Retaining Engineering Students: A Case Study at Aalborg University*

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With an increasing need for engineering people throughout the world, high educational dropout rates are becoming a serious problem. The field of dropout and retention often inquiries into why students leave. The focus in this article is the positive and institutional angle – what does it take for a higher education engineering program to retain engineering students? To investigate this overall research question of what actually works at a program level, an engineering program doing well regarding retention, is singled out, the relatively new Interaction Design (IxD) program, to explore the reasons why and compare with existing knowledge within the field. The question guiding this exploration is: *What is it that the IxD program does well regarding retention?* The case study applies an explanatory mixed methods approach based in a review of successful studies on retention. Qualitative data are used to design the questionnaire and to substantiate the quantitative results. The questionnaire was sent out to all students from 1st, 3rd, 5th and 7th semester. Alongside this, we also interviewed staff. Aligning expectations with stakeholders outside and inside the university, an internal, progressive logic across the curricula of the entire program, a problem- and project based learning approach and extracurricular student groups across the semesters support both the academic and the social integration of the students. This piece of work draws forward the importance of alignment and the need for continuous expectation reconciliation between students and the university as a key issue in what works in retention beyond active group-based learning and as a continuous focus and activity on the part of the university.

Keywords: retention; engineering education; interaction design; sense-of-belonging; professional and social integration; PBL

1. Introduction

Student retention is an issue that gathers more and more attention within the engineering education community. This is mainly due to the increasing need for engineering people paired with untenable dropout rates of 50–60% in engineering programs at many universities all over the world [1–7]. Engineering students drop out of college more often than non-engineering students do and they do take a longer time to graduate [1, 7]. Thus, there is a need to understand why a significant number of engineering students do not complete their course plans of study and how we as educators can counteract that trend.

Up until recently, Aalborg University (AAU) in Denmark has avoided this development, even compared with other Danish universities [8]. The commonsense logic has been that AAU adheres to a problem and projectbased learning (PBL) approach that inherently combats dropout. A very recent large-scale English investigation about retention and dropout states that this is more than common-sense logic:

> "High-quality, student-centred learning and teaching is at the heart of improving the retention and success of all students. Academic programs that have higher rates of retention and success make use of group-based learning and teaching, and varied learning opportunities, including real-world learning and work placements." [9].

Similarly, Kezar et al. [2] conclude:

> "a meta-analysis by Freeman and colleagues (2014) conducted of recent science education research papers conclusively confirms that by using active learning strategies as opposed to traditional lecture, student exam scores increase and failure rates drop dramatically. As a result, most recent reports reiterate the need to focus on creating more student-centered learning environments that use the most effective research based teaching, learning, and assessment strategies to promote student success (American Association for the Advancement of Science, 2011; Association of American Medical Colleges-Howard Hughes Medical Institute Committee, 2012)."

Active learning strategies seems to be a chief recommendation, when discussing strategies to increase retention. Lately, however, we have started to see some dropout rates at 30% at AAU despite the fact that group-based learning, real-world problem design and collaboration with industry are hallmarks of our educational model. Several research projects have been initiated to investigate this apparent paradox [8, 10]. Our initial results show different dynamics for different educational programs; briefly accounted here as e.g., an increasingly overloaded curriculum, mismatch between advertisement of the education and the realities of the education, lack of support from faculty and difficulties getting through e.g., math courses. This demonstrates a longstanding truth within the field that retention and dropout are phenomena with a

complex causality of a practical, academic, pedagogical and social nature [4, 7, 11–14]. It also indicates that there is more to successful retention than focusing on creating more student-centered learning environments that use the most effective research-based teaching.

To get a closer understanding of what actually works beyond the point of active learning strategies, we chose to scrutinize one of our educational programs that has a dropout rate close to zero, the Interaction Design (IxD) program. At the IxD program, students learn to design interactive digital products, environments, systems and services, as well as explore how a user can interact with physical products. Looking at the successful IxD program would help us understand why some educational programs at the university do better and shed some more light on what it takes to be successful, when it comes to retention. Thus, the more specific and instrumental research question for this study has been: *What does the IxD program do well regarding retention?* As we will spell out later, in the theoretical and the methodological sections, we do a comprehensive study of the entire study program. This includes among other things interviewing both staff and student groups at several semesters, a questionnaire for all students, scrutinizing the history of the program, the organization and teaching of the curriculum.

Before we look at existing literature as far as successful retention goes, we recall a short note on the understanding of the concept of retention. Ortiz and Sriraman [3], in quoting Reason (2009), note that the concept of retention is used when discussing institutional efforts, while the concept of persistence is used when discussing individual student behavior. There is also a geographical difference, in the sense that American researchers often use the word 'persistence' to indicate students who persist in pursuing their degree and do not drop out, while European researchers prefer to use the term 'retention', which implies that something or someone needs to retain something, i.e. universities need to retain their students [7]. We will use the concepts of retention and persistence in accordance with the understanding laid out here and the concepts of student or college success [1] to embrace both or all dimensions of holding on to students at college level.

2. Theoretical Framework

2.1 Studies on Successful Retention

An initial search in the database Eric was conducted (February 2020), using the search terms engineering education, retention, freshman and success with the restrictions of English papers being peer reviewed, within the area of higher education from the year 2000 and onward. It yielded only 20 papers, indicating that research on successful achievements as regards retention within the area of Engineering Education is still scarce. Acknowledging this, a more comprehensive, but also vaguer, search string in several databases would most likely result in a large amount of irrelevant papers to go through and this happened. We composed a comprehensive search string: (engineer or STEM or sciences or natural sciences) AND (retention or retain or holding power or persistence or student success) AND (student or freshman or freshmen or undergrad or bachelor) AND (what works or solutions or success or success stories or effective or efficient), and searched in the following databases: Eric, Psychinfo, Scopus and Web of Science. We delimited the search to English peer-reviewed articles from the year 2000 and onward looking strictly at higher education, where this delimitation was possible. It should be noted that in delimiting the search to peer-reviewed articles, we knowingly did exclude at least one major investigation, the aforementioned English large-scale investigation on what works as regards retention at college level, carried out among 13 English universities [9], indicating that administrative bodies at colleges are aware and do take actions on the issue. These kinds of initiatives have not yet found their way into the research field, though.

