PLANNED, TAUGHT, LEARNT: ANALYSIS OF TRANSVERSAL SKILLS THROUGH CURRICULUM USING PORTFOLIO

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ABSTRACT

There is an everlasting effort in education to successfully ensure that the intended learning objectives are clearly taught and effectively learnt at the end of the educational cycle. This has been especially difficult in teaching and learning complex sets of competencies, for example, transversal skills in domains such as engineering education. Yet, studies focusing on transversal skills often address student learning outcomes, but rarely how teachers teach them, and even less so how they are represented in the written curriculum.

In order to create a more comprehensive understanding of how transversal skills are communicated, taught and learnt in engineering education, we designed a qualitative case study with a focus on teaching and learning transversal skills. The data was collected from five distinct sources within one master course. This included examining the written curriculum as presented in the course syllabus, the taught curriculum with data from the teacher interview and teaching materials, and the learnt curriculum coded from student portfolios.

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In our results, we reflect on alignments, gaps and potentials in teaching and learning transversal skills. Alongside, through our case we argue that alignment in learning intentions and outcomes is stronger due to using a training portfolio and explicitly requiring reflection as part of the assessment, which does not prevent other learning outcomes from evolving spontaneously. We also discuss suggestions for portfolio design and its use in teaching and learning transversal skills in engineering education.

1   INTRODUCTION

Whenever a course is put in place, there is a learning objective that a teacher expects the students will achieve. While there is no way of controlling what students actually learn, careful pedagogical planning of a constructive learning environment is a way to support reaching the intended learning objective. Systematic, intentional construction of the parts of the pedagogical input combined with analysing of the educational outcomes falls under the scope of an aligned curriculum [1, 2]. The appeal for curriculum alignment has been growing since the 1950s [3], and studies were particularly focused on achieving learning objectives that are intangible, implicit and difficult to teach.

In many cases within the constructive curriculum alignment literature, the portfolio has been used as an integrated tool that supports the alignment between taught and learnt [2, 4]. In addition to that, the engineering education portfolio has been used to support the teaching of transversal skills [5]. Some of the barriers to introducing the development of transversal skills are indeed related to the pedagogical capacity of creating learning environments, as well as appropriately following the development of skills and their assessment. In most cases, attention is given to what and how students learn [6, 7], and in rare cases how teachers teach the transversal skills, or how they are proposed in course documents and syllabi.

With this perspective, we aimed at discovering how transversal skills are embedded in different aspects of the curriculum and what are the elements that make the translation from intended to learnt curriculum achievable. To understand this, we particularly look into the use of a portfolio as a teaching tool that connects the intended learning objectives to student learning outcomes.

In this paper, we present an analysis of a single course as a case study targeted to explore how the intention to teach certain skills leads to what students learn, and how the use of a portfolio as an assessment tool supports this process. We, therefore, ask two questions:

1. How are transversal skills represented in the intended, taught and learnt curriculum?
2. What is the role of a portfolio as a tool to reflect on and assess transversal skills?

Our intention to research transversal skills and the use of a portfolio in this case study connects to the difficulty of teaching and assessing transversal skills. The intention to understand different aspects of the curriculum connected to transversal skills follows the idea that educational experience is not a single point of analysis, but a system that needs to be comprehensively understood. In other words, by looking only at the student learning outcomes we might not be able to understand

the intended environment and input that students received for reaching the learning outcomes.

In the following, we briefly reflect on two theoretical aspects that support this study, the curricular research and portfolio literature, followed by a swift description of our methodology, a presentation of our results, and a brief summary in the conclusion.

1.1 Curriculum alignment

Curriculum alignment refers to a process that ensures courses and programmes offered by an institution are consistent with its objectives and outcomes. The aligned curriculum is the degree to which learning goals are represented in student learning outcomes and assessments. The goal of achieving alignment is to ensure that students are equipped with the knowledge, skills and abilities needed to succeed in their careers, as envisaged by the institution.

