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Reshaping The Bio Medical Curriculum To Include Socialisation And Subjectification

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Introduction

According to Biesta (2009), the current pedagogical assignment for education is the tripartite development of students on qualification, socialisation and subjectification. Qualification ensures our students in Higher Engineering Education become competent in one or multiple disciplinary engineering fields. Socialisation relates to students becoming aware of the values and norms embedded in academia and the professional environment they will enter after graduation. Subjectification is an ambition to develop the qualification, socialisation and who they become. This pedagogical ambition requires repurposing and (re)shaping the university's curricula.

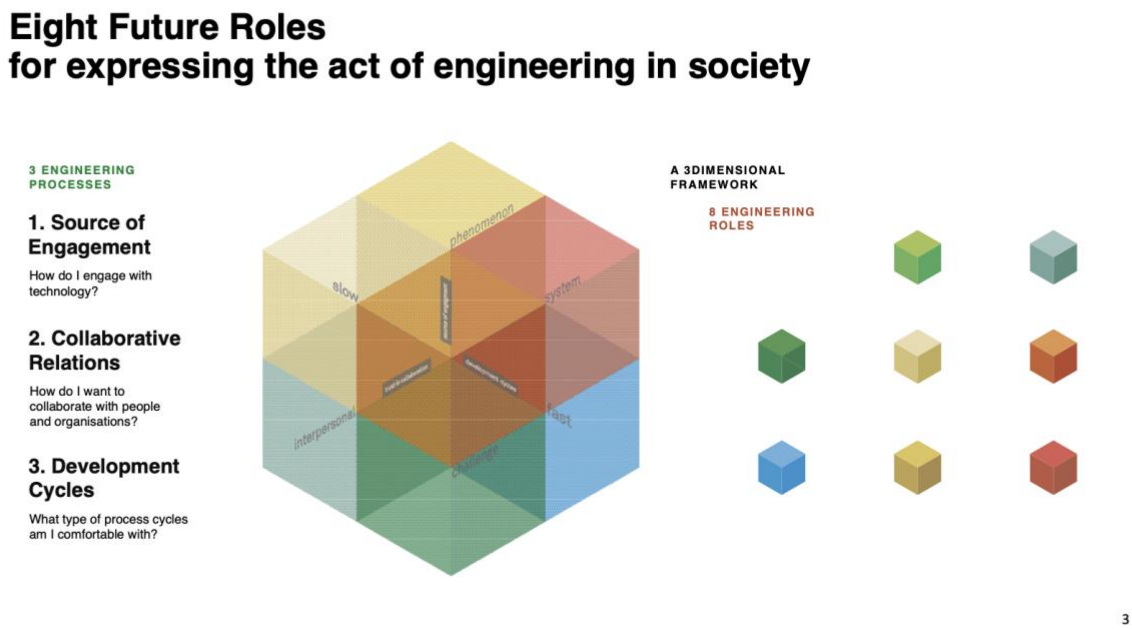


Fig 1. Engineering Roles

In the Bio-Medical Engineering (BME) programme, we have embedded a design-based vision of the future engineer. The Vision in product design methodology has been used to create engineering roles with the involvement and interviewing on expert interviews in the field, literature reviews and validation workshops. The Vision suggests three dimensions our students will encounter in their future engagement with technology. These dimension of engagement with technology, collaboration models and fast and slow production cycles helps students to become all-round engineers (Klaassen et al., 2020). The emergent engineering roles from the dimensional framework are a guiding tool for going through a reflective cycle of development leading to subjectification, socialisation, and qualification. Transversal skills are used to ground the socialisation process of future engineers in the BME context, and qualification is supported by the acquisition of BME knowledge and skills and subjectification through role-focused reflections. Table 1 includes an overview and its intended relationships as expressed in the BME curriculum.

