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From experiential to research-based learning: The Renewable Energy Online (REO) master's program

Christiane Stroth*, Robin Knecht, Andreas Günther, Tanja Behrendt, Michael Golba

Carl von Ossietzky University of Oldenburg, Postgraduate Programme Renewable Energy & Renewable Energy Online, Carl-von-Ossietzky-Straße 9-11, 26129 Oldenburg, Germany

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ABSTRACT

In recent years, there is an increasing demand for flexible, time- and location-independent academic study programs. For this reason, blended-learning concepts have been and are being developed in many disciplines. Such programs can be studied mainly online and part-time, from all over the world, supplemented by short on-campus periods. In the field of Renewable Energy education, the blended-learning master's degree program Renewable Energy Online has been developed at the University of Oldenburg, Germany. This article aims at presenting the concept of this program. Thereby, it focuses on learning-teaching concepts, which address the motivation of students and the needs and resources of diverse groups of students.

1. Introduction

In view of limited resources, climate change and demand for access to modern and sustainable energy services, the need for qualified personnel with university level competences in Renewable Energy technologies has been increased rapidly (IRENA, 2017). In the light of this globally growing demand, an online master's degree program on Renewable Energy has been developed at the University of Oldenburg, Germany. This program addresses international students including participants from developing and emerging countries, who cannot participate in face-to-face master's degree courses due to family or job duties. These individual life situations and diverse backgrounds of the students are considered in the blended-learning format and the didactical concept of the 'Renewable Energy Online' (REO) program. The development of the curriculum and the instructional design draw on experiences from face-to-face master's degree courses ('Postgraduate Programme Renewable Energy' and 'European Master in Renewable Energy') as well as from online study programs (at the 'Centre for Lifelong Learning') at the University of Oldenburg. In the following, the concept and the curriculum of the REO program is presented, emphasizing learning-teaching concepts, which represent the guiding principle of the instructional design. It is shown, how the special learning situation of online studies as well as the individual demands and resources of diverse, international student groups are addressed.

2. The Renewable Energy Online program

The REO program is developed as an English-language, technically oriented master's degree course for natural scientists and engineers with a first university degree and at least one year of professional experience. The program comprises 120 ECTS (European Credit Transfer and Accumulation System) credits of part-time and mainly online study, including two on-campus periods. It aims for qualification of international Renewable Energy experts with qualification profiles ranging from design of wind energy turbines to implementation of photovoltaic systems in rural areas. This implies not only the transfer of knowledge, but especially the development of subject-specific, methodical, personal and social competences on the student's side. After finalizing the program, the students should be able to work in a self-organized, interdisciplinary, problem-oriented, responsible and scientific manner, to present results in a structured format and to critically reflect on them. Prospective employers for graduates are e.g. companies, governments, research institutes and universities or development cooperation organizations.

2.1. Curriculum

The study program consists of several modules, each organized as separated units regarding content and learning-teaching methods. Mandatory modules guarantee a sound education and the acquisition of fundamental competences in the most important fields of Renewable

* Corresponding author.
E-mail address: christiane.stroth@uni-oldenburg.de (C. Stroth).

