Project Proposal 4TU CEE Innovation call

Title: 7 project phases approach visualized

Applicants:
Dr. ir C.C.M. Rindt
M. van Gorp

Objectives and expected outcomes

Goal of the project is to produce a set of two short movies/web lectures to enhance student's awareness of the seven phase approach to design and research projects.

(1) A general introduction of the seven-phase project approach in which the 7 phases are explained and illustrated. Testimonials of users are included
(2) An implementation of the approach in the introduction of the DBL course Design of a modern trebuchet (4GA10).

To enforce the use of the movies, a short online test will be integrated in the course (4GA10) to check the knowledge of the expected project-approach.

Background and justification of the project

For hands-on project based education, a structured approach helps students to learn to answer open questions. A seven-phase project approach has been developed in the base course Engineering Design (4WBB0), mandatory for all TU/e Bachelor students. The base of this seven phase approach is found in literature (e.g. Exploring Engineering, Kosky et al.).

In a previous DBL-project performed by OIW at Mechanical Engineering it has been decided to implement this seven-phase approach[1] in the DBL projects of the Mechanical Engineering department. The goal of this implementation is to increase the student's ability to attack the DBL projects in a structured way; to learn how to answer open questions with no predetermined single-right answer.

From a teacher point of view, the seven phase approach is implemented successfully. However, the tools to increase students' awareness of this structured approach still need to be improved. The provided written information may not draw the students' attention and runs the risk of being skipped, since it is not part of the assessment and deemed not necessary to execute the project. As in previous practice, the students may still start each project without a structured approach and without learning to improve their project handling skills. Therefore, we propose to develop two video lectures/movies, which will make the information more approachable and will probably stick better. It can also be used by the tutor during a group meeting.

The first movie will be a general introduction of the seven phases including examples of their use in real problems. This video may also be used as an introduction of a structured project approach to other teachers TU/e wide who are (re)designing DBL or other project based courses and are looking for a general engineering approach on the design or research process. We will also contact the lecturers of the Engineering Design course to make sure that the resulting movie is usable in the base course.

The second movie will contain a more project specific approach. It will show a sample of how the 7-phase project plan is used in one of the DBL-projects at Mechanical Engineering. This sample movie might be an inspiration for other projects. It will serve an example for other, DBL project-specific videos. In this way, we will be able to show the students how the project approach stretches and develops over the different projects.

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[1] The seven-phase approach as implemented in the Mechanical Engineering DBL is added as appendix tot his proposal.

Project design and management:

Participants

- Michiel van Gorp
- Clemens Verhoosel
- Erik Homburg
- Alexandra Nicolaije (support ESA-W)

Soundboard

- Engineering Design team
- ESA Teacher support
- Students

Proposed activities:

January	Start of project team: assemble and start work group. Define final goal and form Research on possibilities for creating movies
February	Decide on form Start writing scripts
March	Finish scripts
April-June	Create movies
July	Finalize movies Implementation plan for academic year 2018-2019
September	First implementation (general movie) in Q1 DBL-projects at ME
November	First implementation (specific movie) in Trebuchet DBL
December	Evaluation

The project is successful when movies are delivered in time for the use in respectively September and November 2017. Students can be tested on the use of the movies in a test or evaluation. Evaluation / test results in combination with a student feedback panel should give insight in how the movies are used, perceived and if the content has been processed.
Risk for the project is to manage a timely production process and whether wishes can be achieved within the budget.

Dissemination and sustainability of the project

Both movies will be made available online. The teachers and students involved in all DBL courses of mechanical engineering department will be continuous users of the product. This means that the result will be visible and used at least in the 9DBL courses of the Mechanical Engineering department. Furthermore, the multi-department lecturing team of the Engineering Design course will be involved in the development and creation of these videos. Their involvement ensures a multi-departmental visibility of the developed products.
The result can be presented to other users at TU/e through presentations. We will involve ESA Teacher support to help in presenting the result to teachers as a possibility to redesign their DBL or project based courses.

Appendix: 7 project phases explained

Introduction

We have chosen to distinguish seven phases in design and modelling projects. Although these phases have a chronological connection with each other, it is not the intent to suggest that they necessarily follow one after the other. On the contrary, in any project the results of each phase reflects backward on earlier decisions (and sometimes makes revision necessary). Therefore, the phases are intertwined (and not separated by artificial miles stones).
It is not necessary that all projects cover all phases: some cover them all (like for example the Engineering Design project) and some may choose to focus on parts of the design process.

The intend of this structured project approach is to teach the students (with supervision) to produce and execute a research or a design plan. In this way, the student learn to take design decisions, and to justify and evaluate these in a systematic manner. Within a research context the student is able (with supervision) to contribute to the development of scientific knowledge in one or more areas of the disciplines concerned.

Phase 1: Framing the question

A design or modelling assignment is inherently vague and/or ill-structured: there is no single or even optimal answer to such a question. All answers will be (slightly) different and may have different qualities.
The first step is to specify the solution boundaries in terms of requirements, preferences and constraints (RPC) which the answer has to satisfy. Next, it is time to step back to see what properties or functions the solution actually needs. This basically means: simplify, merge and frame the RPC into general functions.
In this initial project phase, it may be deemed necessary to acquire new knowledge necessary to master the problem at hand. For example, it may be necessary to learn working with a specific tool or to learn some new theoretical concepts.

Phase 2: Concept

The concept phase (sometimes also called “ideation”) is used to find as many ways possible in which the assignment can be approached; ways to create something special, unusual, unexpected. This means to stretch the range of possible answers as far as possible (or even looking for apparently impossible options). The concept phase is there to challenge the students to keep an open eye for innovative ideas, to come up with creative solutions, connections and new viewpoints.

Phase 3: Selection

From the concept solutions, one preferred product is selected by examining them in the light of the RPC (for example by using a decision matrix). The student has to use synthetic skills to select the most promising concept solution.
Should all concept solutions fail to satisfy all requirements, it might be that, the requirements can be redefined so that the selected product is capable to satisfy all of them.

Phase 4: Detailing

Now that the preferred solution has been chosen, it is time to start detailing the product as a whole and all its components. The detailing phase is a mix of using existing knowledge for theoretical optimization and practical implementation possibilities. The result of the detailing phase is a list of necessary components (chassis, motors, batteries, etc. or equations, modelling functions, physical parameter set, etc.) and the calculations to support them.
The RPC (defined in phase 1) keep being the guideline: all parts must be chosen to satisfy the RPC. This might also be a reason to go back to the definitions in phase 1 and refine (or redefine) the RPCs.
The detailing phase also comprises the chance to choose your parts to optimize the product, where necessary on an interdisciplinary basis.

Phase 5: Realization

All (model- and/or design-) components need to be made, ordered, tested and assembled.
This phase is extremely critical in the time scheduling: the realization and testing of components always takes longer than expected.
As soon as the first parts have been realized and assembled, they must be tested separately. Each test needs to be documented to make sure that all group members are aware of the test status.

Phase 6: Testing/Finalizing

After all separate parts have been tested and assembled, the product is ready. Now it can be tested to see how its performance compares to the RPC. These tests must follow a preset test plan. The test results are also used for a final product optimization.

Phase 7: Evaluation

During the project, choices need to be made, sometimes on solid argumentation, sometimes on educated guesses and sometimes by just picking something to be able to move on. In the evaluation, all choices made during the process are put to the test, to see whether (or how) they have influenced the result; to see whether, in hindsight, different choices could have led to better results.