



## Wind Energy Master - a fully online part-time programme

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# **Wind Energy Master**

## **A fully online part-time programme**

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### **INTRODUCTION**

The need for continuing education is growing in our society as the work force has become more mobile and learning is a life-long process. Plans for new wind power installations around the world are extremely ambitious for the coming decades [1-2] and this creates an immediate demand for skilled engineers with specialized knowledge [3]. The demand may partly be addressed through an increase of life-long learning opportunities and a greater variety of study modes like part-time, distance, and modular learning [4]. Higher education is entering a new era where practical skills and contact to the rapidly evolving labor market may be valued as much as traditional rankings and accreditation [5]. Online competency-based education has an enormous disruptive potential in this context.

Enrollment fees for traditional university programmes are soaring in countries like the US and UK and a new market for Massive Open Online Courses (MOOC) clearly reflects this. The Technical University of Denmark (DTU) offers a successful MOOC called 'Wind Energy', which has been completed by more than 2.000 learners so far. Analytics from the MOOC show that approximately 50% of the learners are already employed in a full-time job. This is an indicator of the market for online continuing education in the field of wind energy and has been a great motivation for establishing a full online Master's programme about wind energy engineering at DTU.

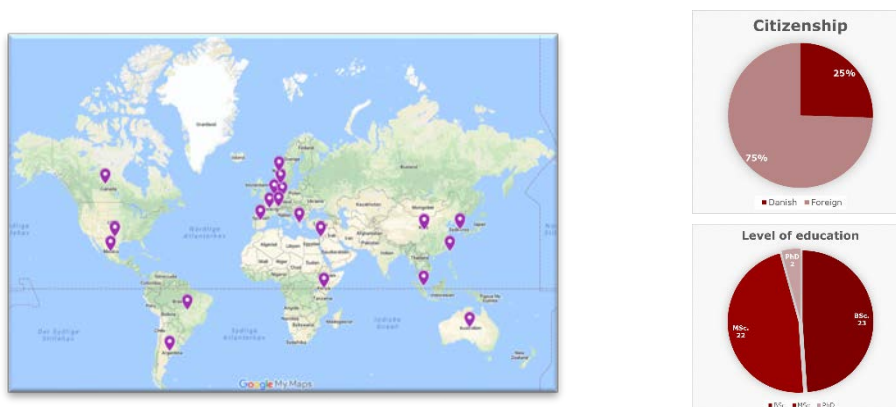
The purpose of this paper is to outline a concept for an online part-time programme, which is currently used for education in wind energy and holds a potential for application within other engineering disciplines. Similarities and differences are examined between *i)* the online teaching and learning experience as opposed to education in a physical setting, and *ii)* a part-time programme for continuing education

as opposed to full-time university programmes. The question is: *Can an online Master's programme for continuing education be used to build up capacity within engineering disciplines?*

## 1 ABOUT THE WIND ENERGY MASTER

[Wind Energy Master](#) is a new part-time programme executed fully online. The programme is designed for continuing education. Regulations by the Danish Ministry of Higher Education and Science state the overall framework. Requirements for access include a bachelor's degree or higher and at least two years of relevant working experience. The programme workload is equivalent to 60 ECTS and it can be spread over several years. Completion of the programme leads to a Master's degree, which is not to be confused with a M.Sc. A full M.Sc. degree would require a work load of 120 ECTS and this may be unrealistic in the context of continuing education.

The target group for the Wind Energy Master is truly global as reflected in the first year's intake of 47 participants from the wind energy industry and related fields all over the world (*Fig. 1*). Of these participants, 75% are located outside Denmark. Around half of the participants hold a M.Sc. degree and the other half a B.Sc. as their highest degree. Two participants hold a Ph.D. degree. The programme was launched for the first time on September 4th 2017.



*Fig. 1.* Left: Current participant's country of residence (map courtesy Google My Maps). Right: Distributions of participant's citizenship and level of education.

