OPERATIONALISING CHALLENGE BASED LEARNING FOR GEO-INFORMATION SPECIALISTS IN AN INTERNATIONAL CLASSROOM

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ABSTRACT

The main challenge for the new generation of international geo-information specialists is to provide accurate, relevant, and actionable spatial information services to society. Consequently, educators need to organize their education in such a way that students students not only to master content, but also acquire essential skills and competencies to collaborate, communicate, and think in a critical, creative, and innovative manner. The concept of Challenge-based Learning (CBL) provides a flexible and effective educational framework for finding a collaborative solution to real-world, open-ended, technology-driven challenges in interdisciplinary teams. A perfect example of a task that our students will face in their professional life, is providing adequate geo-information services to application fields outside of their expertise.

At the Faculty Geo-Information Science and Earth Observation, University of Twente, the classrooms are highly international (from 75% to 100% non-European) and from multiple application fields. MSc students are highly motivated, especially when they can tackle challenges linked to their home countries. By operationalising the CBL concept we want to enable students to co-define their learning path, to enhance 21st-century skills in an international classroom, and to exchange experience with peers and experts, while acquiring essential domain knowledge. In spring 2020, we will embed a CBL approach in an online elective called “Weather Impact Analysis”. In this concept paper, we show how, by using the CBL approach, students obtain deep domain knowledge and skills, while at the same time they acquire 21st-century skills necessary to succeed in a rapidly changing society.

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1 INTRODUCTION

We live in a is changing world; its climate is changing as well as human pressure on natural resources. This makes that skills and knowledge acquired by graduated students necessarily need to change in order to tackle global challenges. Universities and her academic staff will have to rethink their learning environments (learning resources, technology, modes of learning, roles of teachers and students, etc.). We developed a new MSc elective course for a small international classroom, which required a teaching method that allows students to take ownership of their individual learning process. We realized that students should go through four stages of self-organised learning: sensing/feeling, watching/reflecting, thinking and doing (Fielding, 1994). At the same time, there were four boundary conditions to be considered: 1) it is an international classroom (over 75% foreign), 2) it is an multi-disciplinary classroom, 3) students should get ample training in scientific reasoning as their next study phase is the MSc research, and 4) due to the COVID-19 virus and timing of the elective (April-June 2020) it should be taught fully online.

The Challenge-based Learning framework (CBL) provides an environment where skills and content can meet, as teaching is focused on solving real-world challenges (Nichols et al., 2016). CBL is founded on the Experience learning theory of Kolb (1984) and is based on the belief that students learn best when they learn by experience. Implementation of the CBL framework offers students the opportunity to focus on the personal development of knowledge and skills, while improving key competencies for the 21st-century working environment such as interdisciplinary and intercultural communication, collaboration, decision-making, as well as critical thinking. Although students will work in groups, the learning outcomes will need to be reached on an individual basis (Rådberg et al., 2015).

For the new MSc elective course “Weather Impact Analysis”, we adopted the CBL framework of Nichols et al. (2016) for its project work. The objective of this concept paper is to provide a design for this online elective using a CBL approach, while maintaining a balance between exposure to CBL skills, enhancing academic skills, and building new domain knowledge and analytical skills. This set of 21st-century skills, complemented by discipline knowledge, is considered essential for students in their MSc research stage as well as in their professional life after graduation. The presented structure is developed to support teaching staff, that is not familiar with CBL, in their role as course developer and teacher, and want to adapt CBL in their domain knowledge courses.

2 DESIGN AND IMPLEMENTATION OF CBL APPROACH

The course Weather Impact Analysis has four main learning outcomes: by the end of the course, students should be able to understand how weather impacts society (LO1), evaluate suitable datasets to analyze both weather and impact (LO2), explore analytical tools to extract relevant information from the datasets (LO3), and

incorporate new domain knowledge in a CBL context (LO4). The course consists of two parts: first specific domain knowledge and analytical skills concerning extreme weather impact are taught, and subsequently small groups of students work on a real-world challenge. During this project work, students will need to use their freshly acquired domain knowledge and 21st-century skills to find an optimal solution. The assessment methods are an inception presentation and a report, of which the criteria are in line with the learning outcomes.

