Challenge Based Modular Education Upscaled: Piloting and Evaluating an Implementation Procedure

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ABSTRACT

Modular approach in education provides the advantages of student self-pacing, autonomy, and receiving frequent feedback from the instructor. In 2021, the project; CMODE-Up (an Upscaling of the earlier undertaken project Challenge-based Modular On-demand Digital Education) provided evidence-based design principles and an accompanying teacher guide for modular courses in engineering education. A next step towards actually implementing the design framework, is piloting it. In this pilot, we will ask teachers from our university to work with the framework to redesign their course into one or more challenge-based modules. We started off with a short workshop to get teachers motivated to work with us. Teachers were recruited based on willingness and experience with modular courses. During the workshop, the teachers engaged in course design exercises using the design framework. Transcribed audiotapes of the workshop discussions constituted the data for this study. To further improve the framework, the results from the workshop data were combined with results of a descriptive literature review. Relevant articles and conference preceedings were located that can shed light on issues such as design of a course with elective modules. Results collectively will lead to an adapted version of the design framework.

1 INTRODUCTION

Online learning environments and modular structures in higher education enable learners to define and pursue a personal learning path [1]. The modular approach is rooted in educational pedagogies such as programmed-instruction, learner-centered pedagogies, and computer-assisted instruction [2, 3]. Prominent characteristics of a modular approach in education include frequent feedback, self-paced learning, and flexibility in time and location [4]. Such characteristics have an important role in addressing the changing nature of the workforce towards sensitivity to individual interests and learning needs and to autonomous learning experiences [5].

Although a modular approach to course design has been frequently adopted in higher engineering education literature, design principles tailored to modular courses did not exist. In order to address this need, a conceptually grounded template for modular course design was developed in a previous study [6]. The design principles were: (1) course content, (2) module category, (3) alignment of content, (4) module development, (5) implementation, (6) learner engagement, and (7) evaluation.

The need to support teachers with empirically-grounded frameworks to design modular courses has been highlighted by previous studies. Felix-Herran et al. [7], for example, designed and delivered a training program to support engineering instructors' in designing modular courses. This study addresses the need to improve the developed course design framework [6] through a workshop for teachers and a descriptive review.

2 METHODOLOGY

2.1 Design

The first part of this research was piloting our empirically supported framework for modular courses in higher engineering education. Beginning with design principles based on existing research and expertise facilitated the process of piloting and testing during a teacher workshop. The second part included a descriptive literature review to further broaden our understanding on issues such as alignment of modules with other course components, modules in a challenge-based learning (CBL) course, and ways to offer mandatory and elective modules. Descriptive literature reviews are helpful in understanding similarities and differences in studies, while putting the focus on the certain features of interest [8]. In this study, qualitative methods of data collection and analysis were adopted.

2.2 Participants and data collection

Approval from the university Ethics Committee was received prior to data collection. Two teachers at the authors' university participated in the workshop, a full professor at the department of Chemical Engineering and a lecturer at the department of Applied Physics. During the two-hour workshop, the teachers engaged in structured discussions and exercises on modular courses using the framework.

The workshop was organized face-to-face and consisted of: a) an introduction about modular approach in education and the goals of the workshop, b) exercises for the teachers to reflect on designed courses using our framework, and c) a reflective discussion. The discussions were audiotaped. The discussions triggered the teachers to use the framework and to reflect on its improvement. In the descriptive literature review, 20 research studies were included, based on reporting on CBL and on elective modules; articles (n = 9), conference preceedings (n = 9), and book chapters (n = 2).

2.3 Data analysis

First, the audio recordings of the workshop discussions were transcribed verbatim. The qualitative analysis of the transcripts and the located research studies (n = 20) followed a content analysis method [9]. Following the separate analysis of the transcripts and the research studies, results were combined to reach a comprehensive overview.

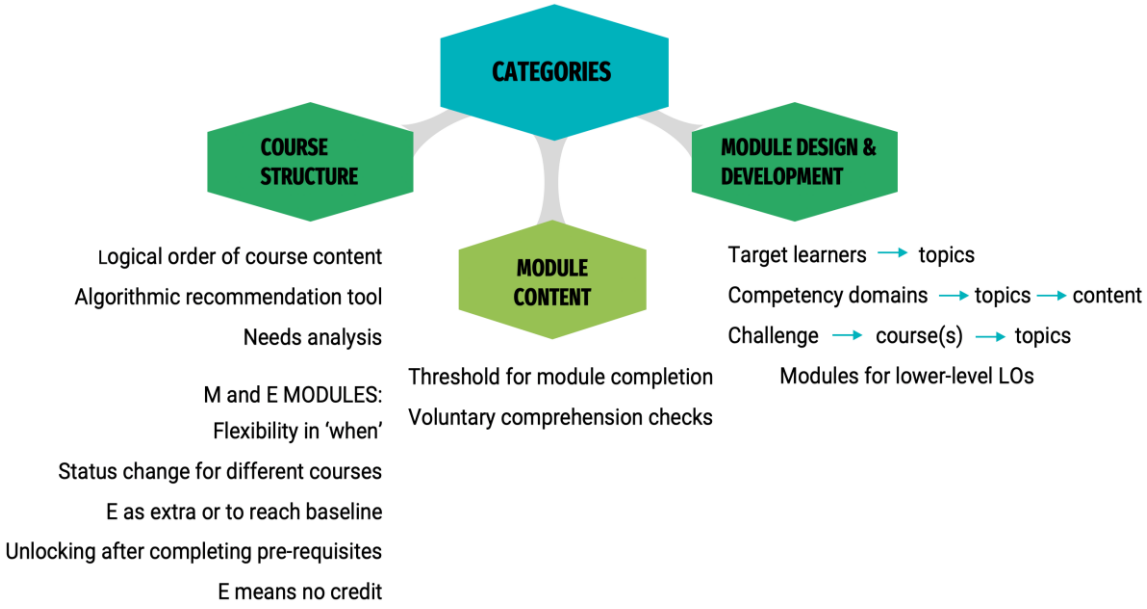
3 RESULTS

Results are summarized in three categories: a) modular course structure, b) module content, and c) module design and development (see Figure 1). Figure 1 shows the codes that emerged under the categories. M and E stand for 'mandatory' and 'elective' respectively on the figure. The codes reported under each category represent new ideas to modify the design framework. For example, the codes given under the category, 'module design and development', reveal that the modular

course design process can begin with considering learner profile first, the course topis, or the challenge. Similarly, the code; 'status change for different courses' under the category 'modular course structure' show that modules can be used as M or E in different courses. The researchers will now work on integrating the codes meaningfully into the course design framework [6].

4 SUMMARY AND FUTURE DIRECTIONS

Using the evidence-based design principles created during our former work, it was now time to focus on a practical implementation, as well as studying what place challenge-based education can hold here. The next step in this research is



incorporating the results presented here into the first version of the framework [6], to make it more practical for the teachers. Examples to that are, in a course with mandatory and elective modules, presenting elective modules as extra support for interested students or to help students reach an expected baseline level. The next step in the entire project is to collaborate with a teacher willing to modularize a course using the revised framework (with several elective modules) and work on the redesigned course.

Fig. 1. Combined results.

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