Title: Development of an assessment tool for Design-Based Learning Environment

Proposal for the 4TUCEE innovation fund 2018.

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Background

In the long run, the aim of the Eindhoven University of Technology is to educate the engineer of the future who deals with complex design challenges which are multidisciplinary by nature (CDCM) requiring creative and innovative thinking and making skills (source: website TU/e). In this context, design-based learning (DBL) is a promising and frequently applied method. An important determinant of the success of DBL is the quality of the coaching.

In a previous project[2] funded and executed by the CEE it was explored what good coaching of students that work on CDCM entails. The project led to several important findings, amongst others the following:

- Coaching students does not take place in a vacuum and should, therefore, be seen as creating a dialogue wherein the coach and students strive for (joint) meaning-making and develop new shared understandings and insights.
- Coaching should be seen as a form of continuous embedded formative assessment wherein the coach supports and/or challenges the student in determining where the student is, wants to go and how to get there with respect to the design process.
- Effective coaching implies targeting the right (underlying) skills and setting the right constraints to guide the design process, while maintaining the 'learning by experience' and 'self-discovery' learning principles.

The aforementioned findings make clear that coaching is a difficult skill and that mapping good coaching asks for an approach wherein the perspectives of both the coach and the students are combined. In this respect the concept of learning environment is a useful concept.

Introducing the Design-Based Learning Environment concept to define the problem.

Learning Environments often encompass the social, physical, psychological, and pedagogical contexts in which teaching and learning occur. It includes the relationship between the teacher and the students, the relationship among the students, students' learning approaches and motivations, supportive learning technologies, how the curriculum has been developed in relation to the learning outcomes specified, the climate in which teaching and learning takes place and students perceptions of it and the potential link between learning environment and learning outcomes (Fraser, 1998; Nolen, 2003; Adams and Granić, 2009).

[1] It was agreed with Angela Tops as contacts person of DPO teach that we will discuss which teacher trainer will contribute to the development of the deliverables. The decision will be made on expertise and availability.
[2] The project ''*How to coach students that work on complex design challenges of a multi-disciplinary nature?*'' aimed to derive insight and understanding into what coaching students that work on CDCM entailed. For this purpose, a literature review, observations and interviews with coaches were performed.

Many studies have confirmed the relations between students' perceptions of the learning environment, approaches to learning and learning outcomes (e.g. Struyven, Dochy, Janssens and Gielen 2006; Trigwell, Ellis and Han, 2012).

In this study, we will use the 3P model of Biggs's (1985;1987) to focus on coaching students in a design based learning environment. As became clear from the previous CEE project, coaching needs to be approached from a dialogical perspective. To date, little is known about coaching dialogues and the learning environment wherein these dialogues take place, how these learning environments affect learning outcomes, students' perceptions and motivation and how such an environment should be arranged for optimal coaching and learning.

In the model of Biggs (1985;1987), the learning environment is conceptualized as an interacting system of three sets of variables: the learning environment and student characteristics (presage), students' approach to learning (process) and learning outcomes (product). Figure 1. pictures how we envision the Design-Based Learning Environment.

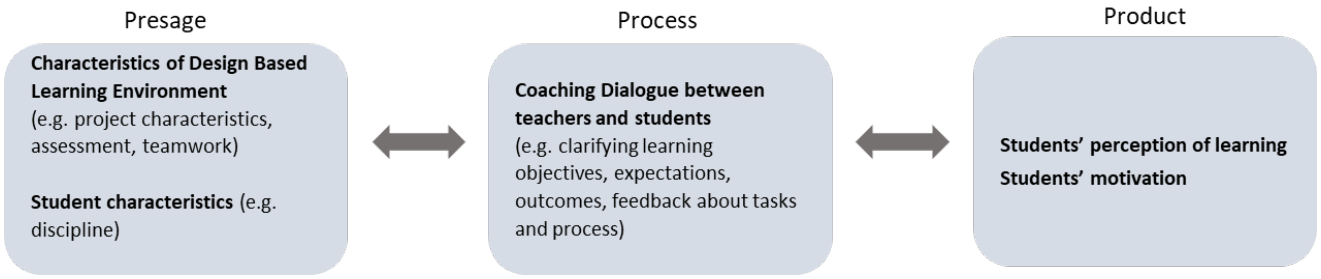

Figure 1. The theoretical model of the study (Based on Biggs's 3P model)

