

CoDiLe – Collaborative Digital Learning

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Abstract

The objective of CoDiLe - Collaborative Digital Learning – is to create a new international course termed "Water Challenges in a Changing World" in the form of a number of independent modules. It uses the advantages of digitized teaching and offers a unique opportunity for higher education professionals to take up these modules and to create and shape their own courses by selecting desired topics. For this purpose, the "Fellowships for Innovation in Digital University Teaching (digiFellows)" of the German federal state of North Rhine-Westphalia (NRW) enabled the creation of a cooperation network with several high-ranking national and international partners from seven different countries. The topics range from urban flood forecasting and coping with extreme events to microplastic in marine ecosystems as well as public health, water resources, and water quality. Each of the 15 project partners is responsible for one module of the course, with all modules being self-contained, modular, and can be individually combined by the students. Each module contains a video presentation on the topic of the partner's expertise, online tests, and challenges to the students, as well as a live discussion with the corresponding lecturer with selected questions prepared by the students. Overall, we offer all students at the University of Siegen and the partner universities access to leading lectures and institutions in various water-related subject areas, and thereby attracting the interest of students from other disciplines.

Keywords: Digital learning; Flipped Classroom; Virtual learning & teaching; Blended learning; Water education;

1. INTRODUCTION

In addition to the medical, social, and welfare aspects, the pandemic situation starting in late 2019 has also been very challenging for many professionals in higher education. This is especially true for lecturers, as traditional face-to-face teaching in presence was no longer possible. Many lecturers therefore incorporated various aspects of digital teaching in their courses. However, this rapid shift to digital teaching is not exclusively a sudden event caused by a pandemic, but can also be interpreted as a culmination of a development towards digital teaching in recent years. For example, the Open University in Great Britain (OU, 2017) or the University of Hagen (FernUniversität Hagen, 2022) have been offering distance learning with only minimal classical face-to-face teaching since the late 1960s and 1970s. Made possible by technological advances of the last years, some "classic" universities were also offering pre-pandemic digitized versions of their degree programs. Probably one of the best-known platforms for such Massive Open Online Courses is edX, founded in 2012 by Harvard University and the Massachusetts Institute of Technology. Today it includes more than 2800 courses, contributed by approximately 90 partner institutions. These courses and degree programs are provided by the individual partner institutions (Edx, 2022).

We are continuing this development and taking it a step further, as we not only provide students with a digital learning experience, but also give them access to the leading scholars in their field across the world, independently of the lectures' home university. This is, to our knowledge, not possible in conventional teaching or in the existing digitized degree programs, since no commitment to each individual university is necessary. We regard this as a crucial point in the context of international teaching in engineering and active learning.

Hence, we not only overcome the hurdles of present and (possible) future pandemics, but also improve the access to national and international expertise. We see digitization not as a necessary reaction to a changing environment, but as a one-in-a-lifetime opportunity to make education better and more accessible. In our view, the three main advantages of digitization are: the ability to overcome challenges associated with distance learning (I) and different learning speeds of students (II) as well as to give live access to the leading scholars (III) at various international universities and institutions, encouraging closer cooperation between universities and increased international cooperation.

We make use of the technical possibilities of digitization not only to compensate for disadvantages caused by the COVID-19 pandemic and future challenges, but also to shape this change positively and to exploit the existing opportunities, leading to increased resilience of our future teaching philosophies. We explain these aspects using our new modular course “Water challenges in a changing world”, which will initially be part of the curriculum of the University of Siegen, and subsequently be taken up by the different partners of this project and beyond. These partners are: RWTH Aachen University, City of Bochum, UCI California, University of Coimbra, University of Exeter, TU Hamburg, TU Kaiserslautern, Kwame Nkrumah University of Science and Technology, University of Messina, TU Munich, University of Oxford, University of Sheffield, KTH Royal Institute of Technology (Stockholm), and UTSA Texas.