The search date was carried out on February 5, 2020, and we landed on 1788 potential articles. Having eliminated duplications, we got 1188 articles. An initial examination of abstracts eliminated the bigger part of the articles, 1061; they either were off topic or e.g., directed toward primary school or peripheral stakeholders like administrators. We eventually reached the number of 127 articles that dealt with the issue of how to successfully hold on to students at college level. Going through this amount of papers, we finally ended up with a result as shown in the Table 1.

Table 1. Overview of articles that dealt with the issue of how to hold on to students at college level

Type Level	Individual – persistence	Course	Institution – retention
Dropout – Reasons to leave	12	2	1
Dropout – Successful solutions to prevent	4	9	11
College success – Reasons to stay	34 (7)	1	14 (3)
College success – solutions to increase	7 (1)	11	21 (6)

When scrutinized, 39 (12 + 2 + 1 + 4 + 9 + 11) really had the perspective of dropout, looking at what would make students leave their education, and an additional 12 (1 + 11) papers dealt only with the relevant issues at the course level. The number of papers regarding college success from an individual perspective, in our terminology understood as persistence, amounted to 34 + 7 = 41 papers, while the number of papers looking at college success from an institutional level, in our terminology understood as retention, amounted to 14 + 21 = 35 papers. Eight individual papers and nine institutional papers dealt with relevant aspects of our study. Our case study deals with college success at the institutional level, and, as visible from the table, 21 of the papers actually addressed specific activities or programs to increase retention at an institutional level. Of these, six proved relevant for our study, but none of them look into retention from an institutional level in the comprehensive sense that we do [2, 4, 15–18]. Two of them present programs that are just about to get started and the reasoning behind them. Two look into what works in terms of improving faculty teaching, one looks into what works in terms of learning communities, and one paper scrutinizes what works for minorities at an institutional level across colleges. Based on this, we can conclude that studies on retention at college level investigating what really works from an institutional point of view are close to non-existing within the engineering research education community.

2.2 Significant Theoretical Focal Points in the Field Of College Success

Looking at the way the field of student success has evolved, this makes sense. From the early days, studies of student success have centered on understanding the single individual and the reasons why some students would drop out of college and not so much on the institutional context [7, 11, 19, 20]. In drawing on Tinto, Ortiz and Sriraman [3] formulate it like this: "Student retention was thought to be a function of individual motivation, attributes, and skills. Thus, there was the notion that students failed, not institutions (Tinto, 2007)." As indicated by the quote, the focus has also largely been on what would make students fail and not so much on what would make them succeed (see [4] for a thorough examination of studies on this). From this starting point, the achievements of minorities and what to do to ameliorate their conditions have been a huge field of interest [7, 15]. There has also been a tendency to emphasize students' pre-college characteristics rather than their behavior, engagement or fit with the given institution in question (Bruinsma and Jansen 2007 quoted in [7]).

Only later, and certainly with Seymour and Hewitt [21], an understanding has grown that the things that unite the students that decide to stay and to leave are bigger than the differences. Seymour and Hewitt [21] did not find "switchers and non-switchers to be two different kinds of people." It is not possible at the onset to point out, for certain, who will leave and who will stay, even if there are statistics and studies that can identify at-risk student groups. Seymour and Hewitt [21] also found that the most common reasons for switching arose from a set of problems, which, to varying degrees, were shared by switchers and non-switchers alike. This is something that more recent studies also indicate (see [22]).

As the field evolved, greater emphasis was placed on the role of institutions in students' decisions on whether to stay or leave [3], still, however, with a main focus on what is wrong with the institutional context and what needs to be improved [1,4]. Today, research underlines that the quality of academic programs and the accessibility to faculty for help and support influenced students' intention to drop out to a much greater magnitude than students' GPA and financial pressure Xu [1]. ". . . '[S]tudents' perceptions of institutional conditions, including the academic program, teaching quality, and accessibility to faculty for help and support, is the primary factor" and in this sense it is "critical for students to feel satisfied with their academic experience and feel supported and affirmed in the learning environment" [1, p.423]. Thus, there are very good arguments to include a broad array of factors in the understanding of retention issues [12].

As of today, research on student success is a complex field involving a lot of variables and perspectives. It is usually divided into three subareas using terms such as student background variables, process variables and organizational variables [7]. Cromley et al. [13] employ the terms cognitive predictors, motivational predictors and institutional predictors, while Xu [1] use terms like precollege characteristics, student behaviors and engagement in college, and institutional conditions [1]. Taking a point of departure in the last set of terms, precollege characteristics can be defined as most often including "gender, race and ethnicity, socioeconomic status (SES), and academic preparation" [1, p. 414]. Student behavior "include[s] the time and effort students put into their studies, peer involvement, and interaction with faculty," while student engagement is "at the intersection of student behaviors and institutional conditions" because student perceptions of the institutional setup influence how they spend their time and interact with peers and faculty [1, p.416]. Finally, institutional conditions "include programs and

practices, resources, and structural features" [1, p. 415]. In this study, we will include all three areas, though with an emphasis on student behaviors and engagement as well as institutional conditions to investigate what a great program looks like, one that retains people. To do this, we will introduce the concepts of social and academic integration, originally coined by Tinto [23], and the concept of belongingness [19] as critical factors for student retention.

2.3 Critical factors for Student Retention: Sense-of-belonging in the Academic as well as the Social Arena

Xu [1, p.416] provides an excellent description of what successful retention can be boiled down to:

> "Regardless of the different terminologies, such as student engagement or involvement, sense-of-belonging, or student or institution fit, the center issue remains to be an individual's interaction with and perception of the academic and social environment materialized by an academic institute (Cabrera, Nora, Terenzini, Pascarella, & Hagedorn, 1999; Meeuwisse, Severiens, & Born, 2010)."