There are different aspects of an aligned curriculum, including alignment within the institutional offer often referred to as curricular coherence, as well as alignment with industrial standards and accreditation requirements. In this paper, we refer to curricular alignment as a course-level coherence that ensures the intended learning objectives are synchronous with student-perceived learning, as in Figure 1.
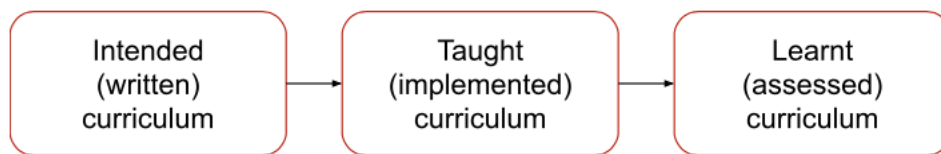

Figure 1: Simplified presentation of curriculum alignment

In this domain, Biggs and Tang [2] have influenced the field by proposing constructive alignment of curriculum, which includes intended written curriculum, teaching activities that create learning opportunities, and assessment, both in terms of tasks and grades that define learning outcomes for students. Similarly to this, van den Akker et al. [8] note that it is difficult to make an exact translation from the intended to the learnt curriculum, pointing out that each educational stakeholder perceives the curriculum and their place in it in a slightly different way. In support of this, Wijngaards-de Meij and Merx [9] observed that the alignment is challenged by students' lack of awareness of their role in the learning process and their preoccupation with assessment. Tyler [3], known for introducing the idea of curriculum development, proposed a non-static model through which he offered four dimensions enclosed in questions for educational processes, including questioning the purpose of the institution, experiences that are to attain the purpose, organisation of activities and educational activities, and methods in determining achievement.

While the simplified triadic approach to curriculum alignment refers to three aspects, namely what is written in the curricular document, what is taught by the educator, and what is attained by the students, different terminology has been used in the literature explaining these three processes. In this paper, we use the *intended* curriculum, instead of *written* or *declared* to indicate what the educational intention was when designing the course. For the second aspect, we use the term *taught* curriculum observing it from a wide perspective of teacher's input, including lesson delivery, materials and teaching philosophy. And finally, we intentionally refer to the *learnt* and not *assessed* or *tested* curriculum. With this, we do want to point out that

most literature on curriculum alignment focuses on assessment and not learning, as this is the regular educational cycle. For us, the term *assessment* was too narrow, hence our intention was to explore what students learn overall, rather than what they submit for the assessment.

1.2 Portfolio

In education and training, portfolios have been gaining prominence, particularly for their use in assessment. Portfolios support "a new perspective on learning since they document the learners' progress and evaluate with a variety of evidence how learner goals are attained, while at the same time providing an alternative for the growing dissatisfaction with the traditional and quantitative assessment" [10]. As the educational evidence on portfolios grew, so did the differentiation between types and uses, and as such Smith and Tillema [10] proposed a typology based on purpose and use, as depicted in Figure 2.
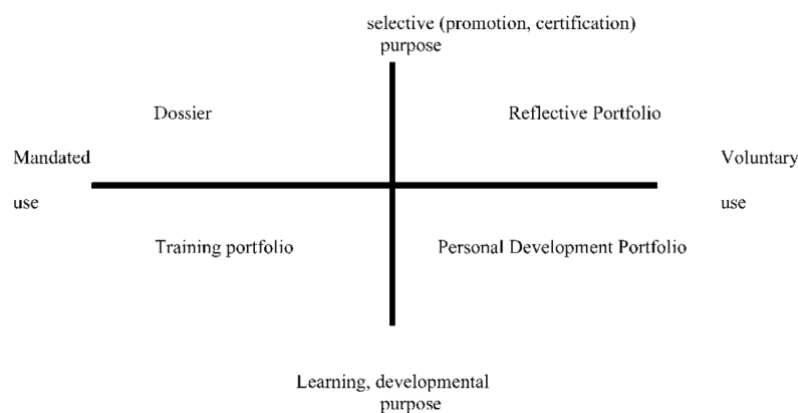

Figure 2: Different types of portfolios [10]

By understanding the different types of portfolios, educators can use them for their intended purpose.