Objectives

In this project, we will approach the coaching of students that work on complex CDCM from a learning environment perspective. Furthermore, our starting point for this project was to build on the ideas and practical knowledge of teachers and to fulfill their needs. Therefore, we have formulated the objectives in close consultation with the teachers. Our aim is:

1. To develop and validate an assessment[3] tool, which is able to identify teachers' and students' perceptions of the coaching dialogue taking place in DBL environments.
2. To implement the assessment tool for formative purposes in DBL projects. The assessment tool will be used by teachers and students in order to identify barriers/obstacles in their coaching interactions and assist them to clarify expectations, communication challenges and (re)design an effective DBL course.
3. To evaluate the implementation and effectiveness of the assessment tool to facilitate coaching dialogue in DBL learning environments.

[3] Through formative assessment, evidence about the effects of coaching interventions is elicited, interpreted, and used by teachers, or fellow students, to make decisions about the next steps in coaching that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited (Nicol and Macfarlane-Dick, 2006)

4. To disseminate the assessment tool (and potentially other insights on coaching) to support teachers in developing coaching skills for DBL courses.

Approach

The present project consists of three parts as shown in Figure 2.

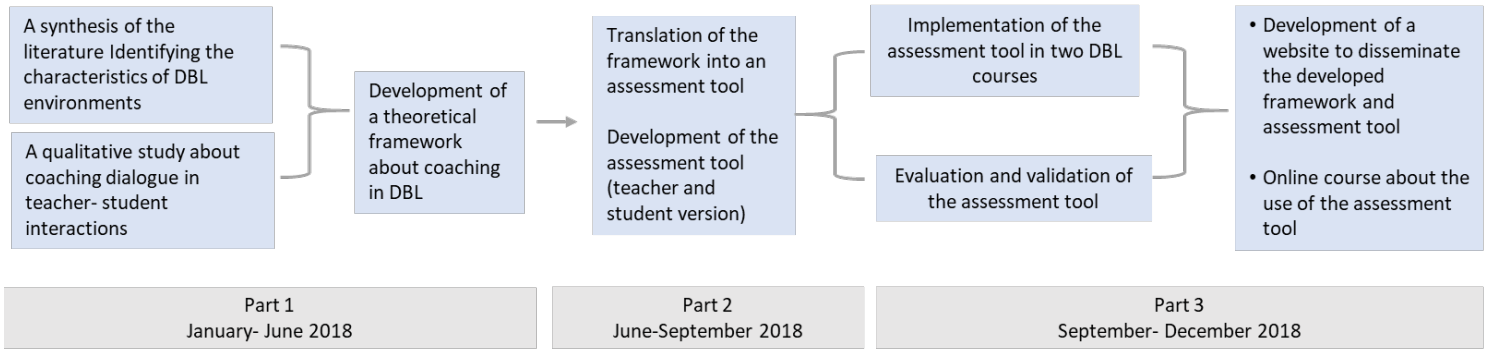

Figure 2. Description of project parts

Part 1. Will focus on the development of a framework describing key elements of coaching dialogue in DBL environments.

Part 2. Will focus on the translation of the developed framework to an assessment tool with two versions a) for teachers and b) for students

Part 3. Will focus on the implementation and evaluation of the assessment tool in DBL environments and its dissemination.

Part 1. Development of a framework for coaching dialogue in DBL

Time planning: January- August 2018

Participating teachers felt the need to know what they are doing and to measure the effects of their coaching on students' learning processes. They asked for a coaching model and questionnaire strongly embedded in the literature. Therefore, the first part of the project will focus on the development of a comprehensive framework that will identify and describe the most important components of coaching dialogue that can affect students' learning outcomes. For this purpose, we will use the 3P model of Biggs's (1983). For the development of the framework, we will conduct 1) a synthesis of the literature 2) an analysis of coaching sessions

Step 1. A synthesis of the literature Identifying the characteristics of DBL environments

Time planning: January- February 2018

Teacher-student interaction is a key aspect of the learning process, in DBL environments. Thus, we will focus the literature search on elements that entail student-teacher interaction, such as dialogical or reciprocal teaching, reciprocal coaching, dialogical feedback, feedback conversations and critiquing sessions. In addition, we will explore previous CEE projects that studied teachers' perception of good coaching and conducted observations of coaching sessions as additional sources of information.