In other words, the students' perception of being academically accepted, appreciated, and included, as well as their experience of being an important part of social life and social activities, is important to the retention of students. Notice also the word "interaction," highlighting that successful retention is not a question of the students or the institutions, but a matter of how these two entities align with each other.

In this study, we will use the concept of belongingness and thus link successful retention to the student's "sense-of-belonging" to the education, academically as well as socially [19, 24, 25]. Strayhorn [19] highlights the following about the concept, displaying also some additional arguments why we have chosen to use this concept:

> "In terms of college, sense of belonging refers to students' perceived social support on campus, a feeling or sensation of connectedness, the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the group (e.g., campus community) or others on campus (e.g., faculty, peers). . . . [S]ense of belonging is relational . . . [and] a basic human need. . . it may take on heightened importance for college students given where they are generally in their personal development (e.g., identity exploration, vulnerable to peer influence). . . . It does not necessarily apply to all people equally. . . . [and it] must be satisfied on a continual basis and likely change as circumstances, conditions, and contexts change" [19, pp. 3, 17, 18, 20, 22, 23 respectively].

College students are, as a group, more prone to issues of belongingness and social identity. It may be unevenly distributed among the students, and

once a sense-of-belonging is obtained, it does not necessarily imply that it will stay that way. Sense-of-belonging is an ongoing debate. A final observation about the focus on sense-of-belonging is that in doing so, we also seek to fill a gap identified by Strayhorn [19] concerning the "ethos of daily college life":

> "The current literature base does not help us to understand how organization or institutional attributes, conditions, ethos, and practices influence college students' sense of belonging, directly or indirectly. . . . Absent are sufficient references to the fact that belonging is a function of the ethos that pervades the daily life of college. Even when scholars make feeble attempts to note the role of institutional environments, they rarely, if ever, explain the mechanisms by which those environments affect sense of belonging." [19, pp 13–14].

In the following, we lay out the design and the methods to investigate what a great program looks like in terms of retention.

3. Case Study Design and Methods

3.1 Case Study Design

The question guiding this study is, as earlier stated: *What does the IxD program do well regarding retention?* Thus, emphasis in this study is on what works in relation to retention by way of choosing a specific case where retention is high [26] at Aalborg University. To find the case we made an inquiry to the study management. They pointed to IxD as an education that has a dropout rate close to zero.

Research points out that the start-up phase and the first year are particularly critical for retention [9, 27]. We have chosen, however, to involve students from the first semester up to and including the seventh semester, because we know from the outset that the older students have a great influence on the academic and social environment of the entire program. Besides that, the IxD program is quite new, from 2014, and involving the older students gives a good background for understanding the development of the program. In addition, we have involved teachers from the IxD program that have been a part of the program from the beginning as well as the student counsellor. Based on this and the theoretical discussion above, the following three sub-questions were identified:

In what institutional context does the IxD program unfold, e.g., as concerns curriculum, organization of teaching, faculty, student organizations, administrative support, teaching facilities (IT, group rooms etc.)?

What type of students attend the education program and how do they experience the program's start-up phase?

What does academic and social integration look

like at each semester: i.e., the 1st, 3rd, 5th and 7th semesters?

3.2 Mixed Methods Approach

This study uses an explanatory mixed methods approach [28]. We used the theoretical framework (importance of start-up-phase and sense-of-belonging) to design both qualitative focus group interviews and a questionnaire and the qualitative data to support the quantitative results. The qualitative data consisted of three focus group interviews with, respectively, 5 students from the 1st semester, 7 students from 3rd–7th semesters and two teachers and supervisors who helped found the program. In addition, we interviewed the student counsellor for the program. Data on dropout rates were collected for the individual semesters. The structure of the focus group interviews with the students was similar. We initially briefed them about the framework for the research project and the structure of the interview. Then, we asked preliminary questions and questions about the students' expectations. After that, we asked questions in relation to the academic and social integration. The interviews with the two teachers and the student counsellor were similar to the students' interviews, with additional questions about their roles and background. The questionnaire consisted of five different parts. The first part was initial questions about student background, expectations, satisfaction and motivation to choose the program. The second part was about the introduction to the study and the initial information. The third part referred to the professional integration, the fourth part referred to the social integration, and the last part was a summary and an opportunity to add further information.

We sent the questionnaire to all students from semesters one through seven, 129 students in total. Responses were received from 55 students: 22 women and 33 men. Thirty-six students answered all the questions. Replies were received from 19 students in the 1st semester, 13 students in the 3rd semester, 9 students from the 5th semester, and 11 students from the 7th semester (see Table 2). We consider the answer rate satisfactory and to secure the validity the questionnaire was focused around what is intended to be measured [29] students' expectations, start-up phase and sense-of-belonging.

All data from the questionnaire and the four interviews were subsequently analyzed according to the three sub-questions.

4. Results

The results are presented in the order according to the sub-questions, beginning with the institutional factors, followed by results concerning the students' choice, satisfaction, motivation etc. and finally the results concerning academic and social integration.

4.1 Institutional Factors

The institutional factors deal with the supervisory body, collaboration with the study secretary, IT structure and programs, IT support, scheduling, teaching platform, practices, resources, and structural features and premises, etc. We begin by looking at the program's establishment and development before moving on to other institutional factors.

4.1.1 The Establishment and Development of the Program

IxD is a new program that started in 2014. The first candidates completed the program in the summer of 2019. The program is small with an admission in 2018 of 38 students. According to interviews with two of the leading forces in the establishment of the program, the background for its creation was both a need in the industry and a recognition of the importance of further developing the students' academic expertise in the field:

> "There are a lot of jobs that are about working with users . . . There is a demand for someone who can build something . . . who can be constructive and not just creative. This is a design-oriented education, . . . a technical education . . . That's what the industry demands."

> "We designed the education program in the way that we thought was the right way to approach this type of education."

