11.20.

Looking forward to hearing from you. Please contact me if you have question or need more information.

Best regards,

Adil Hussain

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Appendix B: Invitation email for online surveys (to the heads of departments)

Hi XYZ,

Just a kind reminder, I hope that you received my email and forwarded it to your faculty members. However, I have not heard anything from them expect a few and I know that they might be busy with the academic semester, especially with the change of mode of education to digital it might become more challenging for many teachers.

Therefore, I have designed an online survey form with open-ended questions for the teachers who time do not have to participate in the individual interviews. I am sure it would be easy for them to answer the survey questions instead of participated in interview.

Can you please forward the Online Survey Form to your faculty member and request them to answer the questions in the form?

I shall be very thankful to you if you self is a teacher and can complete this survey.

Looking forward to hearing from you. I shall be very grateful to them if they can answer the survey questions before 06th November 2020.

Thanks

Best Regards,

Adil Hussain

Appendix C: Calendar invitation (to participants)

Dear XYZ,

Thanks for accepting my request about interview for master thesis with title “Implementing UD of learning materials among teachers in higher education”. As I mentioned in the last invitation email, I am sending you letter of consent which is completely anonymous but as a research project I must fulfil these formal things. The letter of consent is attached in this email which you can sign by using a numeric code in a blank space at the end of letter, you can find more instruction and details in the attached letter.

Please after signing this letter using the code mentioned in the letter, return this letter by reply to this email. In addition, I will provide you brief introduction about myself and details about my project in the start of interview.

The interview is based on following agenda item:

1. Short introduction about researcher (me) and interview procedure,
2. Brief overview about the research project and goals,
3. Formal interview based on semi-structure questions,
4. Wrapping up and end of interview.

Please keep in mind that your personal information and identity shall be confidential and of course you can change your name to an imaginary name for this interview.

Feel free to contact me if you have any question.

Please Join Zoom Meeting using link below

https://oslomet.zoom.us/***

Meeting ID: XXX XXXX XXXX

Password: XXXXXX

Support: https://vm.oslomet.no/

Appendix D: Letter of Consent

Implementing UD of learning materials among teachers in higher education

Researcher: Adil Hussain Supervisor: Norun Christine Sanderson

I have been given information by the researcher Adil Hussain who is conducting interview for his master thesis titled “Implementing Universal Design (UD) of learning material among teachers in higher education” as a part of his degree Master in Universal Design of ICT supervised by Norun Christine Sanderson at department of computer science, Oslo Metropolitan University (OsloMet), Oslo, Norway.

I have been informed that my identity and personal information shall be kept confidential and anonymous. Interview will be conducted by using digital means (Zoom Audio Call) and all the notes are subject to be taken by hand notes (digital format) only.

I am aware that my participation in this interview is voluntary, I also have been informed that I am not obliged to answer any question that I do not want to answer and can withdraw my participation in interview at any time. The information gathered in this interview will only use for academic and research purposes on the above-mentioned research project.

If I have any question about the research after the interview, I can contact researcher Adil Hussain at s329921@oslomet.no and supervisor Norun Christine Sanderson at nsand@oslomet.no.

I consent that I have read and understand this form and provide my willingness to participate in this interview by my own will freely. I am signing this form by writing the code: PXXXX in the following blank: _____.

Dated:

Appendix E: Interview guide

NOTE: Same questions were used in the online survey and all the questions in the survey was required. Participants were free choose whether they want to answer the questions, if they do not want to answer the questions, they are free to skip.

1. What is your area of study or field?
2. How many years have you been working as teacher in this study or field?
3. Can I ask you your age group?
4. What kind of subject usually you teach?
5. What kind of digital learning material do you develop for your lectures and students? Such as word, excel, and/or PowerPoint etc.
6. How did are you handling the situation because of overnight change regarding digital mode of education due to Covid-19?
    a. Did you manage to handle this situation?
        i. If Yes, how did you handle it?
        ii. If No, what are the challenges you are facing?
7. How did you use to create the digital documents before and now?
    a. You might have students with disabilities in your class, how do you manage these kinds of situations while making digital learning materials?
8. As in these days video lectures (both recorded and live) and digital learning material become more popular. How much do you consider texting and caption of lectures?
    a. Does your university recommend you do texting or caption of your video lectures as it is required by the legislation as well?
    b. Do you know how to do texting and caption? Is it easy or tough and what kind of challenges do you face?
9. How long is your experience using computer and IT services?
10. How do you feel about using IT services and tools? Do you feel it is easy or tough?
11. Do you think you are expert in using IT services and tools?
12. Do you use digital means to prepare and make digital learning material for your students? How many years you are using digital way of preparing learning material?