The synthesis of the literature will result in a detailed list of important elements encountered in DBL environments that could play a role in the coaching dialogue between teachers and students.

Step 2. A qualitative study to study the coaching dialogue in teacher-student interactions.

Time planning: March- June 2018

In order to get an in-depth understanding of 1) the dynamics involved in the effectiveness of coaching sessions; 2) students' and teachers' perception of good coaching, and 3) important characteristics of DBL environments, we will analyze the coaching dialogue in teacher-student interactions.

For this study, we will collaborate with teachers in two USE courses, which use a DBL approach. The course coordinators of two USE courses (Robots everywhere and Humans in Technology) have already expressed their willingness to participate in this project.

In these USE Courses, teachers from several departments are involved providing weekly consultation on student groups regarding the design of a product. These courses provide an opportunity to collect data, based on the problems and challenges teachers experience with respect to coaching students while working on CDCM, to design methods for improvement and to evaluate the effects. Collaborating with teachers provides the project team with valuable insights and the teachers with sustainable measures for improvement. The previous CEE project resulted in a positive experience in collaboration between Robots Everywhere course leaders and the project team.

For this study, we will visit and video record the coaching sessions taking place in these courses in Q3 and Q4. Based on the video recordings, we will analyze further the coaching dialogue between teachers and students, in order to identify tensions and key characteristics in the coaching process (e.g. feedback on tasks, process and regulation). Particular attention will be given to contextual characteristics of DBL environment (e.g. the influence of coaches and students' discipline in their communication, the learning style in different disciplines) that could affect the coaching process during the consultation.

We will analyse the video-recordings in order to identify important themes and tensions that arise during the coaching dialogue according to teachers and students. We will select representative fragments from the video. These fragments then will be used for the discussions with the teachers that will take place. We will conduct discussions with the teachers and students in order to explore their initial expectations about the coaching sessions, challenges encountered during the consultations and their perception of them. Undertaking these discussions with teachers has two objectives. On the one hand we aim to identify important themes and tensions that arise during the coaching dialogue according to teachers and students (research goal). On the other hand, we want to stimulate coaches to reflect on their coaching practice and help them develop themselves (professional learning goal).

The synthesis of this information will lead to the development of a comprehensive framework which will identify and describe key competencies needed for effective coaching in DBL environments.

Part 2. Development of the DBL environment assessment tool for teachers and students

Time planning: June- August 2018

For the development of the assessment tool we will use the framework developed in the previous stage. Based on the competencies that we identified in the framework, we will generate items for the assessment tool. We will develop two versions of the assessment tool: a) one for teachers and b) one for students in order to capture their perceptions of the key elements of coaching dialogue in DBL environments.

Expected benefits of the assessment tool for teachers

The teachers will use the assessment tool as a way to evaluate the learning environment and improve/ facilitate the learning processes. The assessment tool for teachers will be used to guide the coaching sessions and making sure that all the important themes (feedback on task, process, regulation, teamwork, etc.) are addressed to ensure optimal learning.

Using the assessment tool will foster teachers' reflection on their own practice, will foster their professional learning and will help them to be better prepared to meet diverse students' needs and to achieve a greater equity of student outcomes. The assessment tool will provide the teachers and students with information to decide whether they need to rearrange the learning environment and which aspects of it. We believe this tool to be very useful for teachers. The teachers of the Robots Everywhere strengthened us in our beliefs by expressing their desire for a tool that could be used as a guide for effective coaching. So, the tool will have the goal to support teachers in their professional development with respect to coaching students.

Expected benefits of the assessment tool for students

The students' version of the assessment tool will allow students to have an active role in the coaching session, rather than a reactive one. That means that the students will not only receive initial feedback information on their project, but also, they will have the opportunity to engage the teacher in a discussion about that feedback and take the lead in the conversations. Furthermore, the assessment tool can help them to rearrange the coaching situations to make it more useful. The assessment tool will provide students with an understanding of the important themes the coaching session should entail (project task, the process, the teamwork) and it will help them to be better prepared for the coaching session, leading to more effective learning. The assessment tool has the potential to provide students with insight into where they are in their learning process and where they would like to go.

Part 2. Implementation and evaluation of the DBL environment assessment tool

Time planning September- November 2018

In this second phase we will pilot and validate the assessment tool for 1) stimulating teachers' professional development with respect to coaching, 2) redesigning the two DBL courses that participated in first part of the current project (Robots Everywhere and Humans in Technology) and 3) providing students with input to re-arrange their learning environment for optimizing purposes.