There is a clear and meaningful outside demand. The composition and content, and the relationship between projects and courses, are also elements the supervisor group worked on diligently and intensely. The supervisors have been very careful to integrate well individual elements of each semester

Table 2. Response rate for questionnaire survey [30]

Semester	Number of questionnaires	Number of answers	Answer rate
1st semester	37	19	51.4%
3rd semester	37	13	35.1%
5th semester	39	9	23.1%
7th semester	16	11	68.8%
Total	129	55	42.6%

and then focus on explaining the program to the students.

During the first few years, there were some adjustments. In order to be able to develop the education, it was important for the teachers to have *a finger on the pulse* with regard to the students; in particular, the first-year students' progress was followed closely. The teachers have been very responsive toward the wishes of the students, and they have had a crucial role in initiating social activities:

> "Some of them [the social activities] we pushed and started, and then the students took over. And that's actually a dream situation."

From the focus group interviews with the older students, it is clear that there is great initiative and ownership among the students in the later semesters. They are very committed to their education and very dedicated to each other. When there is something that does not work according to the students' wishes, they have a great drive to change things. This drive is coupled with a great deal of skepticism toward the university, the teachers, and the structures they are part of.

4.1.2 Nature and Composition of the Supervisor Group

There is an internationally recognized research group at IxD. As mentioned, they have been very much involved in the establishment of the program. There is great enthusiasm among the teachers, and the education is their *lifeblood*, which means that they often *run 10% longer* as they put it. They also state that:

> "It is very much driven by the fact that it has been very important for us to get this education both accredited and up and running."

It also means a lot to the teachers' international reputations to have a program in their own field of research that is very successful. Many resources from the teachers' side have been used to progress the program to the level it is at now. Thus, two of the challenges of the program are its success and its scalability. It is, for example, difficult to acquire newly qualified staff, so there are vacancies that are not occupied.

There is a good collaboration between secretaries and students as the students perceive it. Ninety-seven percent of the students in the 1st/3rd semester answer that there is a very good or good collaboration with the study secretaries, and 4% answer that there is a less good collaboration. The corresponding figures for the 5th/7th semester students are 92% and 8%, respectively.

Regarding the IT structure and IT support, 74% of the students in the 1st/3rd semester answer that it

works well or very well. For the 5th/7th semester students, the corresponding figure is 50%. Twenty-two percent of the students in 1st/3rd semester answer that it works less well, and 4% answer that it works poorly. For the 5th/7th semester students, 50% answer that it works less well.

4.1.3 Education Structure: Scheduling

Eighty-two percent of the students in the 1st/3rd semesters answered that the education structure and scheduling work very well or well. For 5th/7th semester students, the corresponding figure is 58%. One of the challenges that has emerged from the focus group interview with the older students is the merged classes they have with other programs. The students feel overlooked when, for example, they study with architecture & design students.

> "It has happened several times that lecturers have forgotten that we are present. . . . [They have] not prepared anything for us."

The teachers are aware of the problem and say:

> "I think that the merging . . . has had some challenges. We have changed a lot of this, but still have not quite found the right solution."

The challenge is that there is a difference in the structure of the programs. The idea of mixing programs in courses is liked by the supervisors, but, in practice, it can be challenging. It may look *good on a slide* as they say, but the reality is more complicated.

4.1.4 Teaching Platform and Group Rooms

Twenty-two percent of the students in the 1st/3rd semesters answered that the teaching platform works well. For 5th/7th semester students, the corresponding figure is 58%. Of the students in the 1st/3rd semesters, 48% answered that the teaching platform works less well. For 5th/7th semester students, 25% responded that the teaching platform works less well. Thirty percent of 1st/3rd semester students and 17% of 5th/7th semester students responded that the teaching platform works poorly.

Own group rooms are of great importance to the students. Eighty-seven percent of all students state that it is very important to have their own group room. The same percentage of all students thinks that the group rooms work well or very well. When asked for a reason why it is important to have one's own group room, one of the student answers was:

> "You can do more concentrated group work and work without disturbances from others or alarms from other students. You can also have your own things there, especially if you are doing some sketches or other things that can be difficult to take back and forth; it is nice that it can be locked and no one can come and take it."

Regarding the lecture rooms, 26% of the students in 1st/3rd semester answer that they work very well, 67% that they work well and 7% that they work less well. For the 5th/7th semester students, 8% think that the lecture rooms work very well, 83% think they work well, and 8% think they work poorly.

The satisfaction is generally high, and the difference between the youngest and the oldest semesters is repeated.

4.2 Study Choice

Two percent of the students answer that it was important to study at AAU, 71% answer that the program was important, and 27% answer that both were equally important. It is thus the nature and content of the study that draws first and foremost.

4.2.1 Satisfaction with the Program

The study results show that 33% of the students are very satisfied with the program, 53% are satisfied with the program, 7% are neither satisfied nor dissatisfied, and 7% are dissatisfied with the pro-

gram. No student is very dissatisfied with the program.

On the question of satisfaction, there is a difference in the answers between the 1st/3rd semesters and 5th/7th semesters. The 1st/3rd semester students answered that 47% are very satisfied and 47% are satisfied. For the students in the 5th/7th semesters, 7% are very satisfied and 67% are satisfied. There are relatively more very satisfied students in the earlier semesters.

4.2.2 Motivation for Choosing Study and Start-up

A number of questions about what influenced the students' choice of program reveals that design and creativity, problem-solving, construction of new solutions, and technology have great influence or some influence on their decisions, whereas the expectations of others and tradition have no influence or limited influence. This is shown in Fig. 1.