Table 1. Framework for curriculum adaptation

Pedagogic aspects (Biesta 2014)	Dimensions Engineering Roles vision (Klaassen et al. 2019)
Subjectification:	**Engagement with technology**
Engineers should be able to adapt to a changing environment,	Phenomenal/societal challenges addressed.
	Engineering Role identification
Take agency for their own learning/learning path, in which *agency* is defined as the ability to act based on your reasoning and understanding yourself in context.	Reflection and positioning concerning individual engineering roles in relation to the world.
Socialisation:	**Collaborating in technology**
Use engineering topics to interact with the world,	Preferred ways of working on basis of interpersonal trust or via rules and regulations of a system
	Engineering Role in action
Take responsibility for shaping future practices,	Reflection on preferred ways of working as an engineer
Qualification:	**Dimension**
Develop a continuous lifelong learning loop.	Acquisition of skills/ knowledge/ attitudes for slow and fast development cycles of production
	Engineering role application
Critical assessment of professional standards through engineering knowledge/skills practices	Reflection on theories, tools and methods needed.

Methods

In this curriculum development process, we have chosen to determine a roadmap for implementing an environment beholding these pedagogic and dimensional elements from Biesta and the Vision of the future university (Biesta, Klaassen et al.2020). The idea was to create a maximum impact with minimal effort from the teachers involved N= 6. The 1st part of the curriculum development consisted of a start/– stop/continue approach to activities within the curriculum. To prepare teachers, we have undertaken activities that supported the creation of an understanding of the courses concerning the Vision, mapping where we want to operate/tweak courses on a meta-level and designing supporting materials needed for teachers to implement the created framework. In general, activities to generate implementation or guiding principles included workshops with teachers, interviews and surveys with students, teacher surveys on sub-elements etc. This paper reports on one of these workshops and a teacher survey.

In this particular teacher workshop, a brainstorming activity was conducted on a student learning journey map with touchpoints within the Master curriculum that served as a timeline for embedding educational interventions or desired activities in education. This brainstorm has successively served as a basis for input into a roadmap, including guiding design principles for curricular development, including the three pillars of Biesta and the dimensional features of the future university. The intention was to support teachers in the programme in identifying; how these framework ideas could apply to their courses, what is already present in their courses and whom they can ask for help if they want to change their curricular design. These principles will allow them to easily insert and embed the new merged Vision on education, addressing both Biesta and the future vision model. In a follow-up workshop, they were asked to rephrase their learning objectives to align the vision framework with practical courses.

The teachers of all the courses N = 12 were also asked to fill in a questionnaire on which reflective, contextual skills and engineering skills were already used in the 18 courses offered within the master curriculum. Teachers could answer: (1) students are already trained on these skills, (2) not trained on these skills and (3) not trained on these skills, but I would like to add them to my course. The skills were provided with an explanatory definition.

Workshop Results; Formulating Guiding Curriculum Design Principles
According to the developed principles, the university is required to realise a safe context in which experimentation and failure are a part of the learning process. This idea of a safe context propagates programmatic assessment in which multiple performance measure moments are embedded, and 360-degree stakeholder input and stepping away from past failure are focal points. These six Guiding principles steps described in the next section, should facilitate the reshaping of the curriculum endeavour and support students in going through iterative rounds of reflection related to subjectification, socialisation, and qualification elements. Reflection encompasses "whom students want to become with help of the engineering dimensions", "how students act in the outside world", "how students can understand and influence future practices and "how students can change the future”.