Portfolios have, in general, been a useful tool for students' self-regulated learning and reflective thinking [11]. Regardless of the shape in which it is formulated, by directing students' attention to specific aspects of their learning experience, portfolios have the ability to illuminate certain aspects that might otherwise remain implicit or unrecognised during the learning process. In many cases, prompting questions serve as a starting point of reflection and they usually do not prevent students from describing their experiences more comprehensively and freely [12, 13]. Even when a portfolio represents a relatively low percentage of the final grade, students engage with the reflection beyond the course-specific technical knowledge. For instance, Dunsmore et al. [13] point out that although the focus of the course is on manufacturing processes, in their portfolios students reflect on the nature and importance of skills like communication, teamwork and collaboration in team projects. The authors also note that creating even a simple portfolio "provides an opportunity for reflection and articulation" of ideas and issues [13].

2   CONTEXT: HOW PEOPLE LEARN

The course, called How People Learn: Designing Learning Tools, which we selected for this case study belongs to the Social Studies and Humanities courses at EPFL.

The course is offered to first-year master students as an accredited elective two-semester course, and its design is based on mini-lessons tied with project-based learning through students working in teams. The course deliverables are a report and a portfolio, and student teams are supported through a set of on-demand coaching sessions with the teaching staff. Assessment is a mix of summative and formative, with technical report weighing 80% of the grade and portfolio the remaining 20%. In this study, we focused only on the portfolio that targets the development of transversal skills.

The portfolio type used in this course is a training portfolio according to Smith and Tillema's [10] typology. It is divided into 3 parts, the first corresponding to a reflection on the Interdisciplinary Project Management Questionnaire [14] that students are recommended to take at the beginning of the semester. The second part consists of reflective blocks with steering questions on creative thinking, documentation of processes, team communication, and management of divergent and convergent thinking. Each team member is responsible for completing one of the reflective blocks, after which the other team members provide their points of view. These reflective blocks are completed throughout the semester, and this part of the portfolio is not considered in the final assessment. The final part of the portfolio is the only part that is assessed and it includes a tabular summary of previous ungraded reflections, with a particular focus on the change of practice, and two reflective questions related to learning about group management and project management.

In completing their reflective blocks, students are guided by prompting questions and invited to record their meetings in order to source their thinking and reflections. In providing instructions for completing the portfolio, it is explicitly stated that the assessment will focus on the quality of students' reflections regardless of whether the desired learning is achieved or not. This means that the grade is given on the basis of the quality of student reflection, rather than the acquisition of a skill. This encourages students to present honest reflections, rather than create fictionalised attempts to satisfy the teacher's expectations.

3   METHODOLOGY

This research was developed as a case study of a single course involving three aspects of the curriculum and five sources of data. We used a qualitative approach in data collection and creation, as well as in our analysis and interpretation of our results.

3.1 Qualitative case study approach

Following Merriam and Tisdell [15]: "[a] *case study* is an in-depth description and analysis of a bounded system". The objectives of this research were to uncover aspects of the curriculum and the use of portfolios comprehensively through a single course which is why a case study approach was the most appropriate choice. While there are different types of case studies, our intention was to use "a qualitative approach in which the investigator explores a real-life, contemporary bounded system [...] through detailed, in-depth data collection involving multiple sources of information" [16].

In our research design, the bounded system is the course, and five sources of information address the three aspects of the curriculum, and the detailed in-depth

data collection includes written curricular course documents, the IPMQ test and the structure of the portfolio, a teacher interview, and student input in their portfolios.