4.2.3 Information, Start-up and Expectations

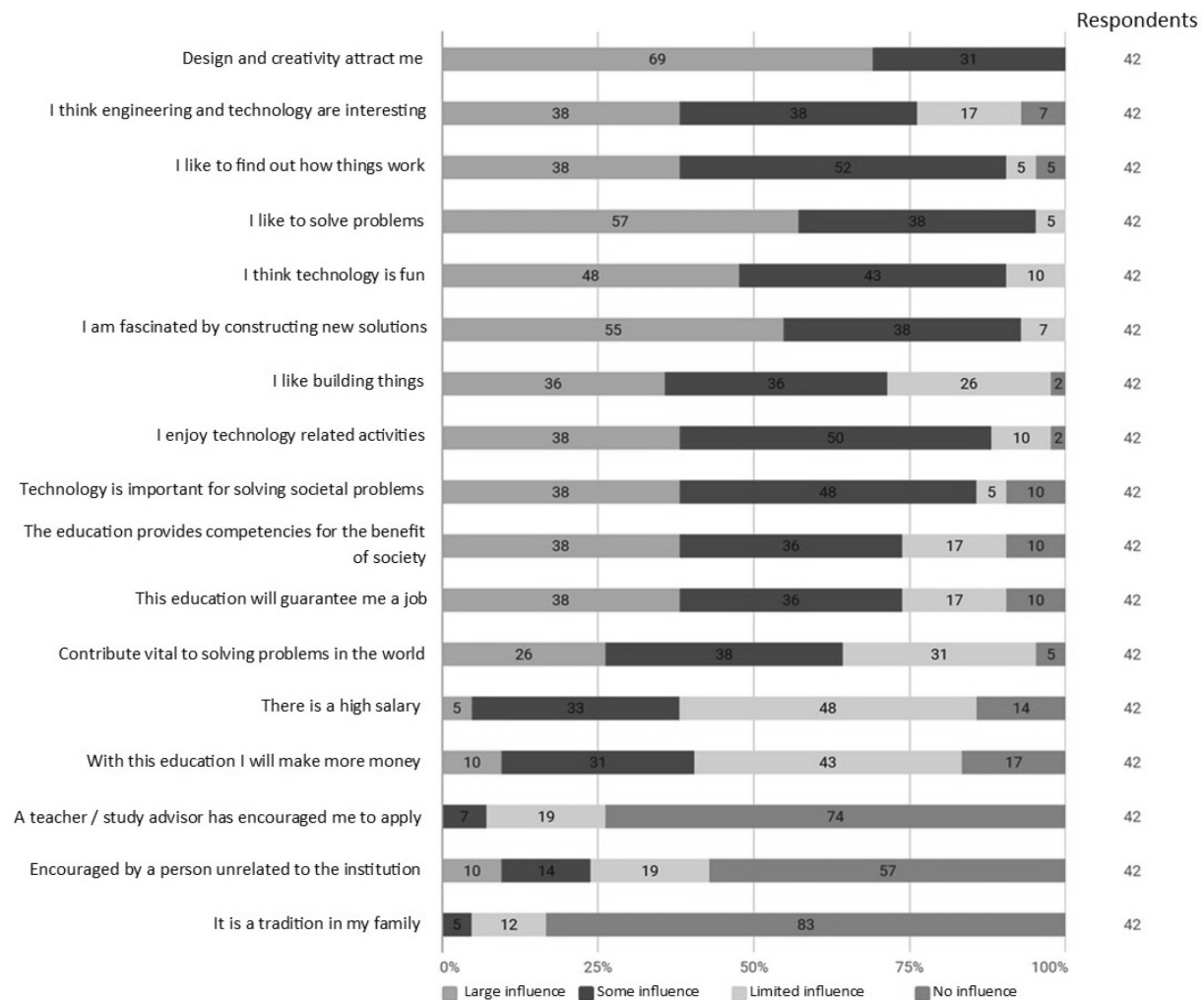The students were asked about the amount of

Fig. 1. Students' motivation for choosing the study.

information before the start of the studies at AAU. Forty-eight percent of all students answered that there was too little information, and 4% of the 1st/3rd semester students answered that there was too much information.

Regarding how the students' expectations for the study have been met, the answers are very different depending on the semester. For the 1st/3rd semester students, expectations are met much more, a little more or just as expected for 82%. For 18%, it is not quite as expected. For the 5th/7th semester students, expectations are met a little more or just as expected for 25% and not fully met for 58%, and for 17% it is much above expectation.

The students have been asked if they have changed their perception of AAU since they started. A total of 54% have said yes, and 46% have said no. There is a difference between students from 1st/3rd semester and 5th/7th semester. For the 1st/3rd semester students, 41% answer yes to the question and 59% answer no. For the 5th/7th semester students, 83% answer yes and 17% answer no. Some of the comments in relation to the change of perception of AAU are:

"There is significantly more group work than I first expected. (Not that it's a bad thing.)"

"I have gained a lot of respect for PBL (when it works and there is good practice)."

"It has opened my eyes to how many administrative bodies have an impact on how my education is, and how things that happen in a completely different place can have an impact locally."

"It is much harder and more time-consuming to study at university than expected. I did not expect that I would have to give up so many activities in my everyday life to make my study work."

"How lectures take place, courses, how much you have to put into a course to get something out of it. The time spent on preparation. Group work and supervisor collaboration. The exams."

If we look specifically at how the students experienced starting at AAU, there is great satisfaction with their experience of the introduction period. The students were asked how they were received at AAU, how the tutor scheme worked, and how the introductory period progressed. Everyone replied that these were very good or that they were well received. For 1st/3rd semester students, 43% were very satisfied, while for 5th/7th semester students, 33% were very satisfied. Regarding the question of the tutor scheme, 92% of 1st/3rd semester students responded that it works very well or well, and 84% of 5th/7th semester students answered that it works very well or well. With regard to the introductory course, 93% of 1st/3rd semester students answered that it works very well or well, and 84% of 5th/7th semester students answered that it works very well

or well. A comparison of the answers for the different semesters – 1st/3rd semesters and 5th/7th semesters – shows that the 1st/3rd semester students are generally the most positive. The students generally agree that the tutors make a fantastic effort. It was also mentioned that the professional start-up is quiet and calm. The students also commented on what topics could be improved in the on-boarding. In particular, they mentioned that more information before the start is desired.

