GET READY FOR A SMART WORLD: STUDENTS' VIEWS ON FUTURE-PROOF EDUCATION

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ABSTRACT

One of the tasks for higher education is to prepare students for their role in a changing world and to stimulate them to develop broader competencies than only in their own discipline. There are many initiatives in which existing curricula are redesigned to prepare students for this changing world. These new curricula oftentimes contain hybrid learning configurations, in which theory and (authentic) practice are intertwined, such as in project-led education, innovation labs, or workplace learning. But what are -according to students- key ingredients of future-proof education?

Within Saxion University of Applied Sciences in the Netherlands, an explorative, qualitative study was conducted amongst 74 bachelor students from >20 programs, including technology and engineering programs, such as mechatronics, industrial design, or biomedical engineering. Focus group interviews were held with 24 groups, of different group sizes from 2-7 students. Interviews started with the question: What are -according to you- key ingredients of future-proof education? The interviewers directly during the interview coded the reported ingredients deductively, following a prespecified scheme based on literature. New themes were added inductively, when necessary. Next, interviewers prompted on the first answers, asking for clarification or examples.

The report follows the outline of the adapted coding scheme. Distinction was made between 1st/2nd year students versus 3th/4th year students since the latter provided more in-depth and experience-based information. According to students, main ingredients of future-proof education are: authentic projects (mentioned in 22 out of 24 groups), blended/online learning (16), self-directed learning (15), teacher as coach (15), active learning (13) and collaborative learning (11). Results were used as input for the formulation of a new educational vision and Education Model, specifying ingredients for our future education.

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1 INTRODUCTION

Working in the future labour market requires new skills from current and future engineers and, consequently, new curricula to help them require these skills. Recently, the executive agency for small and medium-sized enterprises, EASME, published a report [1] in which they present a framework and guidelines for vocational education of how to develop and implement curricula focused on these skills. Based on market and labour market developments, the agency concludes on p.13 that having knowledge or technical skills is not sufficient anymore. Instead, employees need to have the "…*ability to adapt to continuously changing circumstances and to constantly advance one's knowledge and skills. Focussing on technical skills only is thus not enough. Other crucial non-technical skills refer, among others, to critical thinking, creativity, communication skills and ability to work in teams*". This places demands on the education programmes that prepare students for this labour market. With others, EASME pleads to centre education programmes around real-world experience and real challenges, and to create possibilities for real-world application of skills in the curricula, through close collaboration of business and educational institutions.

It is logical that higher (vocational) education uses such analyses of requirements within the labour market as a starting point for designing curricula. Many curriculum innovation initiatives encompass the creation of learning environments, in which school-based learning and work-place learning are intertwined [2]. Some examples are project-led education [3], or innovation labs [4]. Interestingly, the views of students, as future learners in those curricula, often remain underexposed. To what extent do these curriculum innovation initiatives connect to students' views of future learning, and connect to their preferences? *What* do students want to learn, and especially, *how* do they want to learn? As a first step in an institution-wide curriculum redesign process at Saxion, this question was asked to several groups of students in focus-group interviews.

2 LITERATURE

Preceding the focus group interviews with students, the researchers carried out a small literature study, in which they searched for current trends in literature on curriculum innovation. Because of the explorative nature of the full research study, the literature study was explorative too. The researchers regarded the exploration as an expedient to help them analyse students' answers more quickly to detect evident differences, e.g. themes portrayed in the literature but not by students, or vice versa. The themes in the literature study relate to *what* to learn as well as to *how* to learn.

What to learn
In various articles and reports [e.g. 1, 5], there is attention to the balance between knowledge and skills in future jobs and, accordingly, in future-oriented education. Whereas professional knowledge remains important, studies also show that the labor market increasingly asks for skilled employees, beyond mere technical and specialist

skills. These skills are often referred to as *key skills*, *lifelong learning competencies*, or -usually in education- as *21st century skills*. Although there is no uniform overview, several of the following skills are mentioned frequently: collaboration, ICT skills, communication, social skills, creative thinking, critical thinking and problem-solving skills [5]. Recent research [6] also shows that employers see collaboration, adaptability, and skills for personal development as important competences for the employee of the future. These skills build up to their professional identity. In one's professional identity, knowledge, skills and attitude come together, and one's own identity becomes visible in relation to peers, to other professionals outside the discipline, and to the wider society. There is a task for education to help students learn to understand themselves, and to make good choices, for example, aimed at further development of their professional identity. Self-driven learning and reflection skills, as well as a focus on personal development are crucial in this.