3.2 Data collection and analysis

In an attempt to comprehensively develop a case study, we collected data from five different sources corresponding to three aspects of the curriculum.

In terms of the intended curriculum, we used the course document that is publicly available online and provides a description of the course and the learning outcomes for the transversal skills. Since the institution has a framework for transversal skills which is used in course documents [17], we simply extracted the skills as they were presented in the document and classified them under the category they belong to.

To understand the taught curriculum, we collected data from three sources that we defined as important in creating learning incentives for transversal skills. In our first step, data was collected from a semi-structured interview with the course teacher. This allowed us to explore, through a conversational setting, the teaching and learning approach of the educator, their course philosophy and delivery. The interview was conducted by the lead researcher, Kovacs, transcribed, pseudo-anonymised and analysed by using the qualitative analysis software MAXQDA. The coding was done by the lead researcher, and an interrater exercise was performed by the second researcher, Milosevic, on about 20% of the interview segments. This allowed us to establish the validity of the coding process and discuss perspectives in the analysis. It was important for us to analyse the structure of the portfolio and the interdisciplinary project management questionnaire (IPMQ), both tools which guide students to reflect on and assess their skills. We thematically analysed the text in these documents, particularly focusing on transversal skills intended to be developed through the course. As the two main researchers, Kovacs and Milosevic, we looked at the course document and, in the first step, developed our individual analyses. In the second step, we deliberated on our perspectives in an attempt to generate a joint analytical conclusion.

Data related to the learnt curriculum were collected from the content in the 19 student portfolios spread across 5 groups. The course included 56 portfolios in total, however, we used only the data from the students belonging to the same group that consented to the study. The documents were assigned randomised identifying codes, and the raw data was split among the two main researchers, and separately manually coded. Prior to the coding process, we looked into nuanced conclusions from the teacher interview analysis, as well as the analysed structure of the portfolio and IPMQ. In particular, those initial steps in the analysis informed the construction of a codebook, and we applied a mix of deductive and inductive approaches in coding the content in portfolios to identify the concepts that might not have appeared before. Learning was "captured" as explicit and implicit mentions of transversal skills. The results were discussed between researchers and processed into the final visual representation.

3.3 Limitations

While this case study combines a rich tapestry of data to describe the alignment of the curriculum at a course level, we acknowledge that there are other elements of the curriculum that we have not taken into account at this point, such as the hidden curriculum. Furthermore, the elements we have chosen for the taught curriculum are

limited to three aspects, and we accept that there are elements missing, such as observations of classroom teaching, documents and communication on the learning platform, slides shared in mini-lectures and student-teacher exchanges during the coaching sessions. All these elements contribute to the taught curriculum and such relevant data could be considered in further research. A similar limitation can be established for the learnt curriculum; we have explored the reflections offered by students in their portfolios, but potentially, further research could integrate ideas about transversal skills mentioned in the technical reports, which equate to a higher proportion of the grade, as well as observations of teamwork, their final presentations, and their discussions with teachers in the coaching sessions.