4.3 Academic Integration

Academic integration is very important for the students' ability to retain the knowledge of the subject they have chosen. We asked the students what aspects of study are important to them. They responded broadly that the subject's interest, relevance, usability, quality, and learning environment and balance between study and leisure are the most important parameters, together with a good social environment and the capability to finish their studies. A few quotes from 1st/3rd semester students illustrate some of these points:

"... that I can see a relevance in what I am taught and can use it now in the semester project, but also in the future. In addition, it is also important to have a good study environment, both among one's fellow students on the program, but also from other study programs."

"An educational environment where there is also the opportunity to be with my fellow students socially, a good education that interests me, good teachers, good literature, a group room for the project group."

Similar comments were recorded from the students in 5th/7th semesters; however, they added parameters such as a correspondence between expectations and realities, student involvement, a connection between projects and courses, and good facilities. They also pay attention to the importance of the size of the classes. In relation to academic integration, it was emphasized that it is important that the classes do not become too small (i.e., under 30 students) for the sake of the possibility of entering into different types of academic relations with fellow students and in terms of providing a better opportunity to adapt courses specifically to their professional skills. On the other hand, the classes should not be too big because, in this scenario, social integration is compromised. Students from the later semesters also emphasized the importance of the projects being realistic and the existence of a professional challenge.

4.3.1 Workload, Degree of Difficulty, Project Work, and Coherence of Courses

With regard to the workload, 75% of both the younger and older students experienced it as com-
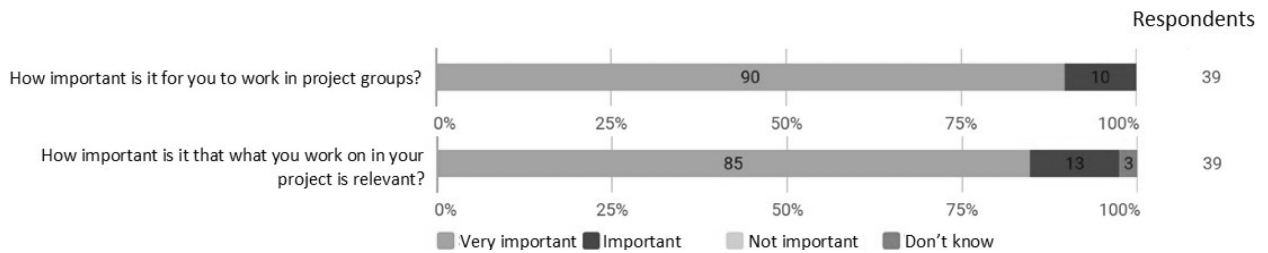
Respondents

| How important is it for you to work in project groups? | 90 | 10 | 39 |

0%   25%   50%   75%   100%

| How important is it that what you work on in your project is relevant? | 85 | 13 | 3 | 39 |

0%   25%   50%   75%   100%

■ Very important ■ Important ■ Not important ■ Don't know

Fig. 2. Students' sense of importance for working in project groups and that their project work is relevant.

fortable, while for 20% it was too much. Seventy percent of the students in 1st/3rd semesters found the degree of difficulty comfortable, while 26% found it difficult or very difficult. In the 5th/7th semesters, 50% of students found the degree of difficulty comfortable and 33% found it difficult. The students experienced an increase in the level of difficulty in the later semesters.

We asked the students to list good aspects about studying at AAU. The common answer across all semesters was group work and AAU's basic PBL model. A few examples are as follows:

"I really like the group work that I know helps me to prepare for my future in the labour market."

"Group work, PBL, Aalborg as a study city, the people."

This fits well with the feedback on how important it is for the individual student to work in project groups. Overall, it was very important for 90% and important for 10%. See Fig. 2.

This is also reflected in how important it is for the individual student that projects are perceived to be relevant. This is very important for 85% of all students and important for 13% of the students. See Fig. 2. For students in the 5th/7th semesters, it is very important for all.

Respectively, 74% and 67% of 1st/3rd semester students and 5th/7th semester students found that the relevance of the project work they are participating in is great. Thus, there is better correspondence between expectation and reality in the 1st/3rd semesters than there is in the 5th/7th semesters. The focus group interviews with the students also show the importance of the projects. The following quotation is from students in the 5th/7th semesters:

"Projects work well!"

A relationship that traditionally has an impact on academic integration at AAU is the coherence between courses and projects. Ninety-seven percent of students in the 1st/3rd semesters think there is coherence or a very large coherence. The tendency is for a downward trend in the 5th/7th semesters, where 67% think there is coherence or a very large coherence and 33% see only a little coherence.

4.3.2 The Academic Environment and the Students' own Initiatives

The big picture shows that 88% of the students surveyed think that there is a good to very good academic environment for their education, 80% believe that they are part of the academic environment, and over half of the students in both groups believe they have an influence on their professional environment. At IxD, a student-driven professional club called FixD has been established, which has been a driving force in establishing professional and social activities. This group has had a significant influence on the academic environment. FixD and its activities are more pronounced in the fifth to seventh semesters.

4.4 Social Integration

Social integration, together with academic integration, is important for retaining students. The issues related to social integration are the social environment, a sense-of-belonging, and the students' own initiatives.

Regarding the overall question of how the social environment works, 92% of 1st/3rd semester students answered that it works very well or well. For 5th/7th semester students, 75% responded that it works very well or well.

The extracurricular student initiative FixD is of great importance to the social field, and it has a little more importance for the older students than for students in the initial semesters. For the 1st/3rd semesters, the student initiative is of great importance to the social environment for 46% and has little importance for 31%, and 23% indicated that they did not know. For 5th/7th semester students, the student initiative has a great importance for 67%, a little significance for 17%, and no significance for 17%.

There is participation in the events that FixD offers often or sometimes for 66% of the 1st/3rd semester students and 75% of the 5th/7th semester students. All numbers are illustrated in Fig. 3.