For our interviews, we selected the themes: role of knowledge, role of 21st century skills, reflective skills, personal development, self-driven learning, interdisciplinarity.

How to learn

It is generally known that teachers can use several teaching strategies that invites students to engage actively in learning during class time. This is referred to as 'active learning' [e.g. 7]. Such teaching strategies can comprise of small or larger cognitive challenges or practical exercises. Examples are interactive Q&A-sessions, or working on cases, in which a problem of industry is being modelled in class. Beyond active learning, there is a major movement in higher education to create learning situations in which practice is not only modelled but becomes the core context of learning [2]. When learning situations represent the work situation, this fosters authentic work-based experiences, which helps students learn how to deal with the full complexity of their future work [2]. Projects can offer students such an authentic context [3] in which they can acquire, apply and deepen practice-relevant knowledge and 21st-century skills. By working on projects, students learn from and with each other. During this process of collaborative learning, students construct and develop collective meaning [8]. This is something that is also becoming increasingly important in professional practice, where work is based on interprofessional expertise and the joint creation of knowledge. By introducing collaborative learning into education, the necessary skills required by professional practice can be stimulated [9].

One way of fostering (collaborative) learning within education programs is in terms of the creation of a community of learners. By coming into contact within this community with different people, their preferences, opinions, knowledge, behaviour, etc., the learner has access to more different sources than the instructor alone and, therefore, to potentially more learning opportunities [10]. Such communities of learners are effective because they lead to social bonding between students and between students and instructors. Being able to work on assignments from professional practice within the community has a positive influence on both student motivation and the learning process [10].

Within the 'new' forms of education, the role of the teacher is often compared to that of a coach. In this role, teachers are expected to create a safe and motivating learning environment and on the other hand to apply coaching activities focused on the learning process. This can be divided into three overarching categories of coaching activities, namely asking questions, giving feedback and offering support [11]. Teachers have a crucial role in creating an atmosphere where students feel comfortable and safe to answer questions, share their images, discuss, make mistakes and fix them. This ultimately contributes to the quality of learning [12].

One final theme, which is permeating education relates to the use of technology. This creates the possibility to move parts of the instruction outside the classroom -online, through video clips, etc.- and to work on elaboration and practice during class. Concepts such as blended learning, flipped classroom, online learning, e-learning, are just a few connected terms, that all relate to a certain combination of online and offline learning. We use the umbrella term 'blended learning'.
Relatedly, we see a trend moving towards more flexibility for students, not only aimed at pace, place and speed of learning, but also on what they lean. Institutions think about individual learning paths. Through the application of technology, these possibilities come into reach.
For our interviews, we selected the themes: authentic projects, active learning, blended learning, collaborative learning, learning in (interdisciplinary) communities, teacher as coach, flexible learning.

3 METHODOLOGY

3.1 Context and research question

Saxion University of Applied Sciences currently hosts 56 fulltime bachelor programs (see table 1) and 14 master programs, clustered in 12 schools. 22 part-time equivalent programs are clustered in a separate Saxion Parttime School (SPS). 22 of the 56 programs have a technological and engineering orientation. In total, there are close to 27.000 students. Whereas three schools specialize in technological and engineering programs, all other programs also explicitly connect to technology, since 'Living Technology' is one of the strategic foci of the institution.

Since summer 2018, Saxion is implementing a new educational vision, which is closely connected to recent theoretical insights, promising practices within the institution and viewpoints of teachers and students. In line with the strategic focus of Saxion, the new vision should also encompass a major focus on technology within all the programs.

Within this context, the reported explorative study was conducted, gathering viewpoints from students. The research question that stood central in this study is: What are -according to students- key ingredients of future-proof education?

3.2 Respondents

Data were collected by five researchers, within a time frame of 2 weeks. In order to make sure that all faculties were represented, every researcher was assigned two or

three faculties. They agreed to interview at least one student group from each faculty, and at least two student groups from the larger faculties.