Fig. 1 Reflective Engineering Model

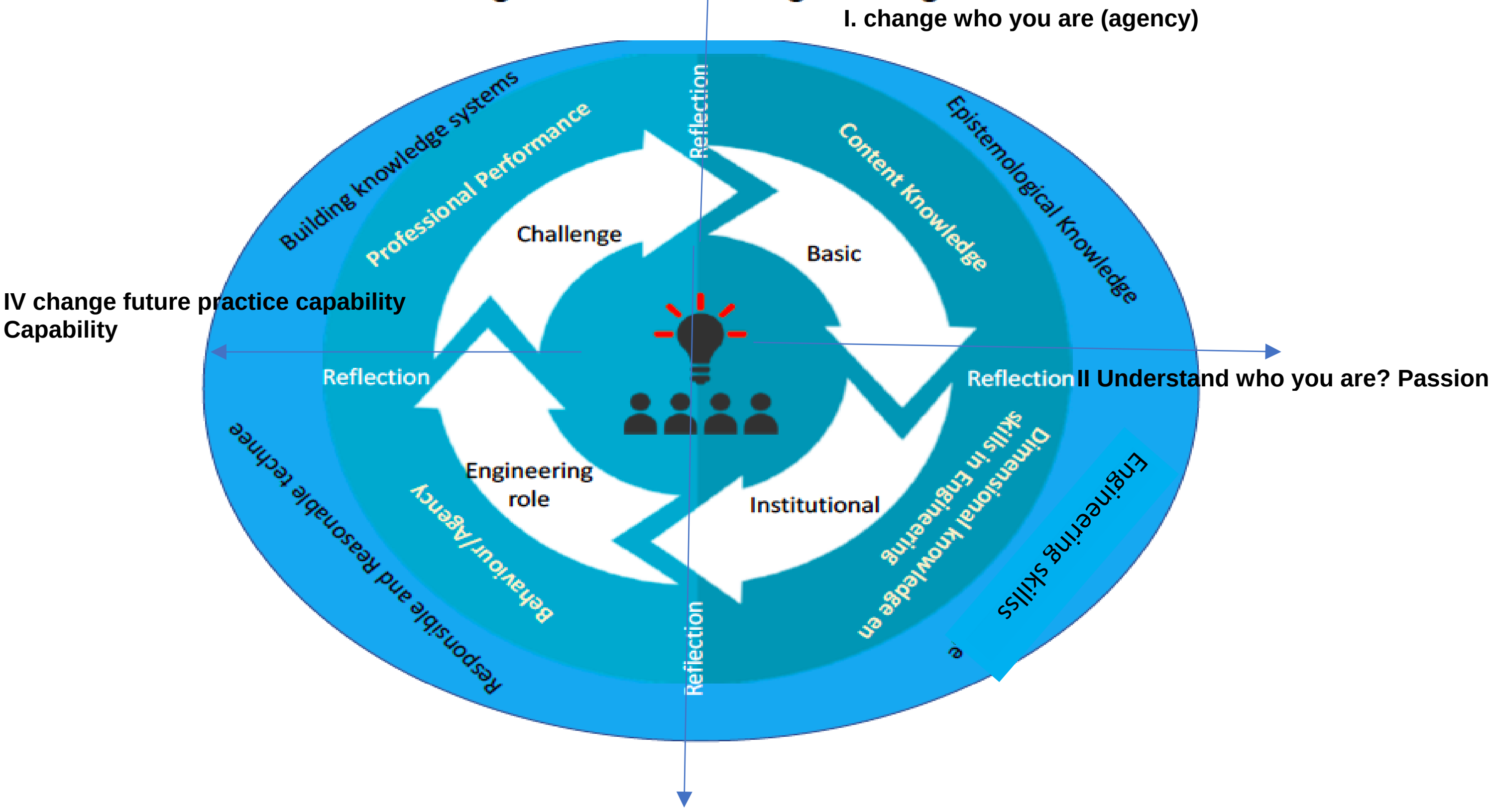


Fig. 2 Reflective Engineering Model

III Tell the world who you are? Identity

Skills and knowledge are part of the light blue and turquoise circle in Fig. 2. of the reflection cycle. Disciplinary & epistemological knowledge for medical, biological, and engineering knowledge and what is probable, possible and impossible is necessary for existing and changing practices. Engineering skills help students position themselves in practice and make technical decisions. Contextual skills include becoming aware of and responsible for the consequence of actions (ethics) that are taken or not taken concerning doing, saying and knowing in practice. Furthermore, finally, reflective skills include understanding one's position in context and practice and being capable of acting based on one own reasoning (Trede's, 2019).

The Roadmap Workshop

In a workshop setting, these profiled ideas have been benchmarked with the lecturers, who mainly favoured adopting these suggestions while equally discussing further refinement and adaptation possibilities within the curriculum along a transition moment timeline. Transition moments are, for example, choosing a master track or a thesis topic. Suggestions mainly focused on providing role models embodying the engineering roles in the BME field and learning from interaction with these people. Teachers were, however, equally expressing concerns about the need for more time to embed these elements and for the students to adapt these skills. E.g., the question is if they need to be assessed in the curriculum and when, in reflection documents, who will do the work. Who has the ownership of reflection documents etc? Moreover, whether these really add value to the curriculum.