2. METHOD

The above-mentioned aspects of digitization are fully exploited in our concept: Firstly, “Water challenges in a changing world” is a course that can be taken completely virtually by the students. No presence of traditional classes is required. Secondly, the courses will be held both asynchronously (video lectures, challenges, evaluations, etc.) and synchronously (discussion based lectures) via the platforms Moodle and Zoom. These platforms allow for different speeds of learning of students, the inclusion of various formats of student self-assessment as well as anonymous student feedback for constant re-assessment of the course. Due to the asynchronous design of the self-study content, different learning speeds become less important, and equal opportunities are guaranteed. Thirdly, there is cooperation with leading international universities and lecturers, so that each individual lecture module is conducted by a different university and corresponding international expert. A high professional level of teaching is therefore guaranteed, while at the same time a wide range of subjects can be learnt by a large number of students. The use of the existing and widespread infrastructure of Moodle and Zoom ensures the greatest possible transferability to other courses as well as to the partner institutions. For this purpose, we were able to bring together 15 international experts in the field of current and future water challenges from leading institutions around the world (see Table 1 for a complete list).

The course is modularly constructed as lecture series and each module contains a single video lecture by one expert. In addition, the latest technical developments are integrated into active learning (e.g. online forums and tests, feedback, possible future developments), creating thereby a new type of learning experience. Didactically, the focus is on blended learning with the use of flipped classrooms and a combination of asynchronous and synchronous sessions with the respective lecturers. The range of available topics is more extensive than the required semester performance, which enables students to participate in the design of the course themselves, making each year a unique learning experience. Another positive aspect is the dynamic change created by switching between different approaches and lecturing styles, as different lecturers take the lead of their own topics. The motivation of the students is thus promoted, by a broader and richer experience brought naturally by the lectures, whereby the examination modalities are kept nonetheless constant to enable continuity and facilitate the assessment of the student performance across different topics

Apart from the educational content, all other tasks are bundled at the University of Siegen, such as formalities, assessments, administrations or the moderation of online discussions, among others. This enables the partner institutions to focus solely on the teaching and thereby optimizing the time invested in preparation of the lectures. This has made the participation of so many top-class academics possible. In terms of work productivity, each partner gets back a multiple of the teaching material which they actually have invested in.

Additionally to the creation of this novel course, we believe it is important to promote digital collaboration and cross-university teaching. The course (and respective modules) created will be made available as an “Open Educational Resource” to the online portal for studies and teaching in NRW (ORCA.NRW, 2022). This enables inter-university knowledge and data transfer, which increases the learning level and makes future cooperation easier to realize. The basic principles of this novel modular construction are suitable for partial integration of its components and transferable to other universities (and beyond). The course and the associated data therefore are made available to all partner universities. As a result of the implementation via the already existing IT infrastructures, it is possible for the project partners to include the course or parts of it

in the curricula of their study programs without any further technical difficulties before it is made available at ORCA.NRW.

3. RESULTS

3.1 INTERNATIONAL PARTNERS

In our project "CoDiLe - Collaborative Digital Learning", a novel international course "Water challenges in a changing world" in the form of a lecture series is designed. The course primarily addresses master's students from the fields of environment and engineering and is created in collaboration with 15 national and international high-ranking universities. The leading lecturers of the partner universities participate by providing a video lecture and selected literature on a topic of their expertise, guaranteeing a very high-quality standard and a wide range of topics. The list of partner institutions, lecturers, and topics are presented in Table 1.

Table 1. Participating universities and lecturers.

Lecturer	Institution	Country	Topic
Prof. Ahadzie	University of Ghana (Accra)	Ghana	Assessing the capacity of communities to flood resilience in greater Kumasi, Ghana
Prof. Aronica	University of Messina	Italy	Flood risk maps and dissemination of information to the public
Prof. Bhattacharya	KTH Royal Institute of Technology (Stockholm)	Sweden	Groundwater pollution - Arsenic fate
Prof. Carvalho	University of Coimbra	Portugal	Detailed flow through and around hydraulic infrastructures
Prof. Chen	University of Exeter	United Kingdom	Water and Public Health
Dr. Datta	UTSA Texas	United States	Water resources and quality
Prof. Disse	TU Munich	Germany	Pre-screening hazard-maps for Flash floods in Bavaria
Ralf Engels	City of Bochum	Germany	Resilience and adaptivity in strategic urban drainage planning
Prof. Fröhle	TU Hamburg	Germany	Climate Change and Future Options for Adapted Protection against Flooding
Prof. Jüpner	TU Kaiserslautern	Germany	Coping with extreme flood events
Prof. Leandro	University of Siegen	Germany	Urban flood forecasting
Dr. Pant	University of Oxford	United Kingdom	System-of-systems risk assessments of large-scale transport networks
Prof. Sanders	UCI California	United States	Modelling and Mapping compound (pluvial, fluvial and coastal) flood hazards
Prof. Schüttrumpf	RWTH Aachen University	Germany	The transport and fate of microplastics in fluvial and marine ecosystems
Dr Shucksmith	University of Sheffield	United Kingdom	Introduction to Flood risk modelling