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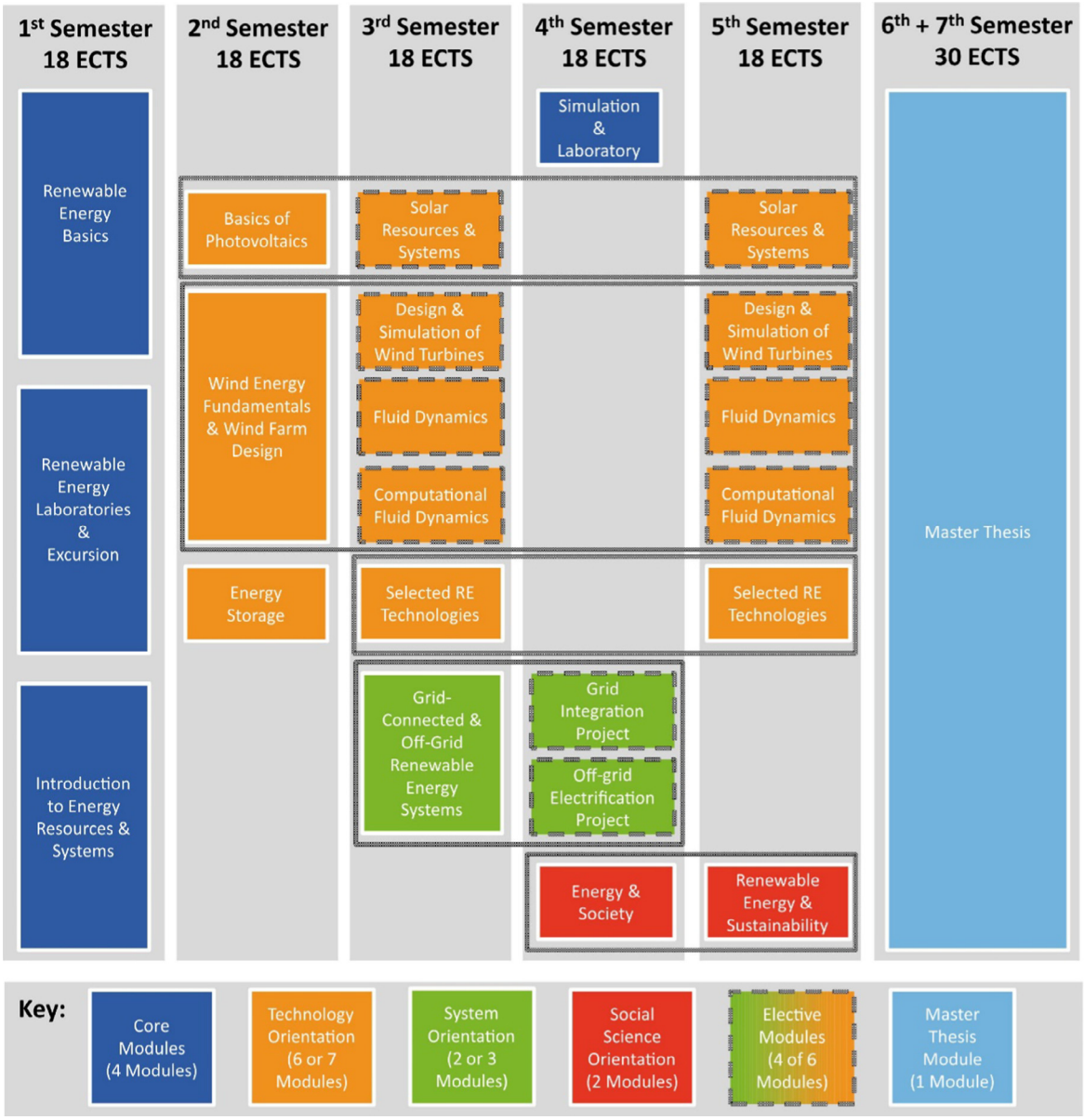

Fig. 1. Course of studies for the standard period of study.

Energy. Complementarily, elective modules as well as the master thesis enable the students to give themselves an individual profile depending on their interests. The course of studies contains four ‘core modules’ of 24 credits and three ‘orientations’ of overall 66 credits: the technology orientation, the system orientation and the social science orientation. Each orientation comprises mandatory as well as elective modules, as illustrated in the course of studies in Fig. 1. The standard period of study is seven semesters, comprising of three modules each for the first five semesters and the master thesis in the sixth and seventhes semester.

The first semester serves to ease the transition into academic studies. The module ‘Renewable Energy Basics’ provides the students with the necessary fundamentals for the following semesters, addressing mathematics, thermodynamics, fluid dynamics, mechanics, electrical power systems and programming. In a second module, the topics energy resources and energy systems will be covered. The module ‘Renewable Energy Laboratories & Excursion’ introduces the principles of scientific working and contains the first on-campus period of two weeks in Oldenburg. During this time, students have the opportunity to get to know their class mates and teachers face-to-face. In a laboratory, they gain first hands-on experiences on basic Renewable Energy technologies as well as insights into measurement methods and data evaluation. The on-campus period also contains an excursion to Renewable Energy companies and plants as well as a framework program with workshops and further activities. The second semester provides the first mandatory modules of the technology orientation and thereby the necessary fundamentals of wind energy, photovoltaics and energy storage. Based on this, the students can choose elective modules of the technology orientation in the third semester. Furthermore, they can study the module ‘Selected Renewable Energy Technologies’, which covers biomass, hydro power as well as solar thermal energy and can be chosen also in the fifth semester of the course. The module ‘Grid-Connected and Off-Grid Renewable Energy Systems’ represents the start of the system orientation and provides the required basics for the respective elective modules in the following semester. Besides these two electives ‘Grid Integration Project’ and ‘Off-Grid Electrification Project’, the fourth semester contains the module ‘Simulation and Laboratory’, which includes the second on-campus period. During two weeks on-campus as well as via online preparation and follow-up, the students deepen their competences in experimental and scientific working as well as in analysis and simulation of Renewable energy technologies