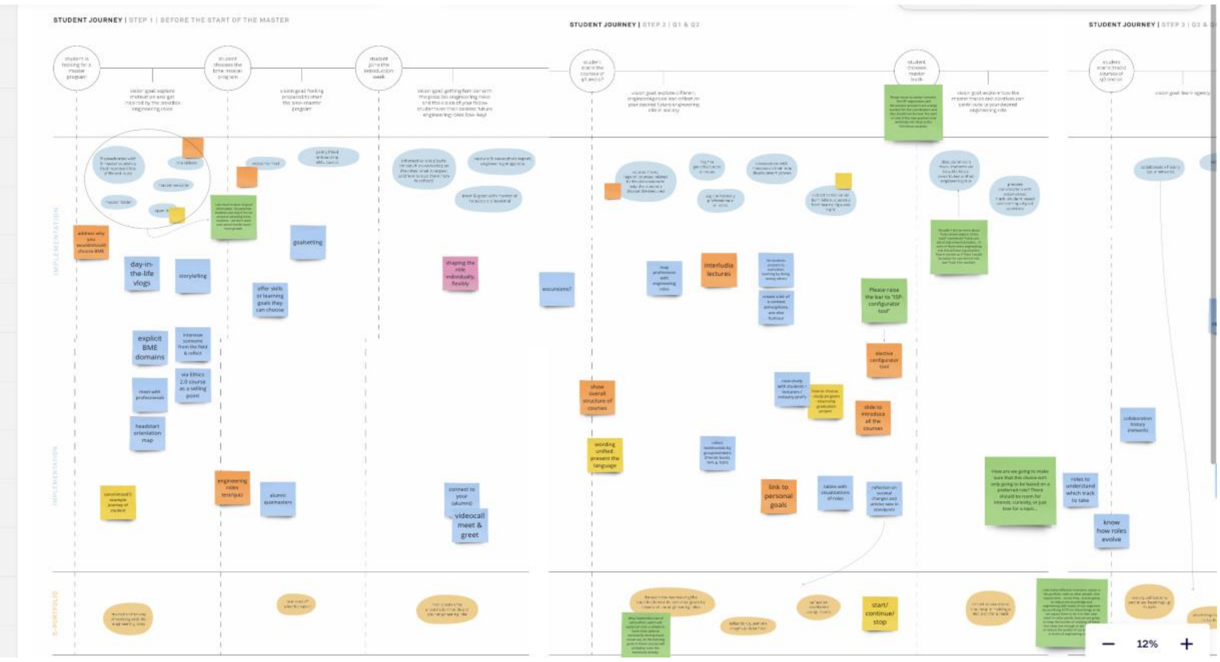


Fig. 3 ideas to embed in the curriculum (post its on roadmap)

Nevertheless, the workshop resulted in 6 guiding principles for curriculum design that would meet the engineering vision's original dimension and address the pedagogical assignment of Biesta. Before the Master, students should be given ownership of their learning experience, providing information about the possible engineering roles and reflective activities to motivate and challenge their attitudes. This reflection might be realised at the open day, introduction day or through other introductory media, such as conversations with people from the field, a video documentary of "a day of…". Another option is the focus on diverse role models presented in the kick-off week, which students use to reflect upon the responsibilities and mission the future engineering students will likely encounter. In the first workshop, students presented their future engineering manifestos (read reflections) in groups. This manifesto helps students decide on their desired Master's track. During the Master, there were many more suggestions for embedding ownership, such as reshaping assignments into challenges involving external stakeholders, flexible choosing which challenges to work on in a team and using engineering roles to set up personal goals, translating (transversal) skills into the learning objectives, and contextualising the course to a greater extent.

Guiding Principles

01 Translating own reasoning into personal goals (subjectification): Setting personal learning goals is supported by identifying a knowledge-skills- matrix and in which courses these can be acquired within the BME master. BME Knowledge and Skills are categorised at different levels; disciplinary, engineering skills, contextual and reflective skills. A reflection portfolio might support the evaluation of these personal goals.