The Wind Energy Master aims to give a broad overview of wind power generation from planning and economics to design of wind turbines. Mapping of industry requirements has revealed that some employees in the wind energy industry lack insight in the consequences of decisions they make for other parts of the production chain and ultimately for the company's economy.

The Department of Wind Energy at DTU holds a vast experience in continuing education and E-learning. The Department has offered training courses for the wind energy industry for decades and since 2011, some of these courses are available online [1-3]. The overarching idea is to offer fully flexible supervised courses, which are easily followed by employees in the industry in parallel with a busy working schedule. The expected long-term outcome is a production of up to 100 DTU Master's of Wind Energy per year who will fulfil their current position better or find new employment in the global wind energy industry.

## 2 TEACHING METHODS

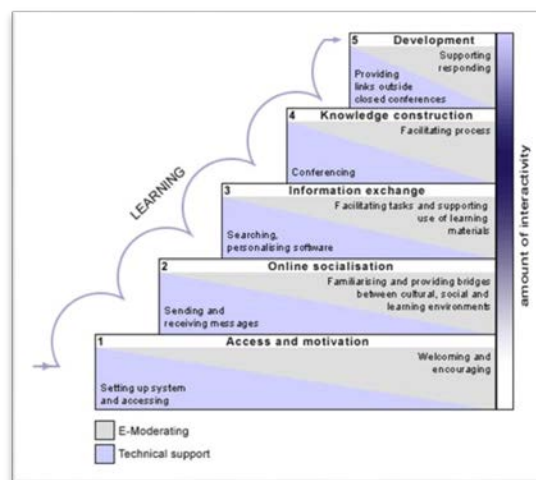
### 2.1 Overall choice of teaching methods

Flexible learning is the overall teaching method chosen for this Master's programme because it allows participants to study anytime and anywhere. The first intake reveals that participants in the programme come with very different backgrounds and qualifications. The flexible learning method together with the use of the most sophisticated E-learning tools allows us to differentiate the learning process.

The individual courses take advantage of a number of additional teaching methods. Learning by inquiry is used through virtual poster presentations and participant's production of short movies about central course topics. Spiral learning is utilized e.g. for the development of a computer code for turbine blade design where new aspects are introduced gradually throughout the course.

### 2.2 Pedagogical model

The five-stage scaffolding model for teaching and learning online [9] is the foundation for the design of this Master's programme as well as individual courses. The model states the importance of building a 'safe' and encouraging learning environment online where the teacher takes a facilitating role. As participants advance up the five-stage scaffold, they will gradually become more and more independent and responsible for their own learning process (*Fig. 2*). In the following, we sketch out our implementation of the model in practice.



*Fig. 2.* The five-stage scaffolding model for teaching and learning online. From Salmon, G. (2011): E-moderating. The key to teaching and learning online. 3rd Ed. Routledge: London and New York.

The Wind Energy Master begins with a one-week 'onboarding' module where participants obtain access to the learning management system (LMS) and university resources such as intranet, library resources, and software licenses. They write a biography, upload a photo and share a few words about their background and motivation in the discussion forum of the course. The Head of Studies greets each participant individually and hosts a live welcome webinar. By the end of the onboarding week, everybody has met each other and any technical issues have been resolved. Participants can now shift their focus entirely to the learning content.

The programme consists of nine independent courses and a final project. The courses are structured into weekly modules with a wide range of learning elements such as short and focused video lectures, practise quizzes, calculation exercises, written assignments, and discussion with teachers and peers. Later in the programme, participants work on a small project, which leads up to the final project. The project work requires higher-level skills and ensures progression throughout the programme.

### **2.3 Assessment methods**

Assessment methods vary from course to course in this Master's programme, in accordance with the rules and regulations about university exams in Denmark. For some courses, summative assessment is carried out through submission of one or more written assignments to be evaluated by the teachers. Other courses use quiz exams with automatic correction. The quiz exams must be taken by all participants on the same date within a time window of typically 2 hours. Questions and answer options are shuffled to prevent cheating. Several courses end with an online oral exam through the meeting platform Adobe Connect. During the exam, participants must demonstrate that they are alone in a room and present a proof of identity. They are then questioned in the same manner as during an oral exam on campus. A censor takes part in selected exams and careful testing of the technical setup is performed in advance to prevent any difficulties during the examination. Defence of the final project takes place on campus and this is the only time participants are required to travel to DTU.