Workshop to stimulate teachers' professional development with respect to coaching

Training students and teachers is an important condition for successful formative assessment (Sluijsmans, Dochy, Moerkerke, 1999). In order to stimulate teachers' professional development with respect to coaching, we will organize a workshop prior the beginning of Quartile 1. In this workshop the teachers of the two USE courses, involved in the previous stage of the project will be invited. We

will introduce them the assessment tool and the workshop will be an opportunity for them to review it and explore ways to integrate it into their Design Based courses in the following Quartile.

Redesigning of DBL courses and implementing the assessment tool

We will use the data-team method, where teachers responsible for the courses and a quality assurance employee or educational scientist work as a team in a systematic and evidence-based way to improve the course (Schildkamp, Handelzalts, & Poortman, 2016). The teachers will use the assessment tool in order to redesign their course. But perhaps more importantly, the method supports teachers to reconsider their own practice, reflect on choices with respect to the course design and help them to consider and experiment with alternatives. As such, it is an important means to foster students' professional development.

Furthermore, the teachers and students will use the assessment tool as a way to structure the coaching session and identify areas for improvement. The assessment tool will be used for the whole duration of the DBL course and it will support teachers to monitor the progress and understanding of students, to identify learning needs and adjust teaching appropriately.

Evaluation of the assessment tool

At the end of the course, we will evaluate both versions of the assessment tool. For the teachers' version, we will conduct interviews with the teachers, who integrated it in their course. The information that we will collect about its use, applicability, challenges during implementation, will contribute to the validation of the assessment tool. In order to validate the students' version of the assessment tool, we will ask, the students who participated in the two DBL courses to complete the assessment tool, at the end of the course.

Part 3. Dissemination

Time planning: November-December 2018

A strategy to disseminate the content of this project is required. Developing a website for the tool can help with dissemination. In the website we will provide information about the theoretical framework and the assessment tool we developed and its use for DBL courses. If possible, we will develop a short online course that teachers can attend in order to receive support and improve their coaching skills and learn how to use the assessment tool for their own course. In this phase of the project we will be assisted by an experienced teacher trainer of DPO teach.

The development of the website will ensure that the assessment tool could be accessed by interested teachers. The short online course could facilitate teachers to learn at their own time, way to implement coaching dialogue in their courses and use the assessment tool either for formative purposes (e.g. to redesign their course) or summative purposes (to evaluate the effectiveness of coaching dialogue).

Fitness between the project proposal, TU/e vision, and the innovation call

This project proposal aligns well with the core elements of the TU/e vision as formulated by Meijers and den Brok (2013):

- Small-scale education and master-apprentice interaction as key elements of academic education.

- High-quality teaching that involves personal interaction with students.
- Emphasis on multidisciplinary and diversity of students.
- Design Based Learning, which is a promising educational approach to educate students to deal complex design challenge that is multidisciplinary in nature.

In addition, this project aligns well with the innovation call:

- The present project builds on previous projects wherein it was defined what good coaching of students that work on CDCM entails. It extends knowledge on coaching dialogue using a Design-Based Learning environment perspective.
- The project is innovative, as it provides a new assessment tool of effective coaching in DBL environment.
- The assessment tool can be used by teachers for formative purposes (redesigning a course) and summative purposes (evaluating the effectiveness of coaching)
- The project includes the development of a website as a platform for dissemination, which new teachers can visit to develop their coaching skills and learn how to integrate the assessment tool in their own courses.
- The project outcomes are transferable and can be applied to other design-based learning contexts.

Deliverables

- A hand-out with lessons learned with respect to coaching dialogue between teachers and students that work on CDCM.
- An assessment tool of Design-Based Learning Environments for teachers to be used for formative purposes
- An ~~(online)~~ version of the assessment tool for students.
- A workshop for teachers on how to integrate the assessment tool in their coaching sessions with students.
- Contribution to a Conference (e.g. ORD, Surf, ECENT, ESERA) and/or paper for a (practical) journal about coaching implemented in Design-Based Learning Environment.

Dissemination of results

The goal of the project is to provide useful deliverables. As described above, we will develop a website in order to disseminate the content of the project. We will also disseminate products via the 4TU.CEE website, during presentations at conferences and via the DPO website/intranet. We will also present at the TU/e Education Innovation Day.

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