Students were approached randomly by the researcher during a lesson break, participation was voluntary. Ultimately, 74 bachelor students were interviewed, from over 20 programs, spread over the four years of studies. One-third (n=24) of these students specifically came from engineering programmes. Focus group interviews were held with 24 groups of students, group sizes ranging from 2 to 7 students. Most groups consisted of 2-4 students. There is a fairly good spread over the four years:
1st year: 6 groups (20 students)
2nd year: 6 groups (15 students)
3rd year: 7 groups (20 students)
4th year: 5 groups (19 students)

3.3 Data collection and analysis

All focus-group interviews started with the question: 'What do you think future education will look like?' During the reporting, these were classified by the interviewer into the predefined categories (themes), derived from literature. Next, probing questions were asked about the various reported ingredients. Students were also asked for examples within the current study program to illustrate their views. Finally, students were asked what they see as the main challenge to get the education of the future realized within our institution. Each interview lasted between 5 and 20 minutes, depending on the group size and on what students had to report. Per interview, the interviewer directly coded the reported ingredients deductively, following the prespecified scheme. The category 'other' was used for new, upcoming remarks. Everything students reported was included. Note that if ingredients were not mentioned, this does not automatically mean that students do not regard these as non-important, merely that these were not on top of their minds.

First step in the analysis was the rereading of all interview reports. It became clear that the older students provided a *more in-depth* view than the younger students, though did not necessarily report more themes. For this reason, during analysis, clusters were made of the 1st/2nd year students on the one hand ('younger students') and 3rd/4th years on the other ('senior students').

As a second step, we summarized all data in one *descriptive data matrix* [13, p.240], ordered by theme, and used this as a basis for the description of results. We looked at how often certain themes came up in the interviews, specified per year (see Table 2), and also specifically searched for any contradictions that arose.

4 RESULTS

4.1 General results

Table 1 provides an overview of how often the different themes were put forward by the various student groups. Themes reported most often, marked with an '*', are working with authentic projects (22), blended learning (16), Self-Driven Learning (15), teacher as coach (15), active learning (13), collaborative learning (11).

Due to the text restriction for this paper, unfortunately, we cannot present all data. Therefore, below, we will highlight these most often reported themes, which came across in both technical/engineering and non-engineering programmes. Sometimes, the general scope of reasoning is illustrated or completed by an exemplary quote from one of the students.

Table 1. Frequencies of themes as topic in the interviews

Theme: *what to learn*	Year 1+2	Year 3+4	Total	Theme: *how to learn*	Year 1+2	Year 3+4	Total
Role of knowledge	5	3	8	Active learning *	5	8	13
Role of 21st skills	0	1	1	Authentic projects*	12	10	22
Reflection	0	4	4	Collaborative learning *	5	6	11
Personal development	5	3	8	Learning in communities	5	3	8
Self-Driven Learning *	7	8	15	Teacher as coach *	7	8	15
Interdisciplinarity	3	6	9	Blended learning *	8	8	16
				Flexibility	4	6	10
				Other	3	6	9

4.2 Most often reported themes

Without using the specific word 'authentic', almost all groups see the relevance of working on **authentic projects** and expect this to increase in future education. In this respect, interdisciplinary work is regarded as important by 9 groups of students.

Overall, younger students foresee a clear link between theory and practice, so that *"one can clearly see what he is being trained for and can more easily choose where he wants to work"*. They suppose that lessons will have a focus on application of skills and feedback. Students consider the importance of professional practice as a motivational driver: "*You will do your best for a real client*". Some students even expect learning to take place outside school, in the workplace. In general, they hope to find a good balance between freedom to choose projects and activities of their liking, and structure.

The senior students expect programs to be always up to date with trends and developments in the professional field. They expect more and larger, practice-oriented projects, and they find these more relevant and motivating than small assignments or regular lessons. They expect projects to steer their lessons. As one group puts it: "*In the education programs of the future, more attention is being paid to soft skills, but they are offered only at moments when you really need them. So, no separate course about communication, but offered in workshops, when you are actually going to use it. … The question becomes whether courses will be necessary at all and whether working from books with problems is not very old-fashioned. Only when you start working in practice, school assignments will start making sense to you*". Several student groups expect to be able to work solely on professional products, with the support of a teacher as coach. One group would regret that: They hope for a good variety between projects and lectures and that "*there will not only be projects".*

Another clear trend is an expected increased focus on **online learning** activities, enabled by technology. Younger students expect more self-study activities through the computer and e-coaching, and stress that for this purpose good ICT skills are essential. Senior students foresee the use of technology for knowledge acquisition, but also to elicit interactive participation in lesson settings. They also think it will become easier to learn in a personalized way, e.g. to make one's own choices, and that the starting point for education will be the qualities of the individual student that he/she wants to develop. They, thus foresee more personalised learning paths, enabled by technology. At the same time, some students do not feel the need for *full* personalization. Neither do they prefer online education above blended learning. They see the value of Virtual Reality as a way of bringing practice into school, enabling students to practice skills as if it were just real. Some students expect online tests to replace paper and pencil tests, since "*After all, there is hardly any writing in the office anymore*".