3.2 REALISATION AND IMPLEMENTATION

In addition to the video lectures, students are provided with literature and new technical developments in active learning. The latter consists of online forums for exchange among students as well as digital challenges like quizzes and digital tests. Each block of topics has a self-contained modular structure. After self-study of the topics, processing of the digital learning aids in the interaction between the students with each other via online forums, a virtual live discussion with the lectures is also made possible.

The sequence of the learning phases is shown in Figure 1. In the first phase, the students receive the video material of the respective lecturer, as well as selected literature. This provides them with a broad spectrum of information and enables an individual self-study phase. In the second phase, the first interactive exchange between the students takes place. Using predefined questions, discussions are initiated via Moodle. In this phase, new questions are collected, which are discussed interactively live with the respective lecturer via Zoom in the third phase. Finally, an online test allows students to do an initial self-evaluation. After completion of the selected topics, students will be graded on a scientific poster on one of the topics of their choice, which is created and presented in group work.

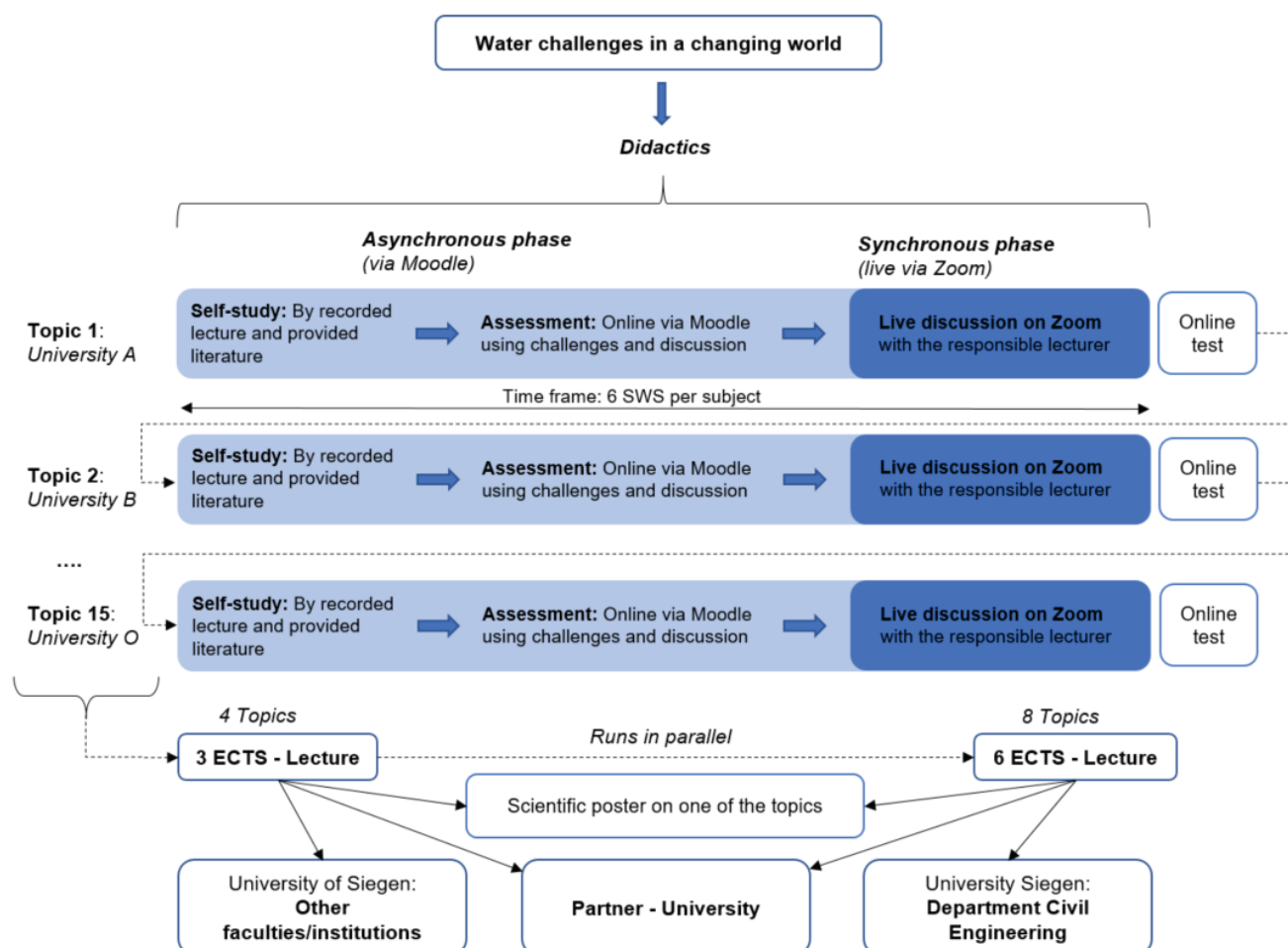


Figure 1. Flowchart of the different learning phases.

The extent of available topics is more comprehensive than the necessary semester performance, which allows students to design their own course differently every year. At the beginning of the semester, they can choose their 8 (A) or 4 (B) preferred topics and design the course individually. This design thus also allows for different implementation at the University of Siegen and the partner universities. The course will be offered as 6 ECTS (A) at the Dept. Civil Engineering in the Master Curriculum for Civil Engineering as well as 3 ECTS (B) for all interested students of all other institutions of the University of Siegen.

4. CONCLUSIONS AND DISCUSSION

We have succeeded in creating an open course based on a lecture series termed "Water challenges in a changing world", providing students with access to leading scientists. In total, 15 internationally recognized lecturers from various universities collaborated in this effort. The lecture series combines asynchronous and synchronous elements in order to enable different learning speeds, including different phases of self-study.