02 experimenting with forward reflection (subjectification) – reflection is introduced using future engineering roles we expect will be relevant in 10 years and can guide students and help them shape their futures. Analysing the knowledge, skills and development path of favourites in the field on a dimensional level helps to shape a personal future profile, using principle 01 to get there.

03 Taking an ethical stance and acting responsibly (socialisation) – is about being aware of what product and research results are distributed and adapted into the world. Reflections on how they interact with the world and their actions' impact are vital socialisation aspects for the students (Walcott et al., 2019). Case studies and explicit evaluation of challenges in team settings should guide the learning process.

04 Supporting pivotal transition moments – students discovering their way of being and supporting the transitions to help students get a more straightforward learning path is pivotal for subjectification. Students presenting and upgrading their manifesto regularly with supportive feedback from peers and professionals help navigate the pivotal moments.

05 Studying in an ecosystem learning environment- requires the students to operate in contextualised environments in interaction with the world (stakeholders in organisations, businesses, and citizens. Therefore, students need informed visions, critical thinking skills and evaluative judgment to assess how to operate in the ecosystem (Spencer-Keyse et al., 2019).

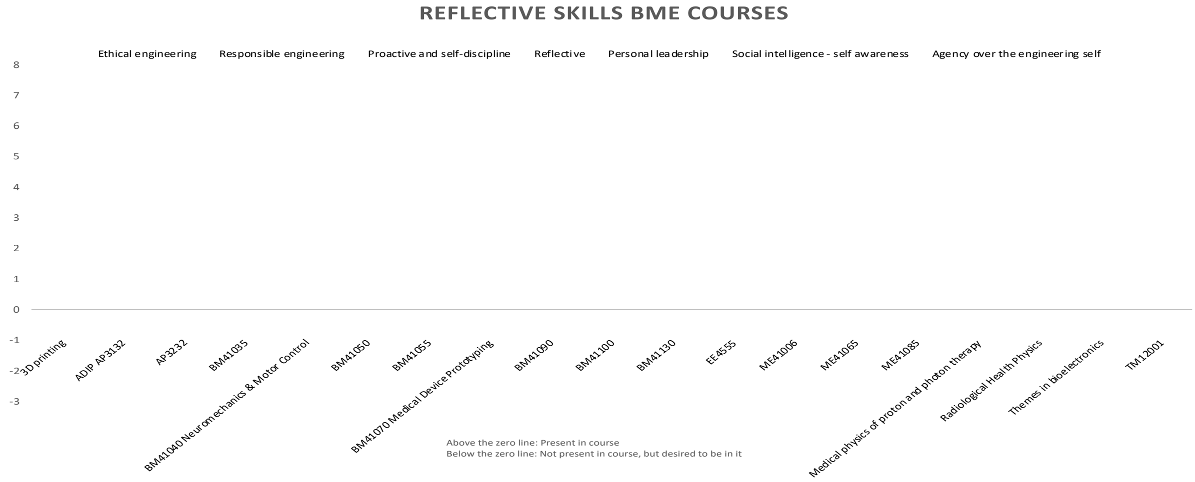
06 Exchanging insights and experiences – the joint dialogue at different levels about pertinent topics are crucial to socialisation, including peer feedback, outside professional involvement, and group discussion with teachers, mentors and guests (Goggins et al., 2022, Diez- Palomar et al., 2020)

Getting the six basic principles into the learning objectives in language that is accessible and provides a joint reference frame allows the teachers to emphasise to students the need for specific skills training. The credit structure can support it and provide an overview of the skills growth within a specific principle. A reflection portfolio and the continuous looped learning that will occur through reflection will allow students to adapt better to different work contexts. Working group dynamics, debates and peer reviews should support students in innovating and changing future practice. Alternatively, after the workshop, more attention can be paid to creating a dashboard summary and enhancing reflection on the professional transition in the workforce.