### **2.4 Teaching technology**

The online programme is taught through the LMS called Brightspace, which is integrated with student and course administrative systems at DTU. The system is the single point of access for all course content. We put a major effort into alignment between courses when it comes to the LMS setup. This helps participants to navigate in the learning material. Teachers use a range of tools and technologies to produce the learning content. To mention a few, video lectures are produced in a dedicated studio, or on the teacher's own PC using a screencasting tool. Quizzes and assignments are setup in the LMS, which contains functionalities for teachers to give feedback and to monitor the participant's progress. Some teachers use a tablet to draw and explain content.

### **2.5 Interaction amongst teachers and participants**

Teacher-participant and participant-participant interaction is the key to a high completion rate and a deeper learning throughout the Master's courses. Asynchronous communication takes place through topical discussion forums and e-mails. Synchronous communication takes place via the chat function in the LMS and through weekly live sessions where participants get the opportunity to ask questions directly to the teachers, or give their own presentations of key learning points. Since the participants are distributed all around the world, a morning and an afternoon version of each live session is offered and participants have the opportunity to view recordings of the sessions afterwards. Altogether, the team of teachers strive to offer a fully flexible programme where interaction can occur anytime and anywhere.

## **3 COLLECTION AND ANALYSIS OF EVIDENCE**

Surveys are carried out each semester to gather data about the participant's learning experience and outcome. At the programme level, a survey addresses the online

learning experience and the programme as such. At the course level, DTU's procedure for quality assessment is followed where an evaluation form is completed by the end of each course. Once the evaluation forms are gathered and analysed, they are reviewed by the Department Study Board and results are published. All surveys include a space for free-text comments so participants can write specific comments to be considered by the teaching staff. Results presented in the following are based on the evaluation forms gathered from the first cohort of participants during the autumn 2017.

## 4 RESULTS

### 4.1 Programme level

Fig. 3 shows examples of participant's feedback at the programme level. The feedback shows very clearly that participants find the onboarding week valuable as 92% agree to this. The result is very motivating for continuing or even expanding the onboarding activities in the future. When it comes to the level of flexibility offered by the Master's programme, 65% are satisfied. Free-text comments reflect that some participants feel restricted from attending the live sessions due to their responsibilities at work. Typically, only a fraction of participants attend these optional sessions.

A vast majority of 86% find that the online learning experience is fruitful as compared to learning in a physical setting. This result is very encouraging, not only for this programme, but for the use of a similar concept for development of other educational programmes in the context of engineering. It is supported by the fact that 96% of all participants would recommend the Master's programme to others.