The international classroom during the first year of the course (2020) contained 10 MSc students, a mixed population of European and non-European as well as a mixture of academic backgrounds. None of these students had an academic background in atmospheric sciences, so domain knowledge for analyzing extreme weather events and their impact on society was provided in the first part of this course. The teaching staff was scientific experts in various domain fields, supported by an educational consultant. Staff involved are highly experienced with didactic concepts for international classrooms, which makes raising cultural awareness an implicit part of all steps in the educational structure presented below. To ensure the balance between domain knowledge and CBL skills, the role of the teacher in this project phase had to be dual: domain expert with facilitation skills.

Figure 1 shows the newly developed basic course design for the project work, where teachers and students didactics meet to build towards the learning outcomes strengthened by CBL skills. Within the course, both students and teachers have various tools for self-reflection and instruction, allowing a personalized learning process. The adopted CBL framework by Nichols et al (2016) consists of three phases: Engage, Investigate, and Act. Within the course we translated these phases as “to understand the challenge”, “to explore the possibilities by analyzing information”, and “to solve the challenge by presenting a working solution”.

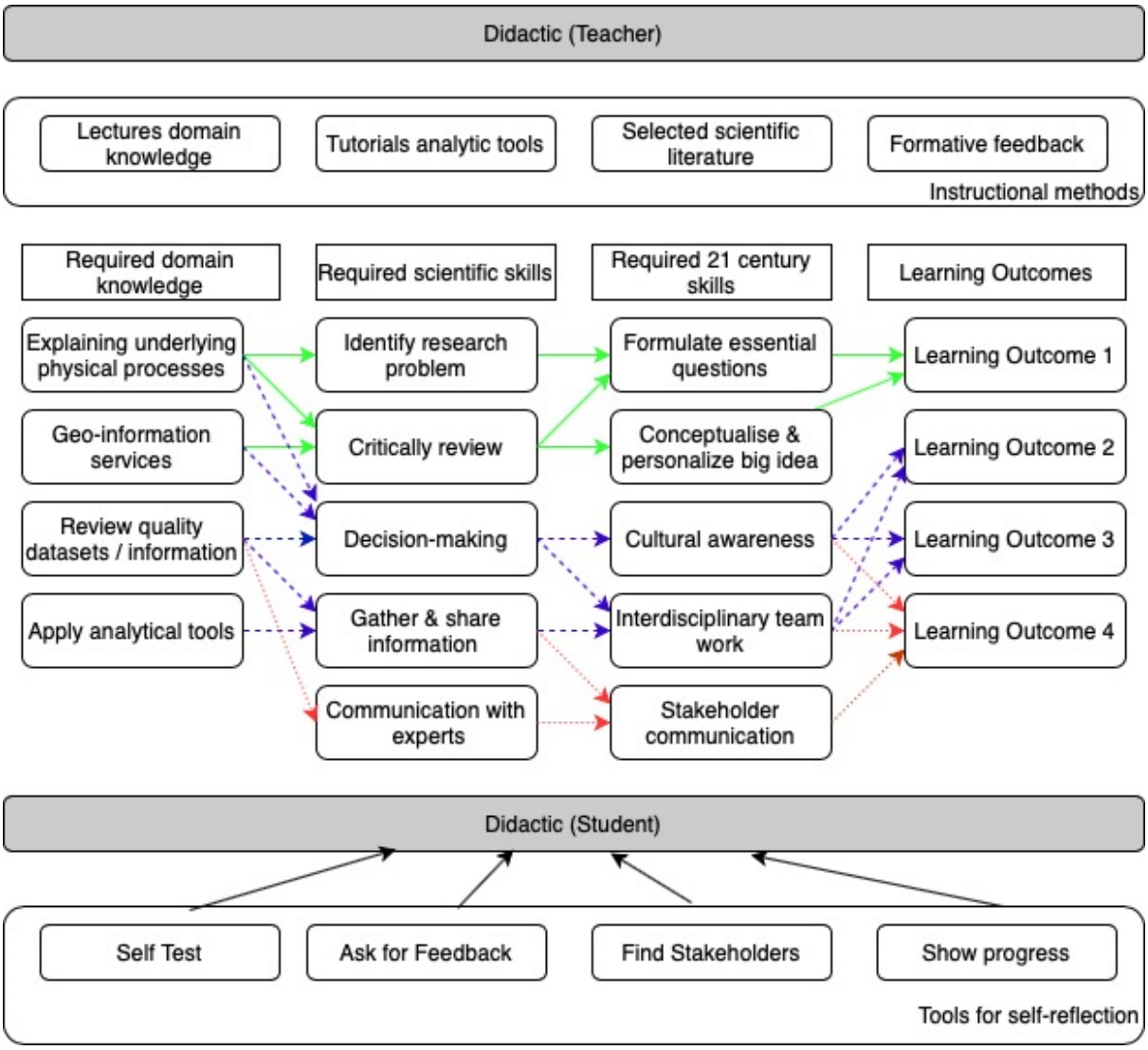

Figure 1 Educational structure showing relationships between the didactic activities of teachers (top) and students (bottom) with respect to maintaining a balance the required domain knowledge, required domain skills, 21st-century skills, and the learning outcomes. The solid green arrows refer to CBL phase Engage, blue dashed arrows to CBL phase Investigate, and dotted red arrows to CBL phase Act.

The first phase, ENGAGE (solid green arrows), requires the students to explore a real-world challenge and develop essential questions to show a deep understanding of underlying processes and research done by others, and narrow the challenge to a research question. In the second phase, INVESTIGATE (blue dashed arrows), students are to formulate guiding questions. They discuss within their teams what resources (knowledge, data, and analytical tools) to select for investigating a variety of solutions. In the last phase, ACT (dotted red arrows), students generate possible solutions, discuss these with experts and stakeholders, and present an “optimal” solution to the original plan.

The figure shows that the second and third phases depend on similar skills and knowledge, because students might have to redefine their information and data services after reflecting on their possible solution to the real challenge. Students document, reflect, and share every step of the process on the progress made. Open formative evaluations are planned to ensure students reflect and communicate on their steps in the individual learning process with their peers and experts.