In general, in all years, students like to be in control of *what* they learn and *how* they will learn, and they also want good support from their teachers. In this context, the relevance of study career guidance was mentioned. A number of students see this as an important component within future-oriented education. A condition for this is that it is clear what choices can be made and what room students are given. It is striking that students see it as a task of the study programme to make the various options visible and see themselves less of a pioneer. In other words: 'I would like to be **self-directed**, but this is only possible when the frameworks within which this can be done are clear'.

Several younger and senior student groups emphasize the importance of personal contact, e.g. learning with peers, working in groups, and meeting with teachers. Moreover, younger students more often than older students seem to express an explicit need for good **teacher coaching** and guidance. This teacher guidance can be focused on, for example, stimulating the process of collaboration in a project setting, on motivating for learning or on encouraging self-directed learning. These students also expect coaching on making good choices, for example during the selection of assignments or (optional) subjects, and in determining what is a good test moment. Younger students portray teachers primarily as transmitters of knowledge, but at the same time do not find this a very motivating function. They rather prefer a short instruction from their teacher after which they can start to practice and experience themselves. Younger students also mention the need for feedback on assignments which they currently, according to them, do not always get from their teachers.

5   DISCUSSION

This small, explorative study was conducted as a first step in an institution-wide curriculum redesign process at Saxion University of Applied Sciences in the

Netherlands. In focus group interviews, we asked 24 groups of students 'What are - according to you- key ingredients of future-proof education?'
Although participation was voluntary, the researchers trust that the students interviewed are representative of the population, regarding gender and race. The students were approached randomly, and they all agreed to participate. They covered one-third of all programs and came from all faculties, also reflecting the specific 'culture' of the faculties. Despite this assumption, the results should be interpreted with care, also because of the small number of students involved.

In the focus group interviews with students, it became clear that students somehow associate all the prespecified themes with future-proof education. The interviewed students do not have major differing views, compared to what was put forward in reports and studies [e.g.1,6]. In this paragraph, we will discuss the findings, and share some observations of the researchers, also based on non-reported results. In this respect we hope to be able to give the reader a wider view on the data, than could be presented within the limited number of pages of this paper.

Students' views are coloured by current experiences
The phase in which students currently enjoy education seems to partly colour their views. For example, where younger students reported that the development of professional identity is important, they were not yet able to properly describe the consequences for education. Another example is that the importance of exchanging different perspectives from different disciplines (interdisciplinary education) was mentioned more often by senior students, who were just undertaking interdisciplinary courses in the latter years of their program, such as in the Smart Solutions Semester.

Senior students provide a more in-depth view than younger students
Overall, the younger students seem to find it more difficult to make 'education of the future' explicit than senior students. They seem to put a stronger focus on the structure of the programme. For us, while designing our future-proof education, it is relevant to consider whether this focus on structure stems from the students' own intrinsic need for structure, or whether it is mainly a reflection of the current state of their study programme, indecisive of how future-proof the study programme is. It is, therefore, important to first determine the ingredients of future-oriented education in itself (what needs to be learned), and next, to elaborate those in such a way that they address the learning needs of students, since this is necessary for their motivation and for supporting their learning process.

Theory and practice should be intertwined, authentic projects will to be core
The researchers got the impression that, in their answers, students sometimes seemed to mix up their *views* of education of the future and their personal *needs* of what they would like to see portrayed in their programme. Having said that, almost all groups mentioned the importance of having a continuous alternation between

theory and practice. Almost all groups reported the necessity of working on authentic projects and expected this to increase in the future. Interdisciplinary work was also mentioned as important by a number of students. This provides strong support for the current curriculum innovation initiatives in higher education institutions [2,3,4].

Projects provide contexts for collaborative learning (as process and outcome)
In line with literature [9], students regard collaborative learning as an important skill for the future. It is, therefore, important that this is addressed explicitly in the study programme. Collaborative learning can take shape pre-eminently within projects contexts. Here, students make high demands on the coaching of their teachers. They expect support, for example in the form of feedback on the collaboration or reflection on personal development. The fact that some student groups also reported that they do not always get frequent or adequate feedback from their teachers deserves attention. Is this something that holds for more students? Is it due to practical obstacles such as available time, is the importance not recognised, or are some teachers insufficiently skilled in providing adequate feedback, and should this be trained?

