

# Engineering teachers' approaches to design and deliver inclusive teaching in flexible learning spaces

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**Abstract**— This Work in Progress Research reports on an on-going study about engineering teachers' approaches to inclusive teaching when designing MOOCs (Massive Open Online Education). It is part of a larger project exploring ways in which MOOC-initiatives can facilitate educational change within Universities. Our assumption is that the teachers, may develop their understanding of inclusive teaching, and, if so, transfer that knowledge into the design and delivery of regular course offerings given by universities. The knowledge generated in this study can help to shape future initiatives for faculty development and support, regarding engineering teachers' ways to design and deliver flexible scalable forms of teaching that facilitates inclusiveness in the learning process.

**Keywords**— Distance, Open and Flexible Education, Faculty Development, Inclusivity and Diversity Initiatives, Open Educational Resources and Practices

## INTRODUCTION

In recent years, higher education has expanded its offerings of online learning resources extensively, making learning more flexible and available. Open educational resources (OER) including MOOCs (Massive Open Online Education) are not only expected to reach new learners outside university, but also to provide support for students with various needs and, hence give opportunities for increased inclusion [1, 2]. In the public debate, MOOCs are associated with a range of key facets such as; openness, availability, and inclusive learning environments where inequities due to for example gender and socio economic background are partly neutralized [3]. Flexibility in time and space, increases accessibility to learning material and, are expected to better support students with special needs [4]. In different ways, the major MOOC platforms of today are designed to facilitate inclusiveness and aid students with, for example, hearing or visual impairments.

In engineering, as well as in other STEM education fields, inclusion with respect to attracting and retaining female students has been a concern for many years [5-7]. In later years, inclusion of other underrepresented groups have also received attention, and awareness that individuals may experience alienation due to more than one difference of gender, class, ethnicity or culture [8-10]. Inclusive teaching is

not only a matter of increasing the number of women, or supporting students from different social and ethnical backgrounds, as well as students with disabilities. Inclusiveness is also about understanding how the norms and values that permeate STEM education influence the students' experiences of inclusion or exclusion [8, 9]. An increased awareness about, not only the number of students with special needs, but also what inclusion encompasses calls for attention to how education should be delivered to secure student completion. In this paper we pay attention to *teachers' approaches to inclusive teaching* in a wide sense, as emphasized by Hockings [11] definition:

*"Inclusive learning and teaching in higher education refers to the way in which pedagogy, curricula and assessment are designed and delivered to engage students in learning that is meaningful, relevant and assessable to all. It embraces a view of the individual and individual differences as the source of diversity that can enrich the lives and learning of others."* [p.1, 11].

## I. INCLUSIVE TEACHING IN THE MOOC CONTEXT

The introduction of MOOCs offer teachers a tool to make informed decisions about their teaching based on learning analytics. Still, many challenges remain in relation to MOOCs, where low completion rates [12] lack of student interaction and engagement remain a concern [13, 14, 15]. A recurring concern with MOOC research is its focus on MOOC participants as a homogenous group and there is little research documenting how different groups of participants engage with the MOOC material [16]. The need for differentiation of MOOC participants and their performance is important in the context of engineering education especially from the viewpoint of inclusive teaching. Also, when MOOCs are making their way into on-campus engineering, for example with both MIT and Georgia Tech offering campus credit for MOOC performance and a number of hybrid versions are also starting to emerge; the quality of MOOCs are becoming a concern for engineering education in general. On-campus students now have the possibility to study together with, or in the same courses as professionals or, prospective students with the ambition to be

admitted to University studies. Georgia Tech's masters in computer science has reported on new categories of students attending their MOOC master's program, and early data suggests that student accepted with lower academic credentials outperform their peers [17].

Studies regarding MOOCs have certainly offered evidence of learner behavior, but there is also a need for more research into university teachers' experiences in relation to MOOCs [18]. In engineering education, there is a lack of empirical work [16] and much of the existing research is anecdotal where teachers reflect on their own MOOC experiences [19, 20]. Previously, university teachers' motivation for engaging in MOOC development has been explored, and, the findings suggests that teachers engage in MOOC development to increase the visibility of their discipline and university, and as a way of improving campus education, but also to open access to education and reach other student cohorts [16]. Offering MOOCs are also seen as a moral contribution to society, since education is made available for people who traditionally do not have access to higher education [18]. This is further elaborated on, in a study about how academic staff and leaders, as well as ICT staff involved in MOOC-development conceptualize MOOCs [18]. In the latter study, MOOCs were also thought of as a catalyst for educational change. Teachers involved in making MOOCs reported that they had reformed their teaching practice, for example by flipping their classroom, and increase the video-streaming of lectures [18]. However, it takes time for teachers to develop new ways of thinking and practicing, something that has been acknowledged in MOOC development [19]. Furthermore, studies suggest that teachers should collaborate and get support from experts with specific knowledge in MOOC production [18, 21]. For example, one study found that as many as a third of the teachers had little or no experience of distance learning before engaging in MOOCs [21].