Results Teacher Questionnaire: Embedding Skills in the curriculum
The second part of mapping the opportunities for change in the curriculum along the framework while making use of the guiding principles was to find out the already used skills in the curriculum. We have used a questionnaire to investigate the knowledge and skills distribution. The questionnaire on skills included in the courses shows skills in coloured blocks representing the different skills and, at the bottom, the different courses in the curriculum. The questions (1) What do you already address in your course and (2) What is not yet used in your course are depicted above (used) and below (not used) the zero line in Fig. 4,5, and 6. What might be used is not represented in the graphs.

n Figure 4, reflective engineering skills such as responsible and ethical engineering, social intelligence and awareness, proactivity and self-discipline, agency and personal leadership, and reflection skills have been asked. The graph shows that, for example, agency training only occurs in three courses with a particular design focus. (prototyping/ health physics and BME 41). The other teachers need to include this reflective skill in their courses or know if they do or do not. However, responsible, and ethical skills are included in 11 and 12 courses, respectively.

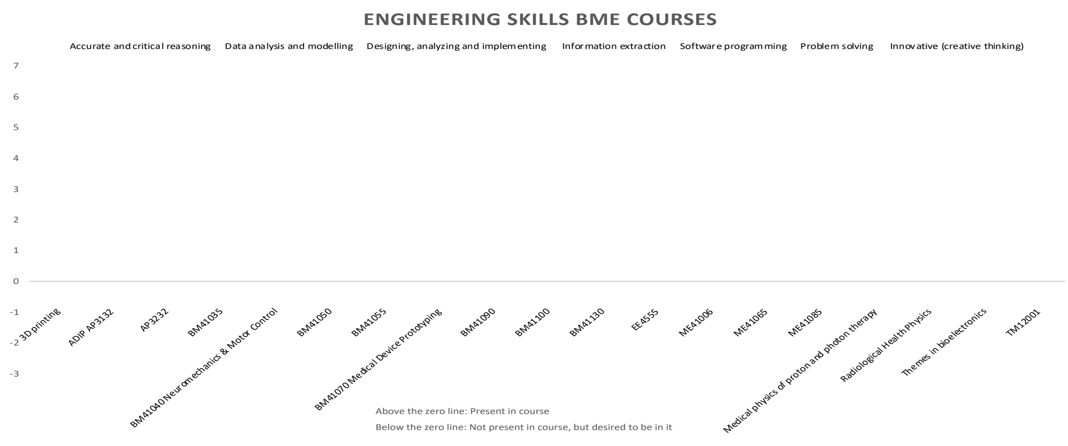
Furthermore, one course, for example, has only one reflective skill included self-discipline; the other skills are not named, as in not occurring in the course, which makes one wonder. A few more courses have this exact visualisation. Do the teachers not know what skills are addressed in their course? Do they not understand what is being asked? Do they address it, but do they not assess it? Do they only do it a little? The results were a reason to engage the teacher in a more elaborate discussion.



*Legend: Ethical Engineering (lavender), Responsible engineering (orange), Proactive and self-discipline(grey), reflective (yellow), personal leadership (cobalt blue), social Intelligence and self-awareness (green), agency of the engineering self (dark blue)