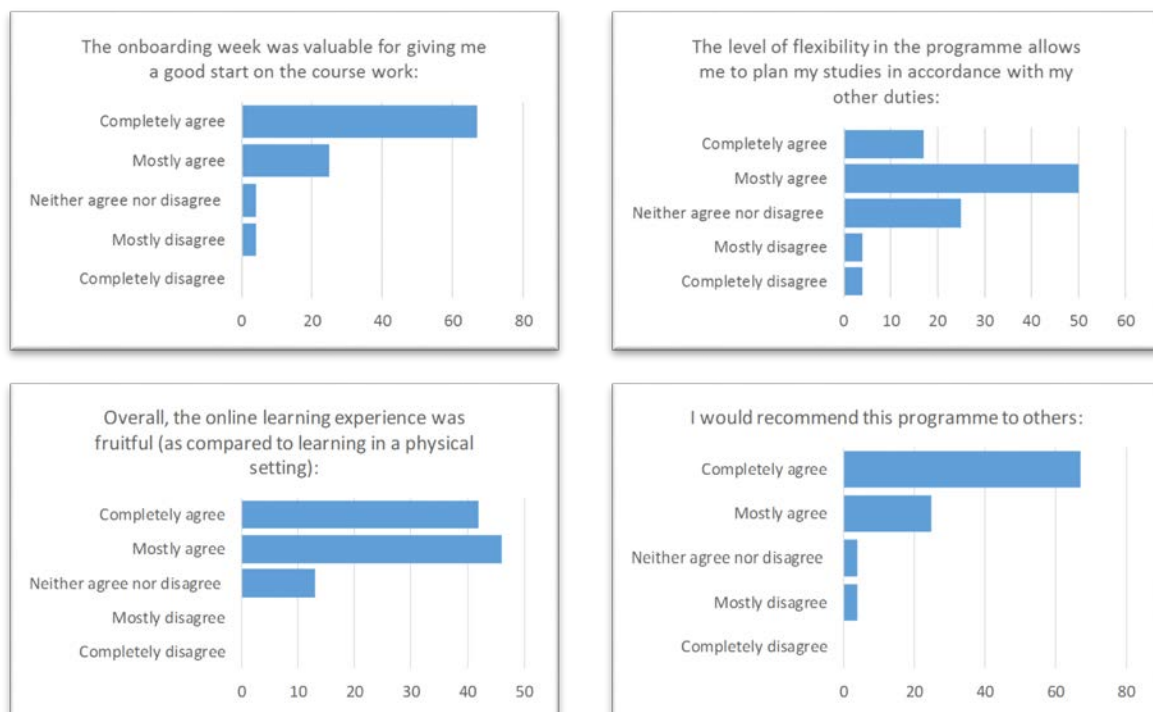
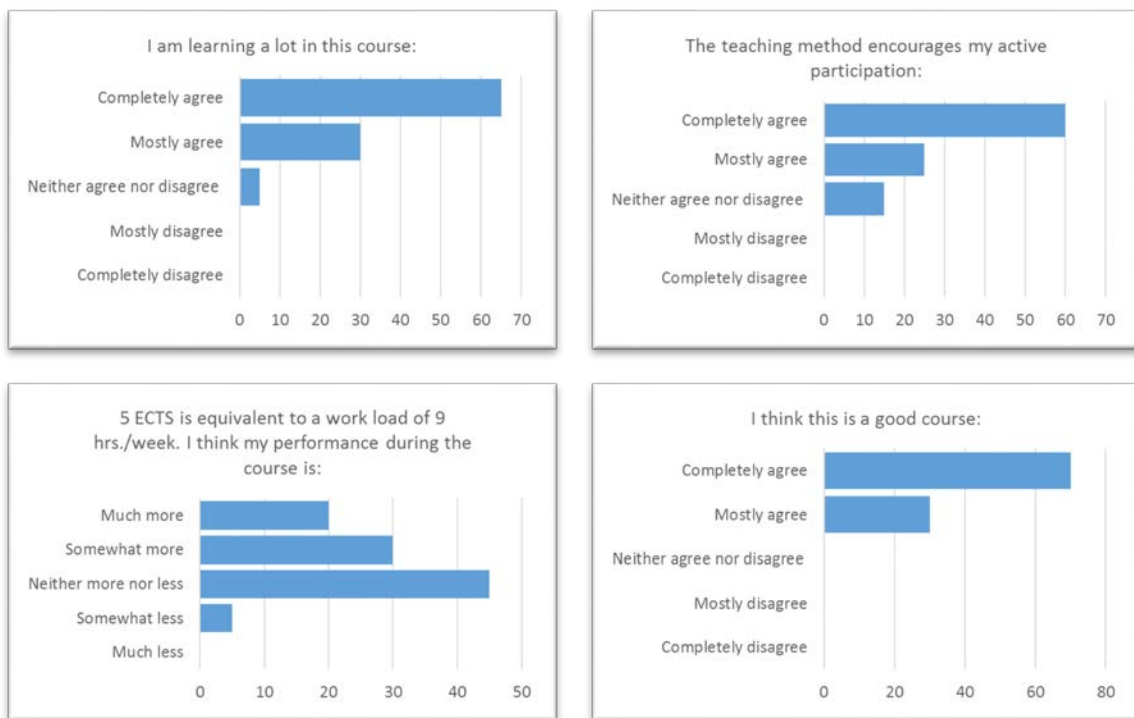


Fig. 3. Examples of participant's feedback at the programme level. The plots are based on survey responses from 23 participants during the autumn 2017.

