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READY FOR SUCCES, FIRST YEAR EFFICIENCY FOR INDUSTRIAL DESIGN ENGINEERING EDUCATION.

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ABSTRACT
The Industrial Design Engineering (IDE) bachelor program of the School of Engineering and Applied Science at the Rotterdam University of Applied Sciences started a program in 2015. Its goal was to increase the study efficiency of the first-year students: we wanted more students to pass the first year successfully. The students, teachers, management and work field are very pleased by the IDE program and the level of the graduates. But the study efficiency was still negative. Of all first-year students in 2013, 22% succeeded to finish all first-year courses (60 ECTS), after the second year, 43% did not succeed and had to quit the program. In 2014, with a better teacher approach on building a learner's community and a better organisation of the curriculum, the first-year efficiency increased to 45%. Still 38% did not succeed within 2 years and had to leave.
After extensive research IDE increased the first year ECTS threshold, limited second changes by tests and added a small compensation in the first-year program. This as a goal to improve the student bonding to form a strong engaged learning community.
In 2015, the results of the first year increased to 70% successful students to finish all courses (60 ECTS) in their first year, 10% was able to finish the first-year program in the second year, they achieved the increased threshold of 52 ECTS.
This paper elaborates on the complex combination of factors which influenced the increase of first-year student learning efficiency.

Keywords: Course Efficiency, Student Motivation, Learning Community, Course Innovation, Design Engineering.

1 INTRODUCTION

1.1 Educational vision

Within the Industrial Design and Engineering (IDE) program a team of professionals continuously works on improving the IDE program and their educational performance. This is a never ending, ongoing process of ideation, experimenting and evaluation. Goal of the improvements are satisfied students, satisfied companies and satisfied teachers. The professionals in the IDE team behave like educational designers; they love to design the learning process that leads the students to become professional Industrial Design Engineers. The team works on both innovation of the program and innovation of the instruction, introducing both didactical as pedagogical interventions.
In 2010, the IDE team started a transformation of the program to connect the program to new educational insights [1]. The team members, a collective of engineers focusing on finding product-focused solutions, grew into a unit of educational designers [2].
Designing the IDE program, the team started with the adjustment of the bachelor targets, the bachelor IDE level, the final qualifications. With this as a starting point the team designed a learning process and learning environment that enables the students to reach the required level.
In our educational vision, the learning process is the core. From day 1 in the program the students are encouraged to focus on their learning process. It may therefore well be that the student has made a choice that, later on, proves not to be the most favorable or even the wrong one. More relevant, however, is that it was not the teacher who made the choice, but the student himself. We believe that each student can develop himself into an IDE professional.

1.2 Triple helix of profound learning

IDE developed the triple helix of profound learning [3], Figure 1. Within this learning context, students, companies, researchers and teachers are co-learning in a triple helix with the student in the centre. Each stakeholder is a co-learner and thereby all parties are invited to amaze themselves and to share and develop knowledge and skills and thus climbs into competence. In our vision, IDE students become sustainable practitioners by focusing on their learning process instead of focusing on their design and engineering results.

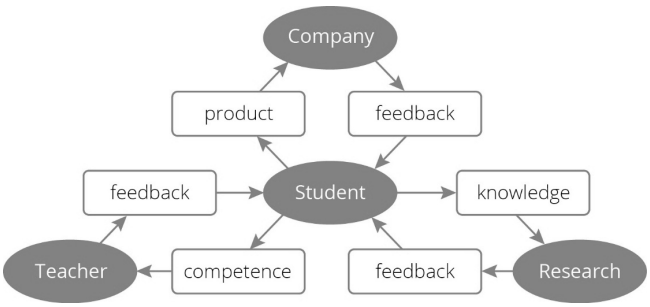

Figure 1. Triple helix of profound learning [3]

Focusing on the learning process within the triple helix of profound learning creates an environment that provides space for experimentation and failure. An important success factor, or perhaps the key to learning, is the necessity of feedback and of assessments for learning; without feedback, no learning [4]. The feedback may come from fellow students, teachers, researchers and clients. Students learn with and from each other.