Increased awareness of the need for more inclusive pedagogy put pressure on teachers to be able to make informed decisions about, how to design instructions and activities for learning and assessment that supports students with various needs [17]. Flexibility in pace, place, and, mode, does not ensure inclusiveness [22], and it is well known that it can be challenging for faculty to change and re-think the delivery of education [18, 23-25]. Also, research on inclusive pedagogy suggests that teachers' lack knowledge about students' different needs which hinders the translation of inclusive pedagogy into teaching practice [1, 11]. Furthermore, even with increased knowledge, for example gained from teacher training courses, change initiatives may fail to impact practice, due to, for example, local teaching traditions or gaps between theory and practice [23, 24, 26]. When teachers engage in the development of MOOCs, they have the opportunity to 'learn while practicing', and gain support by experts in, for example, media and instructional design. Our assumption is that the teachers may develop their understanding of inclusive teaching, and, if so, transfer that knowledge into the design and delivery of regular course offerings given by universities.

In this study, *we aim to understand the different ways that engineering teachers approach inclusive teaching when designing MOOCs*. We use phenomenography both as a

theoretical framework and empirical research approach to analyze, understand and describe teachers' experiences of what inclusive teaching means in the context of designing and delivering MOOCs. The knowledge generated in this study can help to shape future initiatives for faculty development and support, regarding engineering teachers' design and delivery of flexible scalable forms of teaching that facilitates inclusiveness. This study is part of a larger research project exploring ways in which MOOC-initiatives can facilitate educational change within Universities.

## II. TEACHERS' VARIOUS WAYS OF THINKING AND PRACTICING

This study builds on the tradition of phenomenography and over two decades of research about university teachers' conceptual understanding of, and their approaches to teaching and learning [27, 30]. With the intention to explore teachers' breadth of awareness regarding teaching and learning, phenomenography has been influential in research, as well as in faculty development initiatives [27-29].

Phenomenography is a qualitative, empirical research approach useful as an analytical tool, as well as describing how humans experience phenomenon in the world around them. It is well-known for findings on variation in conceptions of different educational phenomena, such as particular disciplinary concepts like motion in physics learning [27]. Phenomenography is explained extensively in the literature and it is premised on the notion that individuals understand, interpret and experience phenomena in a number of qualitatively different ways [27-30]. Relevant for this investigation are previous studies showing teachers' conceptual understanding of teaching and learning. Although the studies are framed in different ways, and there are nuances in the results that differ, the body of studies in this regard, shows that teachers tend to approach teaching and learning with a 'teacher-centered' view or, a 'student-centered' view [27].

*A teacher-centered view is a combined focus on the teacher, the teaching strategies, and the transmission of knowledge from teacher to students.*

*A student-centered view is a combined focus on students, their learning and development and conceptual understanding.*

From a phenomenographical perspective, teachers' conceptions are not 'either or', but shows the depth of awareness, and can vary with different situations. The student-centered approach is more sophisticated because the teachers' focus in a teaching and learning situation includes what is happening for both the teacher and the students [27].

Research on inclusive teaching shows that teaching practices that facilitate inclusion are student-centered [11]. Focusing on the students' learning and environment, the teachers strive to provide safe and respectful learning spaces where students can collaborate, and individual differences are allowed. Teachers also relate to students' lives and are culturally aware [11]. Furthermore, a course structure based on student-centered learning has been found to facilitate learning for all students, but especially for underrepresented student groups [31]. However, teachers' limited knowledge of students' various needs is an obstacle to inclusive teaching

[32]. In addition, science and university teachers differ in their view of what inclusive teaching means, ranging from the idea of inclusive teaching for all students (implying that they are the same), focusing on the needs of special groups, to inclusion as attending to students as individuals [33]. In the debate about faculty and educational change, studies like the aforementioned are criticized for looking at beliefs, and not teaching practice. Although correlations between teachers' conceptual understanding of teaching and learning and, their way of practicing have been found [34], previous studies tend to neglect that espoused theories may differ from how teachers practice in various situations. We acknowledge that teachers' intention can vary with context and, therefore choose to study teachers' experiences related to one educational setting, namely MOOC-design and delivery. Doing so, we attend to teachers' approaches including both their intentions and their beliefs.