The experience of being part of the social environment is greatest among 5th/7th semester students. Here, 66% experience being part of the social environment to a great extent and to some
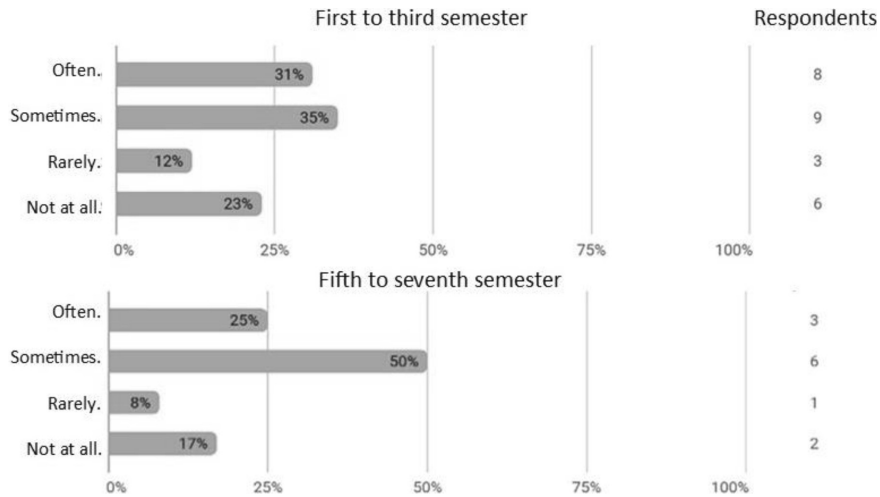
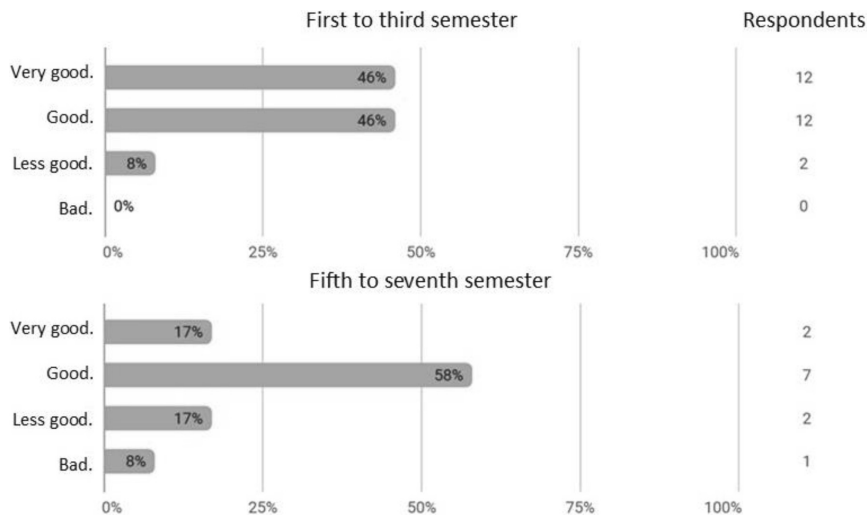**Fig. 3.** Participation in the events that FixD offers.

Fig. 4. Sense of unity in the study.

extent. For 1st/3rd semester students, just 47% experience being part of the social environment to a great extent or to some extent. Forty-six percent of 1st/3rd semester students feel to a lesser extent part of the social environment; the corresponding group of 5th/7th semester students account for 25%.

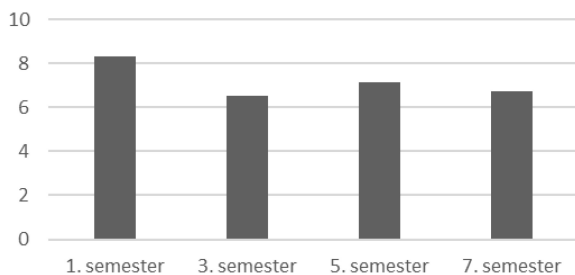Looking into the individual study, the unity of

Fig. 5. Students' affiliation with the program across semesters, on a scale from 1 to 10.

the study is assessed as very good and good for 92% of the 1st/3rd semester students and 75% of the 5th/7th semester students. It is assessed less well for 8% of the 1st/3rd semester students and 17% of the 5th/7th semester students. Eight percent of the 5th/7th semester students perceive the togetherness as bad. See Fig. 4.

4.5 Academic and Social Integration – Sense-of-Belonging

On a scale of one to ten, how much do you feel that you belong here?

The students have been asked to indicate, on a scale from one to ten, how much they feel that they belong to the program. There is a big difference in the experiences of belonging between the different semesters. First-semester students experience a very high degree of belonging, compared with other semesters. The lowest affiliation is that of 3rd semester students. See Fig. 5.

5. Discussion

In the introduction and theory sections, we argued that there is more to retention than focusing on creating more student-centered learning environments that use the most effective research-based teaching. What actually works is beyond the point of active learning strategies. The interviews and the questionnaire have helped us understand why some active learning educational programs at the university do better and shed some more light on what it takes to be successful, when it comes to retention. The results show that there are many parameters to take into account and there is a difference when looking at students from first semester to seventh semester. To answer the overall question, we begin by addressing the three sub-questions.

5.1 In what Institutional Context does the IxD Program Unfold?

The IxD program is a program that from the beginning was designed to match a clear and meaningful outside demand in the industry. It is a design-oriented education where the students are taught to build something, not only to be creative but to construct something. We know from research how important this approach is for retention [17, 18, 24]. On the other hand, if students cannot see the meaning of what they are doing in the program, alienation, the opposite of belonging, occurs, which creates urges to leave the study [31]. At the IxD program, project work is the cornerstone of the program. The importance of project work is something that is widely acknowledged among the students. When project work is combined with great relevance and appropriate academic challenges, this is of great importance for motivation and retention [32].

Moreover, IxD is a program that has been adjusted in order to develop the education with inputs from the students, because an education cannot be conducted as if it is frozen in time [12, p. 50]. At the IxD program, there is an internationally recognized research group. The founders of the IxD program have been involved in the development of the program from the beginning, and there is a great spirit among the teachers, which rubs off on the students. The result of this development is an education structure and coherence between project and courses and a scheduling that works well according to the students, even though there are some cross-listed courses across programs that need to be adjusted. Other research shows that the pace by which the students' get a sense of where they are going and how the curriculum contributes to this have a large influence on retention [33].