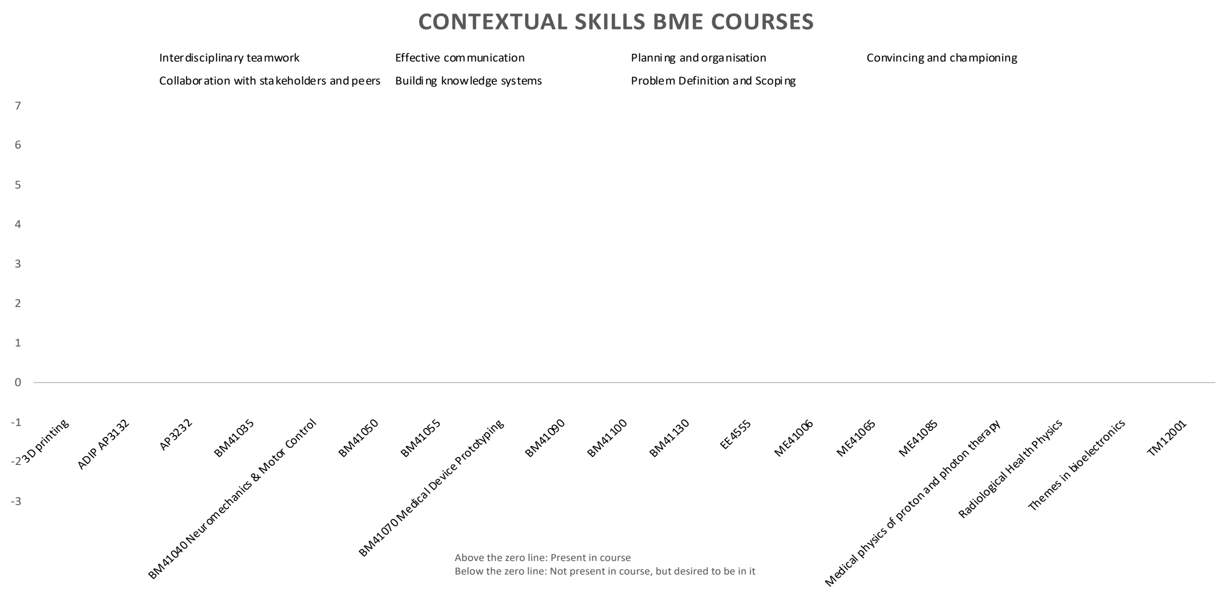
Fig. 4. Reflective skills

In Fig. 5, the Engineering skills are somewhat better recognised. Eighteen out of nineteen of the courses address accurate and critical reasoning. Information extraction happens in thirteen courses. Twelve out of nineteen address problem-solving skills and innovation (creative thinking). In ten courses, design, analysis, and implementation occur. Data analysis and modelling are not necessarily together with software programming in nine courses.



* Legend: critical reasoning (lavender); data analysis and modelling (orange), designing- analysing and implementing (grey), information extraction (dark blue), software programming (cobalt blue), problem solving (green), Innovation (creative thinking) (yellow)

Fig. 5 Engineering Skills



*Legend: Interdisciplinary teamwork (lavender), effective communication (orange), planning and organisation (grey), convincing and championing (orange), collaboration with stakeholders and peers (cobalt blue), building knowledge systems (green), problem definition and scoping (dark blue).

Fig. 6 Contextual Skills

Figure 6 Contextual skills, for example, twelve courses address problem definition and scoping skills. Surprisingly, these only sometimes occur together in the same courses where problem-solving is addressed. In eleven courses, interdisciplinary teamwork occurs, of which six also address engagement with stakeholders and peers. Seven courses contribute to external knowledge systems or disciplinary knowledge building. These are, again, different courses. To make sense of these outcomes, we need some serious, cross-tabular mapping in which the nature of the courses is also addressed and a follow-up conversation with the teachers about interpreting the results.

In a follow-up workshop in discussion with the lecturers, it appeared that not everyone had equally understood the explanation of the skills and their definitions, making the results difficult to interpret. Nevertheless, the next step is to reformulate learning objectives and recalibrate when and where the desired knowledge and skills are addressed in the curriculum.

Conclusions

This paper discusses a few design-based steps that may change the Master Programme BME with minimum interventions according to the six guiding principles explained in the results section. This approach has been chosen to alleviate the high work pressure on teaching staff and the fact that Covid-19 has seriously impacted the teachers' well-being. Teachers have been open to discussion and making the best of it. However, it was only sometimes easy to take them along this ongoing road of change and provide them with much-needed ownership to adapt to a new framework. We have had valuable discussions with teachers, resulting in constructive collaborations to press forward towards a new master curriculum slowly. From students' surveys reported elsewhere, we found a positive impact on student's professional capabilities, particularly in personal development (Klaassen et al., 2022). However, much must be done to achieve a more persistent and sustainable change.

Discussion and Limitations

n this hands-on design-based study, we have provided insight into a design-based approach towards curricular change. The development of a road- map proved to be a suitable means for calibrating opinions and aligning reference frames. On the other hand, the survey provided ambiguous data that could not be clearly interpreted. Each step in this process included a double diamond approach, from brainstorming new elements to bringing them back to the curriculum, sharing activities and interpretation, to converging towards one meaning and interpretation. Therefore, these steps have been used for a resocialisation process into engineering education and re-establishing teacher identity for the future, more than anything else.

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