### III. METHOD

We employed a phenomenographic research approach to discern qualitative different ways that teachers experienced inclusive teaching [30]. Ten teachers engaged in MOOCs were chosen to take part in semi-structured interviews of their experiences in designing material included in their MOOCs. The tentative analysis of six of these interviews is included in the preliminary findings presented in this work-in progress paper. The interviews included questions about the teachers reasoning about various target groups, their motives and intentions of making MOOCs and, illustrative examples, choice of references and, video design including symbolic values expressed by for example choice of colors as well as, human interactivity and assessments. All teachers have previous experiences of teaching in traditional higher education courses ranging from a few years to more than 20 years of teaching experience, and they all had experience of using learning platforms in their teaching. All teachers collaborated in teams including experts in course design and media production during the MOOC-development.

Interviews were audio-recorded and transcribed verbatim and initially three of the researchers independently made an initial categorization, and then, via the phenomenographic analysis outlined in table one below [18], discerned qualitatively different categories representing the teachers' approaches including their beliefs and intentions. The data were pooled together into one data set, and the final categories therefore represent different approaches, rather than different individuals. To ensure trustworthiness and increase credibility the emerging categories were compared, discussed, and calibrated between the researchers before arriving at a final set of categories (tentative in this version of the paper) [35].

The research team is well experienced in using qualitative data analysis in general and, phenomenography in particular. In line with quality criteria for phenomenographic studies [27, 29, 35], (i) each category reveals something distinctive, (ii) the categories are logically related (iii) and the outcomes are parsimonious (only the necessary categories are presented). The findings gained in a phenomenographic study are different categories presented in distinctive and succinct ways, showing the various understandings, approaches or breadth of

awareness held by the informants. These various approaches are likely to be transferable and found in other similar educational settings, in this study; other teachers, experiencing inclusive teaching in the design and delivery of MOOCs.

*Familiarization*: reading through the interview transcripts to get a feel for how the interview proceeded; at this stage all data in the data set are given equal consideration

*Condensation*: identifying meaning units and marking these for the purpose of further scrutiny; the size of the meaning units can vary; different fragments of sentences can be associated with different ways of experiencing the phenomenon

*Comparison*: comparing the units with regard to similarities and differences

*Grouping*: allocating responses that express similar ways of understanding the phenomenon to the same category

*Articulating*: capturing the essential meaning of a certain category

*Labelling*: expressing the core meaning of the category; steps 3–6 are repeated in an iterative procedure to make sure that the similarities within and differences between categories are discerned and formulated in a distinct way

*Contrasting*: comparing the categories through a contrastive procedure whereby the categories are described in terms of their individual meanings as well as in terms of what they do not comprise

Table 1: The phenomenographic analysis [18]

### IV. PRELIMINARY FINDINGS AND DISCUSSION

The preliminary findings suggest that the teachers find it challenging to consider inclusiveness in the design of MOOCs. Included in their reasoning about inclusive teaching is their understanding of teaching and learning in general but also perceptions of what a MOOC is, or should be. Our phenomenographical analysis resulted in four tentative categories representing different approaches to inclusive teaching in the design and delivery of MOOCs, inclusive teaching as; *Online Availability*, *Adaptation to The Targeted Group*, *Accessibility for Disabled Learners* and, *Addressing Individuals with Heterogeneous Backgrounds*. Each approach is described in more detail below and illustrated with a representative quote.

#### A. Inclusive teaching as Online Availability

This approach is characterized by teachers' understanding of inclusive teaching as making material available to a larger audience. The underlying belief is that since the MOOCs are open and available to everyone with access to the internet, they are inclusive by definition. The teachers' focus is on the content, and in particular the video lectures, and how these can be made openly available. In order to make the course available to a broader audience, adjustments to simplify the content and find the appropriate level of difficulty may be needed. Such an example is to lower the requirements for the level of mathematical skills needed to participate in the course. The following quote illustrates this approach:

*"It is made available to anyone, with no prior knowledge what so ever. Then, there might be [courses] with required*

*prior knowledge, but for me the main purpose is to make it [the content] available.”*