3 EXPECTED RESULTS

We envisage that our CBL framework, and the experience we will gain during the delivery of the course, will result in a workable course design for implementing CBL effectively in an international classroom. Within the faculty ITC, this course will be the first domain knowledge MSc course that has a CBL framework embedded, and where domain knowledge and CBL skills have to be balanced and evaluated. During the execution of this course, special attention will be given to the individual learning experiences of the students. Although the student population will be around 10, we are curious to find whether there are similarities or differentiation between various cultures, MSc programs, or other factors.

Compared to regular domain project work done within the two MSc programs, we expect that students will, at the end of the course, be better prepared for tackling real-world challenges that are connected to academic content. The CBL structure presented allows students to explore their interests in a variety of ways, where intercultural, international, and interdisciplinary perspectives play a role in finding solutions for big global challenges. The students will be prepared to implement newly gained domain knowledge into a real problem, explore possibilities, and communicate their optimal solution.

While operationalizing CBL in an international classroom, we do not expect that cultural interplay, respect, and acceptance will be a major challenge. All teaching staff has large experience in teaching international classrooms. Also, the students have been exposed to other cultures and disciplines for about a year already. We believe that the success of CBL implementation even benefits from the international classroom, where intercultural awareness plays an implicit role when having to share, document, and reflect on their work.

During and after the course, the presented structure will be evaluated and adopted. Although the course will be completely online, we do not expect major adjustments when delivering this course physically in class again. At the SEFI conference, we expect to present the improved version, such that our design can be used by other domains, also outside the geo-information sciences.

4 SUMMARY AND ACKNOWLEDGMENTS

Maintaining the balancing between disciplinary knowledge, academic skills, and CBL skills will be crucial to prepare MSc students for the research stage as well as for their professional careers. A common factor is that none of the students has an academic background associated with the main topic of the course, i.e. weather impact. This concept paper provides a generic structure for a course design where domain knowledge and skills, as well as the 21st-century skills are integrated. At the conference, we will share our experiences on how adopting a CBL approach in a scientific teaching environment worked out in practice.

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