13. Do you know about universal design of ICT or accessibility?
14. Have you ever considered universal design while making learning material for lectures and students?
    a. Do you consider universal design while creating these documents?
    b. How easy do you feel when you think about considering universal design while making learning materials?
        i. If easy, what make it easy for you to develop learning material universally designed?
        ii. If difficult, what kind of challenges do you face or considered hard for you to develop documents universal designed?
15. Do you think is it important to consider universal design in higher education?
    a. What could help you to make it easy for you to make the learning material universally designed?
    b. What kind of help from your higher education institution would be help for you to make the learning materials accessible and universally designed?
16. Did your students ever complaint about the accessibility issues with the learning materials that you provided them?
    a. If yes, what kind of accessibility issues they found in these documents?
17. Does your university recommend you use different digital tools that support you in teaching? If yes, what kind of tools you usually use for teaching and digital learning materials? For example, many of the teacher might have not use these tools before, are they challenging to use?
18. Do you think these tools are universally design and accessibility to use for all type of users?
19. How are you in adopting these new technologies in your everyday teaching especially in this new situation?

Appendix F: Accessibility checklist for different documents in workshop

Word document(s)

The checklist (for word documents) is as following:

- Clear language (The Language Council of Norway (Språkrådet)[3])
- Good contrast between text and background (Colour Contrast Analyzer[4])
- Structure content with styles (titles, headings, bold, italics, underline). Necessary for easy navigation.
- Font size, minimum 12 (Arial)
- Font type: even letter thickness, e.g.: Calibri, Arial etc. (Avoid fonts with serifs and dashes, e.g., Times, Times New Roman)
- Left-aligned text to avoid different spacing between words.
- Line spacing 1.5.
- Paragraph spacing and page breaks instead of line breaks to get 'air' between paragraphs / new page.
- Alternative text for images, diagrams, etc.
- Define the language used in the document.
- Descriptive and visible links

NOTE: This is not a comprehensive list of all the requirements required in the Norwegian Regulation of Universal Design of ICT but as possible as minimum requirements to make a word document accessible.

PDF- and PowerPoint document(s)

The checklist (for PDF-documents and PowerPoint) is as following:

- Save Word as PDF
    - Select «Save as» and file format «PDF».
    - Click on «Options» and tick:
        - Create bookmarks using:
            - Headings
        - Document structure codes for accessibility.

[3] The Language Council of Norway (Språkrådet). Retrieved on 17.11.2020, https://www.sprakradet.no/
[4] The Paciello Group – Colour Contrast Analyser. Retrieved on 17.11.2020, https://developer.paciellogroup.com/resources/contrastanalyser/

- PowerPoint
    - Check the reading order of slides.
        - Click on the slide you want to check. Select "Home", "Arrange" and "Options".

NOTE: This is not a comprehensive list of all the requirements required in the Norwegian Regulation of Universal Design of ICT but as possible as minimum requirements to develop universally designed PDF-document and PowerPoint presentation.

Excel document(s)

The checklist (for Excel document) is as following:

- “The simpler, the better” – Morten Tollefsen (Tollefsen, 2015)
- Feel free to divide large tables into several smaller ones.
- Avoid empty cells, rows, and columns.
- Define column and row headings (in the code, and thus visually)
- Give spreadsheets descriptive names.
- Feel free to add charts in own sheets.

NOTE: This is not a comprehensive list of all the requirements required in the Norwegian Regulation of Universal Design of ICT but as possible as minimum requirements to develop universally designed Excel document.