4   RESULTS

In this study, we focused on the alignment of the three aspects of the curriculum by using portfolios in learning and teaching transversal skills. We mapped our overall analysis in Figure 3 to visualise the alignment at specific stages and highlight the coherence and gaps.
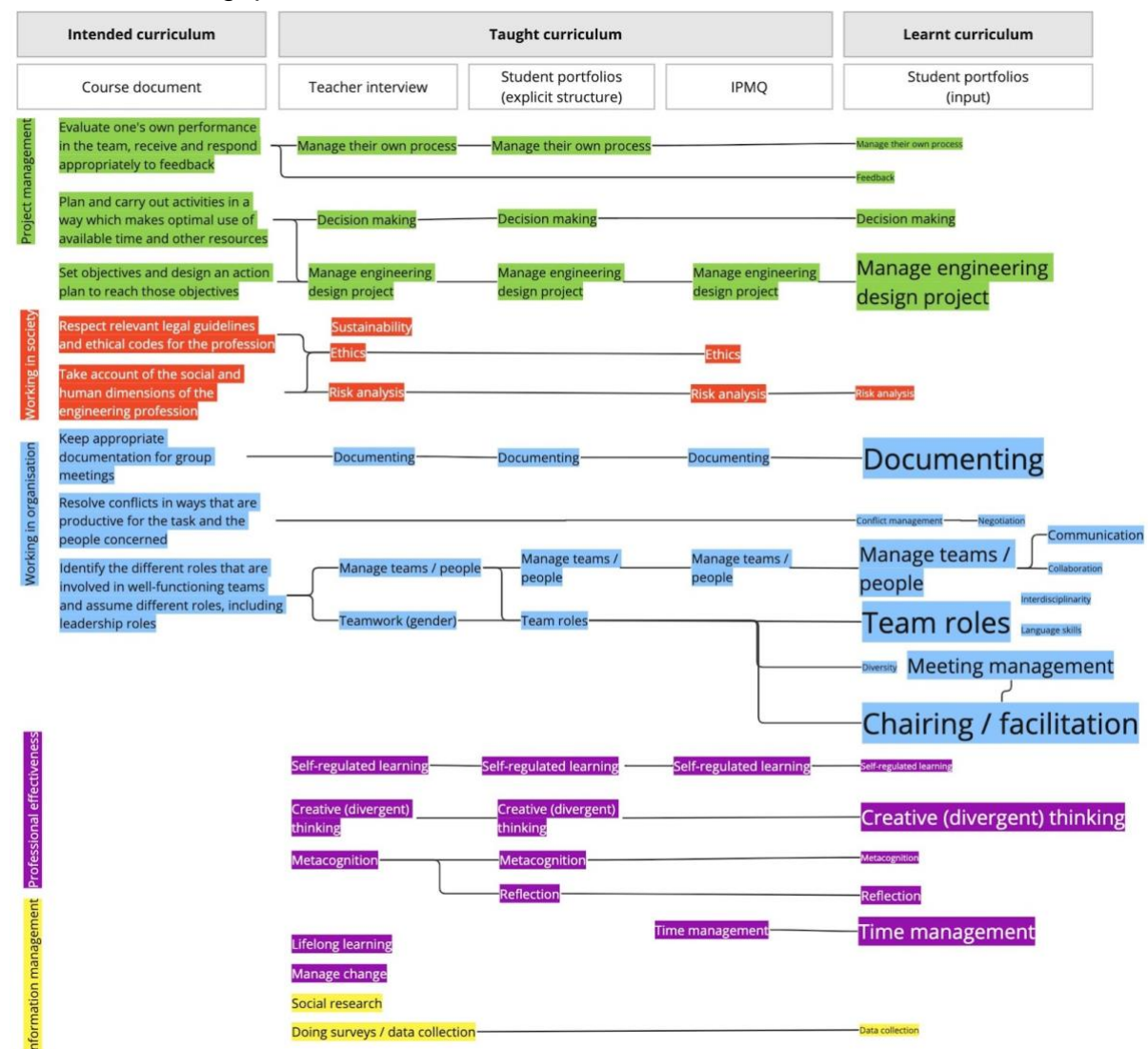

Figure 3: Visualisation of curriculum alignment

In reading this map, we point out several observations; each phrase or word in the map represents a transversal skill mentioned at a specific point of data analysis. In the first row (intended curriculum), the wording is richer and longer because it corresponds to the institutionalised transversal skill list that teachers use in constructing their course documents (see [17]). The colours of the map also correspond to how the transversal skills are grouped into five families, and these five competence families and 32 skills are pre-set by the institution.