Institutional factors such as IT structure, IT support, collaboration with the study secretary, and lecture rooms work well according to the students. We know from research how important the institutional support for learning and responsiveness from the staff are for the students' persistence [1, 6, p.48] and how the opposite can lower the students' self-efficacy [34].

Thus, conclusively, the management of this program is doing all the right things in relation to what research shows. The key in all this is continuous alignment. Group rooms seem to be very important for the students too.

5.2 What Type of Students Attend the Program and how did they Experience the Start-up Phase?

When looking at the results of the analysis, it is clear that there is generally a great satisfaction with the IxD program. This applies to all students. Even if half the students wanted more information prior to the study entry, the students feel well received at the beginning. They especially emphasize the tutors, who do a great job, and the introductory courses at the start-up. Building early engagement is very important and shall continue throughout the student life cycle [19, p. 23, 27, 35, p. 17]. We know that the first year of college, especially the first semester, is critical to students being incorporated into the college campus, as well as their eventual persistence through to graduation [14, 36]. Moreover, we know that supporting actions early in the first and second terms is recommended [37]. The good introduction to the university we see in the IxD program is a very important part of improving retention.

In connection with the students' motivation for choosing the program, it is clear that parameters such as design and creativity, problem-solving, construction of new solutions, and technology are important for the choice of the IxD program. When interviewed, it became clear that the students have a very clear idea of what their study entails in terms of subject and identity, and they have a very clear understanding of their role as interaction designers. They identify themselves as interaction designers, even though it is a new education program, and they have a clear understanding that there is a need for precisely their qualifications in industry. This reflects well the actions of the supervisors and teachers in terms of creating alignment both externally with industry and internally with the program across semesters. Successful engineering learners may need to develop clear understandings of their academic discipline and future career pathways [6, p.48]. The expectation reconciliation and alignment have been clear from the beginning, and we know from research that minimizing the gap between the students' expectations and what they experience is very important [33, 38, 39].

Comparing with previous studies at AAU, it is clear that in other programs with high dropout rates, the expectation reconciliation with the students has not been sufficient, both in terms of rationale for the education in general and the rationality of the individual educational program content [8,10]. In one program, e.g., students did not expect that programming was an important part of the study, which is was.

In this program, expectation reconciliation has had top priority. Already from the beginning, the students had a good idea of what to expect and a good introduction to the program, which created a good basis for incorporating the students into the program.

5.3 What does Academic and Social Integration look like at the Different Semesters?

In relation to academic integration, the students at IxD mainly experience having an appropriate workload and an appropriate level of difficulty in courses and projects. Research shows that there is a concern that STEM programs do not give students adequate time for extracurricular activities or there can be a competition for the student's attention with many courses at the same time [12, p. 48, 7, p. 66 referring to Van den Berg and Hofman 2005]. This is not the case in this program.

The social environment works well in the IxD program. The students mention the students' own initiatives at FixD, which organizes several social activities across the semesters, as an important part of academic integration. By this, the students are making their own community of practice or learning communities or are making the student a legitimate peripheral part of the engineering community from the beginning, which again is an important part of sense-of-belonging and has a positive impact on retention [4, 12, 24]. The efforts of the older students to help the younger students academically have great importance for academic integration and for students adapting to a new academic environment [12, p.51]. This, combined with the large satisfaction with supervisors and teachers, gives the students of the IxD program good academic integration. From other research, we know that the quality of the academic program, teaching and the professional development of teachers are very important for student persistence [1, 12, 40].

Many of the students consider themselves to be an important part of the social environment. The affiliation of the students with the IxD program is considered to be relatively high. This is not only based on good academic and good social integration but also based on the students' own assessments. The character of the students' affiliation is worth paying attention to. It seems as if the students in later semesters feel affiliated to the other students in the program and hardly have any affiliation with AAU or the teachers. There seems to be a certain contradiction between the perspective of older students and AAU as an institution, which is related to a large discrepancy between the students' visions and dreams of a very special education, where not only professionalism and the social environment are above average, but also the infrastructure of the education. Overall, the satisfaction from the 1st/3rd semester students is higher compared to the 5th/7th semester. There can be many reasons for that. The older students have been part of the program from the beginning. They have been a part of the development whereas the younger students experience a more developed program. Differences in affiliation can also be interpreted as there are differences with students from semester to semester. Moreover, it is important to understand that sense-of-belonging must be satisfied on a continual basis [19, p. 23]. It is not sufficient that the students feel a sense-of-belonging in the beginning of the study. There is a need to have a continuous alignment between the students and the study. Circumstances, conditions and contexts keep changing, and sense-of-belonging is susceptible to change in both positive and negative directions.

Conclusively, both the social and academic integration are in focus in this program. The workload is fine, the satisfaction with the teachers and supervisors is high, and the students have their own community of practice. Again, this program does all the right things to secure a good student retention.

6. Conclusion

Overall, the reasons why the IxD program is doing well is concluded above and show a high level of agreement with existing research. Looking at the validity and the transferability of the conclusions we expect that the results will be directly transferable to other active learning higher educational settings that take the same precautions as this program does.

On a broader level, answering the more principle question of what works, going beyond active learning as a specific pedagogy, this study suggests that the key is alignment and continuously focusing on the expectation reconciliation between students, university and perhaps even the job market. This finding is not very present in the current literature base on retention, especially not when it comes to actions on the part of the institutional level. When the management organized the program, it was

based on a clear job-market-related rationale with a focus on high quality and well-founded progression. In addition, management was very attentive to communicate the idea and structure of the overall education and individual semesters. This gives meaning and transparency to the students, and it makes it possible to align the program with the students and to negotiate and adjust the expectations in a continual process. It is worth underlining once more that this is an ongoing process – as also the differences in sense-of-belonging between the different semesters bear witness to – and as such needs continuous attention on the part of the university. This is perhaps one of the most intriguing consequences of the study findings.

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