## 4.2 Course level



*Fig. 4.* Examples of participant's feedback for the course 'Materials in Wind Energy'. The plots are based on survey responses from 20 participants who followed the course during the autumn 2017.

*Fig. 4* shows examples of participant's feedback at the course level by the end of the course 'Materials in Wind Energy'. Of the 20 course participants, 19 persons or 95%, agree that they are learning a lot in the course and 85% agree that their active participation is encouraged. All 20 participants agree that the course is good.

When it comes to the participant's workload, 50% state they have spent more than the estimated nine hours per week on the course work whereas only one person has spent less. This reflects the challenge of meeting the diverse group of participants at the right level of difficulty. Free-text comments show that programming has been a challenge for some and they may have spent extra time on learning to program in addition to the actual course work.

## 5 ONLINE EDUCATION VS. A PHYSICAL SETTING

We have presented a few key evaluation results from the online Master's programme in wind energy. The full evaluation surveys hold further details about the participant's perception of the programme and each individual course. We will base our final remarks on all the evidence gathered during the first year.

The concept for an online Master's programme presented here embraces a wide range of learning activities and assessment forms most of which require active participation. For example, participants may be asked to complete a quiz or write reflections in a discussion forum by the end of individual video lectures. The continuous engagement of participants ensures achievement of the learning objectives and contributes to

constructive alignment and a deep approach to learning. All of this is challenging in a traditional physical setting such as a lecture room.

Structuring of the learning content within a LMS makes the online learning process transparent and easy to follow. Participants are always aware of their own progress and teachers are, too. The teacher's supervision can thus be directed towards the participants who need it the most. For instance, participants who are a bit behind with exercises or assignments receive an encouraging message from the teacher. The high level of transparency represents another strength of online education compared to teaching and learning in a physical setting.

Establishment of a personal connection between teachers and participants is essential for the success of this programme in contrast to large-scale unsupervised online courses such as MOOCs. The teacher's online availability on a daily basis and the personal feedback on assignments give a personal touch and feeling, which is almost equivalent to meeting each other in person. The personal connection is of course also dependent on the participant's willingness to reach out for the resources at their disposal. Experiences from the Master's courses show that some participants are eager to contribute to written and oral discussions online whereas others hesitate. Active participants are bound to get the most out of the courses.

## **6 CONTINUING EDUCATION VS. FULL-TIME UNIVERSITY PROGRAMMES**

Flexibility is an important strength of this part-time programme with respect to university programmes on campus with much more rigid time schedules. We can reach participants all over the world; and individual participants can study when and where they want. With the flexible teaching style comes a large degree of responsibility for one's own learning. Most participants live up to this challenge but a few cannot find the time to fit studies into their daily routines and drop out.

The biggest challenge when it comes to this part-time Master's programme is to match the very diverse backgrounds and levels of knowledge of the participants in the programme. A way to address the issue in the future could be to differentiate the learning activities so participants get challenged with different problems depending on their level of background knowledge. The positive side of the participant diversity is that there is a large potential for integrating real-life problems and examples in the teaching based on participant's inputs. This brings the teaching closer to reality and to the immediate needs of the wind energy industry.

## **7 CONCLUSIONS**

Early findings from the first semester of a new online part-time Wind Energy Master show that online teaching can be powerful for engaging participants in courses and for achieving a deep approach to learning. Evaluations by participants at the programme and course level show positive results and indicate that learning objectives can be achieved and new engineering disciplines mastered from a distance. The concept presented here could easily be applied in connection with other engineering disciplines, as it is independent on the field of teaching. Findings and experiences from the first year of teaching the programme are promising for growing continuing education online and for achieving life-long learning objectives all over the world for the benefit of society.



## 8 ACKNOWLEDGEMENTS

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