Under taught and learnt curriculum, the wording is shorter and corresponds to inductive coding of the data collected from different data sources. We created connections between the phrases and words to indicate alignment between different curricular points. For instance, the first blue line (*documenting*) was present in all aspects of the curriculum we analysed. In the learnt curriculum, students mentioned some skills more than others, so we gave them different weights (four different font sizes) to explicitly show the amount of impact.

4.1 Intended curriculum

The most interesting observation about the intended curriculum is that we can see several transversal skills being taught and mentioned in student reflections, but not in the course documents. This is particularly visible in purple and yellow lines, which in the institutional skills families correspond to *professional effectiveness* and *information management* categories.

Another interesting observation is that some skills, such as *conflict management*, were mentioned in the course document, do not appear in the taught aspects, and then were occasionally found in the student reflections (blue second line). This leads to the assumption that, since the skill intended in the course document is not emphasised through the taught curriculum, it may have not been very effectively reflected upon.

4.2 Taught curriculum

The taught curriculum was analysed from three data points: teacher interview, portfolio structure and the IPMQ. It is interesting to observe that not all of these three aspects contain all the transversal skills mentioned, which might not also be necessary. What we can see, particularly with the first red line with *ethics* (Fig 3), is that even if a specific skill is represented in the course document and taught at some point in the curriculum, it may not appear in the learnt curriculum.

Similarly, as pointed out in the previous section of the intended curriculum, the taught input seems to be richer than the intended objectives listed in the course document. This misalignment is particularly prominent with skills in purple, i.e. *creative (divergent) thinking* and *time management.*

4.3 Learnt curriculum

At the point of the learnt curriculum, we can quickly observe that there are many more skills, especially in the blue category, than in the intended and taught curriculum. This shines a light on students' unintended learning through reflecting on their course experiences, but also shows that even if some skills are not represented in the intended or taught curriculum, they are not "prevented" either.

On account of skills weight (size of the font in Fig 3), our observation was that in many cases these were the skills that were more emphasised in teaching materials, particularly with the prompting questions in the portfolio. For instance, *documenting* skill was thoroughly addressed in one reflective block, hence it is not uncommon that students' attention would be focused on it. In the case of *team roles,* we see the same pattern, but also with additional aspects like *chairing/facilitation* and *meeting management*. This points to the potential of using portfolios for directing students to reflect on particular skills they gain through the course.

5   CONCLUSIONS

Research on aligned curriculum has the potential of opening the discussion on how efforts of teaching and learning skills at different stages of the curriculum are represented. In our case study, we reflected on how portfolios as an explicit demand for reflection can support the learning of transversal skills and as such we noticed where the alignments and gaps appear in the course design, delivery and uptake.

Biggs and Tang [2], as well as Tyler [3], remind us that constructive curriculum alignment needs to open questions, such as what is intended for a course or a programme, how will this be supported and scaffolded in different aspects of teaching, including assessment, and how will it be evidenced as a learning achievement. The use of portfolios has shown that attention can be specifically drawn to reflecting on certain skills, hence, making the intention explicit to the students [13].

Our case study shows that purposefully directing students' attention to reflect on skills they use through their project work can bring a better alignment between the intended and learnt curriculum, and support student learning. Preparing a portfolio structure that supports this reflective process leads to greater awareness of the specific skills. Setting an objective at the beginning and evaluating oneself at the end helps in understanding the learning journey, and potentially how it can be improved for and by the learner. We also notice that skills that were not intended or even taught still do appear in the learnt curriculum, most likely in connection to neighbouring skills, confirming that they are not prevented by the teaching approach nor by teaching tools presented in this case study.

On the translational side, the visual representation of the aligned curriculum can be a helpful tool to suggest how teachers can optimise their efforts for teaching and learning transversal skills. It gives a presentation about the places in the curriculum where a stronger emphasis could be made in terms of reflective questions, and what are the points missing in the initially proposed curriculum. We see great potential for this kind of research on a course level, but also beyond a single course - a larger analysis could provide input to a stronger alignment of the full corpus of courses at a programme level.

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