Students want to steer their learning process ánd find this difficult
Whereas employers are in need of employees who are able to steer their own development [6], the theme of self-directed learning needs more attention and elaboration during curriculum innovation and implementation. Whereas students do stress their wishes to take responsibility for choices, they expect the programme to spread out exactly their options and choices, thus diminishing the amount of their own control. Where this seems natural for younger students, we would expect senior students to able to set their own goals and take more control. It seems to be important to have teachers who are capable of supporting this self-directed learning process and who can help students develop these skills. It might also be realistic to acknowledge that it is already a good start if graduating students, who just enter the labor market, have developed self-*regulating* skills, and realize that they will further develop a self-*driven* attitude during their career.

Not every student likes online learning
The theme that seemed to get most opposite views was blended learning. Whereas this theme came across in two-third of the student groups, when addressing the opportunities of technology to create online learning situations, some students were not so positive. At most, they value a blend between online learning activities and face-to-face activities, but they would regret a move towards online education. Since the interviews were held in the pre-Corona era, it would be interesting to find out whether the current enforced online learning experiences during Corona have made them change their minds.

Especially regarding the theme of blended learning, it is important to note that students interviewed were all students who were physically present to enjoy face-to-face education. There is a small chance that this approach has prevented students

from participating who stayed away and who might have a preference for online learning.

During the interviews, most students stressed the importance of the coaching role of the teacher, and the necessity to learn together with other students, in communities. Although coaching and collaborative learning could be supported online as well, programmes need to deliberate on good blends of online and face-to-face activities. In either way, there should be a good structure of supervision by instructors, or more flexible choices regarding how students want to learn.

To conclude, the views of the interviewed students on ingredients of future-proof education are mainly in line with the developments mentioned in literature and initiatives in higher education. Their answers provide insight into their needs. It was difficult to distinguish the role of the teacher as a separate theme. It seemed connected to all other themes. From a students' perspective, the teacher is and remains crucial in future-proof education.

REFERENCES

[1]   EASME (2020), Skills for industry 4.0: curriculum guidelines.

[2]   Bouw E, Zitter I, and de Bruijn E. (2019), Characteristics of learning environments at the boundary between school and work: A literature review, *Educational Research Review*, Vol. 26, pp.1-15.

[3]   Powell P and Weenk W (2003), Project-led engineering eduation, Lemma Publishers, Utrecht.

[4]   Weerheijm R and Miltenburg I (2017), *Powerful learning environments: A guide to designing innovation labs*. Hogeschool Rotterdam Uitgeverij, Rotterdam.

[5]   Voogt J and Pareja Roblin N (2010), *21st Century skills: Discussienota [Discussion paper]*, at the request of Kennisnet, University of Twente, Enschede.

[6]   Peters S, Corporaal S, Wolffgramm M and McGovern K (2019), SEFI-proceedings complexity is the new normality, Balázs Vince Nagy, Mike Murphy, Hannu-Matti Järvinen, Anikó Kálmán, Budapest, pp. 1835-1850.

[7]   Freeman S, Eddy SL, McDonough M et al (2014), Active learning increases student performance in science, engineering, and mathematics, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 111, pp. 8410–8415.

[8]   Wortman O (2002), Stilstaan bij leeractiviteiten in het projectonderwijs [Learning activities in project-led education], *Tijdschrift Onderzoek van Onderwijs*, Vol 4, pp. 61-65.

[9]   Hämäläinen R and Vähäsantanen K (2011) Theoretical and pedagogical perspectives on orchestrating creativity and collaborative learning. *Educational Research Review,* Vol *6, No.* 3, pp. 169-184.

[10] Beishuizen JJ (2015), *10 jaar communities of learners in praktijk en onderzoek [10 years of communities of learners in practice and research]*. Afscheidsrede. Free University of Amsterdam, Amsterdam.

[11] Ketelaar E, Beijaard D, Den Brok PJ and Boshuizen HP (2013), Teachers' implementation of the coaching role: Do teachers' ownership, sensemaking, and agency make a difference? *European Journal of Psychology of Education,* Vol 28, No. 3, pp. 991-1006.

[12] Schneider M and Preckel F (2017), Variables associated with achievement in Higher Education: A systematic review of meta-analyses. *Psychological Bulletin*, Vol. 143, No. 6, pp. 565-600.

[13] Miles MB and Huberman AM (1994), Qualitative Data analysis: An expanded Sourcebook 2nd edition, Sage Publications, Thousand Oaks.