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Exploring future work processes – Conclusions from an interdisciplinary project in Building Information Modeling

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Abstract

In an iterative design process, a new interdisciplinary module prototyping digital workflows in the area of Building Information Modeling was created. The process, accompanied by academic developers, followed the design-based research approach and used a multi-method-evaluation design. Based on the data obtained, core elements and the key difficulties of interdisciplinary collaboration in educational settings are described in a heuristic model illustrating the interplay of challenges and learning potentials in three dimensions of two levels each. Although limited by the sample size, the model might be used (and further tested) for the development and monitoring of digitally supported interdisciplinary cooperation projects in higher education.

1. What do we aim for? / Background of the project

The environments we live and work in are subject to massive changes. Future graduates will operate in conditions that are more dynamic, less predictable, more complex and harder to analyse. These developments need to be reflected in the competence profiles our educational institutions focus on. Research highlights “collaboration, communication, ICT literacy [as well as] social and / or cultural skills [and] citizenship” as commonality of different approaches to future-ready curricula, but identifies gaps in implementation and practice (Voogt & Roblin, 2012, p. 309). One way of fostering such a set of competences is to address real-world problems with digital tools using an interdisciplinary and project-based approach (Harth, 2019). However, interdisciplinary research and teaching at higher education institutions is still far from mainstream as it opposes the disciplinary creation and transmission of knowledge (Frodemann, 2017).

FH Münster University of Applied Sciences has therefore set the goal of counteracting this gap with the help of Wandelwerk, Center for Quality Development, which has helped to initiate and support more than one hundred teaching development projects.³ The project described here prototypes a new educational approach to developing competences needed in the field of Building Information Modeling (BIM). BIM is an approach for representing the planning, construction and operation of buildings digitally and thus enhances cooperation across different processes and professions (Pilling, 2009). Even though the field is developing dynamically, a gap between vision and implementation persists (Miettinen & Paavola, 2014).

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The aim of the project “BIM interdisziplinär” is to address both the potentials and the difficulties of interdisciplinary project-based learning with digital tools by developing and implementing a seminar located at the interfaces between architecture, building sciences, construction management and structural engineering (Strotmann, 2019).

2. How did we proceed? Concept and evaluation

As academic developers, we supported senior lecturers from different departments in developing and implementing their innovative educational concept. In an iterative process and following the Design Based Research (DBR) approach (The Design-Based Research Collective 2003), we provided theory-based input and evaluation. Using a mixed-method design, we aimed at investigating the potentials and challenges presented by the more open and more interdisciplinary educational approach developed in the project.

2.1. Course design

The course was implemented as an elective module in the Master’s programs of the departments of architecture, building sciences, construction management and structural engineering. The learning outcomes encompass the competences needed for interdisciplinary work in BIM, the handling of digital tools and their interfaces in the BIM process, and the general openness employed in this exploratory approach. The course itself consists of three phases:

1. Understanding the challenge and team-building
2. Project work and knowledge acquisition
3. Presentation and documentation of solutions

During the first phase teams of four to six students were created and briefed on the challenge; they then started from scratch to create building outlines. In the second phase the weekly four-hour course was used to introduce the basics of all three disciplines involved in the task and for reports by practitioners from the different professions on their experiences with BIM and the digital tools used in the process. The teams also conducted three interim presentations aiming at feedback, knowledge exchange between the teams and support regarding problems. Based on this feedback they started the third phase, where they had to prepare and conduct a final presentation and hand in a project report.

2.2. Data acquisition and evaluation

Following DBR, we provided theory-based input beginning with the concept development and evaluated the educational concept iteratively. We collected data in two cycles. To support course development we gathered feedback from the students mid-term on what helps and what hinders their learning (Snooks, Neeley & Williamson, 2004) and used problem-centred (group) interviews (Witzel, 2012) for insights into collaborative processes. Finally, we piloted end employed a standardised questionnaire focusing on the collaborative process and competence development pre- and post-test.

Table 1: Dataset – Overview

	Iteration I	Iteration II
Students in mid-term evaluation	n = 28	n =23
Students in (group) interviews	n = 4	n = 3
Pre- and post-questionnaire	n=18	n=15

In both iterations, we directly discussed the mid-term evaluation with the lecturers to allow adjustment of single aspects even during the semester. Additionally, we analysed results from all instruments and derived implications for the educational concept together at the end of each term. Comparing these results with literature and other projects, we identified typical challenges presented by interdisciplinary, open-ended courses.

3. What did we learn? Results

Overall, the data indicates the educational potential of a course design that fosters students' future-readiness through digitally supported, interdisciplinary collaboration in an open setting where no pre-defined process or solution exists. On a more detailed level, we derived aspects for designing educational settings which focus on digitally supported, interdisciplinary collaboration. Based on the qualitative and quantitative data we constructed a heuristic model to present typical challenges and the resulting potentials for competence development in different dimensions, each consisting of an individual and a collaborative level.