An initial trial phase is planned for the spring of 2022, with the final rollout taking place in the fall of 2022. Various challenges rooted in the nature of digital teaching still exist for this trial phase. Some students benefit strongly from the routine of physical attendance and also miss the in person community aspects of teaching. We hope to address these challenges by combining synchronous and asynchronous content. Furthermore, we intend to motivate students through alternating online challenges and discussions moderated (and initiated, if necessary) by us. We also hope to gain an overview of student progress through these challenges and discussions, as experience has shown that assessing student progress can be difficult without face-to-face teaching.

Since the course is open to all students of the University of Siegen, this lecture series has the potential to increase the awareness of students towards hydro-environmental engineering. As the challenges around the topic of water play a central role in today's time and society, overlapping with many other areas of research, this new modular course is also very valuable for students from other disciplines. In addition, all partner universities also receive early access to all modules, which will be made available as an "Open Educational Resource" to the online portal for studies and teaching in NRW (ORCA.NRW, 2022) at the end of the year 2022. In our view, this spirit of sharing academic knowledge has the potential to leap the quality of lectures in higher education by encouraging the reuse/improvement of lecturing material and didactics thought for the new challenges ahead.

Further information and details on the project "CoDiLe – Collaborative Digital Learning" can be found on our website (fwu, 2021).

5. ACKNOWLEDGEMENTS

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We appreciate the cooperation and efforts of all lectures in our partner institutions producing the educational content.

6. REFERENCES

- digiFellows (2022). DIGI-FELLOWS Förderlinie. <https://www.dh.nrw/kooperationen/Digi-Fellows-2> , accessed on 08/02/2022
- Edx (2022). Schools and Partners. <https://www.edx.org/schools-partners> , accessed on 08/02/2022
- FernUniversität Hagen (2022). History of the FernUniversität. Hagen, Germany. <https://www.fernuni-hagen.de/english/university/profile/history.shtml> , accessed on 08/02/2022
- fwu (2021). CoDiLe – Collaborative Digital Learning. University of Siegen, Siegen, Germany. <https://www.bau.uni-siegen.de/fwu/wb/forschung/projekte/codile/index.html.en?lang=en> , accessed on 08/02/2022
- ORCA.NRW (2022). Open Resources Campus NRW. North Rhine-Westphalia (NRW), Germany. <https://www.orca.nrw/> , accessed on 08/02/2022
- OU (2017). Facts and figures. Open University, United Kingdom. <https://www.open.ac.uk/about/main/strategy-and-policies/facts-and-figures> , accessed on 08/02/2022