#### *B. Inclusive teaching as Adaptation to The Targeted Group*

The approach to inclusive teaching represented by this category is characterized by adapting the course material and ‘the genre’ to the targeted group of participants. The learners are believed to be homogenous, and therefore the intention is to optimize how different examples in the course are framed and adapted to learners’ with ‘one kind of need’. The intention is to vary course material and types of assignments since variation is viewed as important to support individuals’ learning, but not connected to inclusion. The quote below is an example of this approach:

*“It is mostly about what prior knowledge you need. And whether it’s [the course] for campus based students, or for people who are working, or master students or engineering students. And yes, then you can assume that they have studied certain things, and should have certain knowledge, even if it is not stated as prerequisites.”*

#### *C. Inclusive teaching as Accessibility for Disabled Learners*

This approach refers to a belief of inclusive teaching as making course material accessible for disabled students, and something that is regulated by the requirements for offering courses via the platform. The teachers’ intentions are to include sound, text and illustrations to ensure that people with certain disabilities such as hearing or visual impairment can take on the course content. The ways to do this is predefined and set by the platform requirements, for instance supporting texting of videos. This approach to inclusive teaching also means awareness that there are other ways to support people with various kinds of disabilities, but that the teachers have limited opportunities to fulfill that. The following quote illustrates this approach:

*“Because Y [the platform providers] themselves demands inclusiveness for screen readers and so, for people with disabilities, it comes automatically. But there are many other things to do.”*

#### *D. Inclusive teaching as Addressing Individuals with Heterogeneous Backgrounds*

This approach is characterized by an awareness of the learners’ diverse backgrounds since the course is open to everyone globally. The teachers’ intentions are to address learners in an international and intercultural setting. The belief is that diversity regarding for example ethnicity, age and gender in course images and video clips may influence the participants’ experiences of feeling included. The intentions are therefore to avoid exclusion and choose ways to frame and illustrate course content in various ways. At the same time, the teachers believe that it is hard and frustrating not to be able to fulfill different learners’ needs due to for example time constraints. The following quote illustrates this approach:

*“We are obligated to use what is legal [open source pictures], and therefore it becomes, well, it is important to*

*think... it is a global audience, and then ethnicity and gender is important, and therefore you have to cover these things.”*

## DISCUSSION

Utilizing the phenomenographic approach, we identified four tentative approaches of inclusive teaching that teachers’ practiced in the context of MOOC design and delivery. These different approaches are hierarchical and inclusive which means that they range from a naïve to more sophisticated awareness of what inclusive teaching means in the context of MOOCs.

The first approach, *availability*, is characterized by a naïve understanding of inclusive teaching. Simply by making the MOOC openly available, it was also inclusive. The teachers’ focus on video implies that this is a teacher-centered approach [27], with little concern about what MOOCs may include in terms of, for example assignments, feedback and interactive activities. The last category, *addressing individuals with heterogeneous backgrounds*, on the other hand, acknowledges that individuals are different and that for example the pictures and language used are symbols that may exclude individuals. This reflects awareness about of how values and norms that are intentional or sometimes unintentional are mirrored in the design and delivery of MOOCs, and resonates with previous research on the inclusion in STEM education [8, 9]

Approaching inclusive teaching as *accessibility for disabled learners*, the teachers recognizes that there are students with diverse needs. However, consideration of inclusion was also thought of something that was ‘taken care of by the platform’. This suggests that there is a potential for platform-/MOOC-providers to further build the technology so that teachers become aware of important aspects to support inclusiveness in the learning process for diverse student groups.

Based on the preliminary findings presented here, it seems to be hard for teachers to think about and design MOOCs that can be expected to engage learners with diverse backgrounds and needs. One possible explanation is that the creation of MOOCs is a new and demanding task in itself, and that they for example spend much time on making videos and formulating automated feedback. The teachers reasoned about that ‘more could be done’ but that they themselves only represented one ethnic group or gender, and that it was frustrating not be able to work more inclusive.

In this work in progress we aimed to show how teachers approach inclusive teaching in the design and delivery of MOOCs. Continuing the project, we expect to elaborate further on the findings; for example, the teachers reasoning about learners’ different ways of engaging with the material. Also, we aim to discuss how the approaches found in this study travels to other forms of education. We see that the findings can be valuable when organizing faculty development and support engineering teachers’ ways to design and deliver flexible scalable forms of teaching that take inclusiveness into account.

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