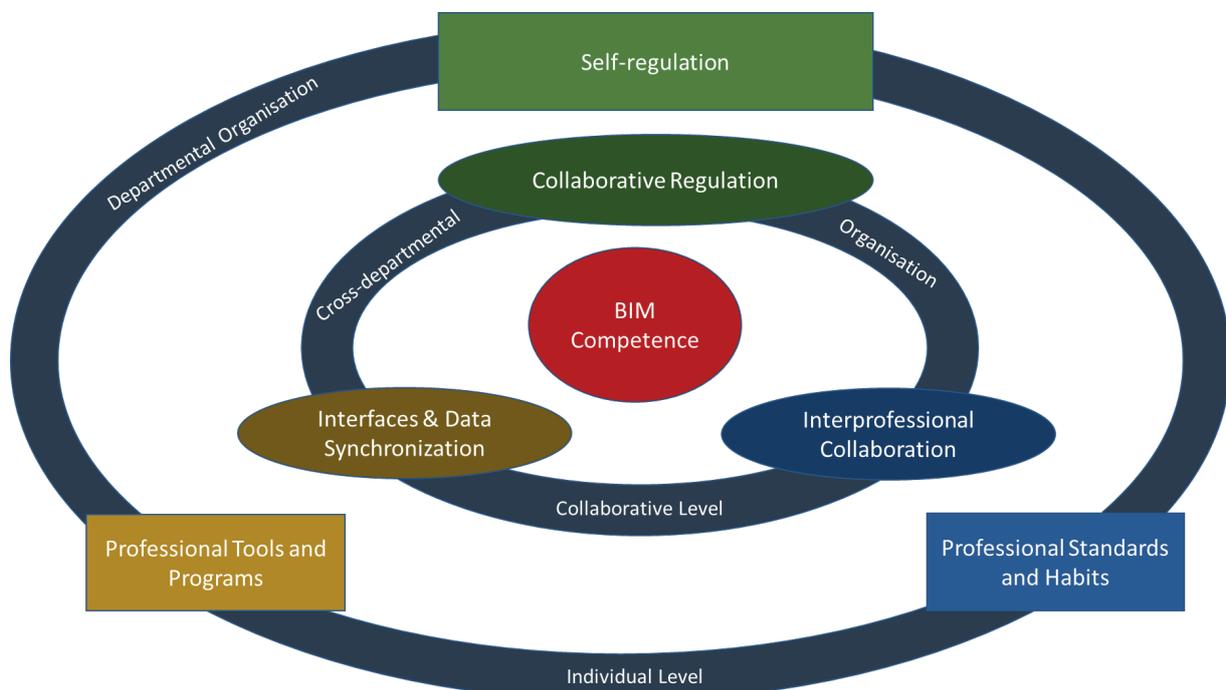


Figure 1: Challenges in different dimensions

3.1. Departmental and cross-departmental organisation

A foundational dimension is organisation, because the department needs to integrate the new module into its programme. On a second level, interdepartmental conflicts need to be solved. Here, finding a common window in the educational schedules of the students and lecturers was challenging.

3.2. Professional standards and interprofessional cooperation

The first dimension relevant for competence development involves standards and habits. On a first level, each student had to adhere to the professional standards of his or her discipline, for example aesthetic aspects in architecture. On a second level, they were challenged to collaborate in a less defined area. Becoming familiar with the other professions, their methods and their ways of thinking was regarded as the most important learning outcome across all instruments, but a closer look into the interviews and group discussions revealed few examples of collaboration. Mostly work was clearly divided cooperatively.

3.3. Professional tools & programs and interfaces & data synchronisation

The second dimension describes challenges resulting from the digital tools used in the collaborative process. First, each student worked with his or her own professional tools, but then the different digital tools needed to communicate and exchange data. Students felt that prototyping and troubleshooting these processes while managing the project timeline was a great challenge and learning opportunity.

3.4. Self-regulation and collaborative regulation

Regulation, as the third dimension, relates to the other two. On a first level, students needed good self-regulatory skills to monitor and sustain their workflow in an intense project. On a second level, they encountered collaborative challenges requiring regulatory processes of the group to deal with upcoming interindividual, cross-disciplinary and / or technical challenges. The interviews again provided insights into different patterns and roles developed by the students. The lecturers acted as role models by demonstrating constructive patterns and roles they had previously experienced in research and projects.

4. Summary and discussion

The DBR approach enabled us to generate deeper insights into the challenges, potentials and developmental processes of digitally supported interdisciplinary cooperation in higher education. Even though sample size was limited to one project, we were able to construct a heuristic model by using a mixed-methods approach and comparing our findings with theory and experiences from other projects. The approach may be used in other educational scenarios implementing digitally supported interdisciplinary cooperation. To stabilize the model and its components more empirical saturation is needed, meaning a more systematic comparison with other cases as well as literature.

One side effect of the evaluation was that during the interviews students reflected on their experiences of interdisciplinary cooperation spontaneously and drew new conclusions. Consequently, we propose including similar prompts for reflection in interdisciplinary modules to support student learning.

Overall, the heuristic model indicates a key risk: the number of challenges in different dimensions and on different levels can overburden students and frustrate educators. Digitalisation is an important aspect of future-readiness for interdisciplinary cooperation, but dealing with this dimension can take up so much space that not enough is left for the development of reflected interdisciplinary cooperation.

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