1.3 Educational program

This educational vision requires a transparent educational organization [5]. The program is transparent and has a simple framework that contains large clusters of ECTS with knowledge driven, practice based and student driven tracks. The planning for the students is made per semester; each semester exists of 20 weeks. During one week, the students work either on a practice based, student driven or knowledge driven track. The assessment of the student focusses on the learning process instead of the professional product. We minimize the summative tests and maximize development driven feedback moments; the condition to do so are approachable and accessible teachers. All education connects to the real world, the world the student is going to work for; professional products and professional situations that lead to the final qualifications.

1.4 Educational environment

Parallel to the organization, the physical and digital environment was developed, meeting the needs of the new education. The processes connected to education logistics were optimized. A safe learning environment and a high level of belonging are conditional to the feedback process. Therefore, it is necessary that students and teachers are able to connect to each other and to find each other. The working space of the teachers is next to the learning space of the students. The learning space of the students reflects the professional space of their future workspace.

1.5 Educational organization

Vision, program and environment support the learning process; the teachers give it a boost. The teachers work as a team [6], having collective responsibility for the whole IDE program. They depend on each other to reach the goals. They share a vision and act from this vision, they practice what they preach. A teacher is a role model for teachers and students [5]. As educational designers [2] they are constantly engineering the program and get input from peer feedback and student feedback. Feedback within the team is given in dialogue with each other and from the learning results of the students. The whole team acts out of self-regulation theory [6], autonomy, competence and safety.

1.6 Study efficiency

The interventions and changes mentioned above led to positive results on satisfaction of the students, teachers and companies and learning output. However, the IDE team was still not satisfied of the study efficiency, especially in the first year of the program. Of all first-year students in 2013, 22% succeeded to finish all first-year courses (60 ECTS), 35% finished the first-year program in the second year and 43% did not succeed and quit the program. In 2014, with a better teacher approach on building a learner's community [7 and 8] and a better organisation of the curriculum, the first-year efficiency increased to 45%, but only an additional 17% finished the first-year program in the second year, 38% did not succeed within 2 years and had to leave the IDE program.

In the Netherlands universities have an academic dismissal policy: students who gain less ECTS than a certain threshold will be expelled from the program. IDE had a Binding Study Advice (BSA) level of a minimum of 48 ECTS for the first year until 2014. Evidence learned that new students aim on the threshold and underestimate the effort it takes to succeed a re-examination. Also, they don't realize that the regular, new courses keep going and on top of the preparation for the re-examination.

The team's goal is to increase the amount of ECTS the students collect in their first-year of study. More students will pass the first-year threshold and start their second year with less unfinished work, so they can pay their full attention to the second-year program. We learned from our experience that the unfinished work can accumulate to an irreconcilable obstacle in the following years of the study.

2 THE EXPERIMENT

2.1 Interventions

After extensive evaluation and research [7], [8], [9] and [10], the team was convinced that better results could be reached by launching two interventions from September 2015. First was to continue with all the development mentioned previously; a further development of the pedagogical and didactical skills of the teachers combined with an excellent educational organization and a connecting environment.

The second one has to do with the student behavior: students are economic beings that often make the wrong choices concerning study planning. These choices are encouraged by the first year ECTS threshold and the number of tests they are allowed to fail and try again. IDE has introduced a combination of measures in September 2015 to improve the academic success of students directly:

- The BSA standard (first year threshold) is raised from 48 to 52 ECTS. Consequence is that the students now have to pass the essential practice based track (projects) of 10 ECTS each semester of the first-year program, which they could fail in the 48 ECTS situation. The practice driven track is a good indicator of the compatibility between the student and our IDE program.
- The number of re-examinations is reduced. Instead of the possibility of re-examining each course, the number of courses that can be re-examined is reduced and the number of re-examinations is limited. In the first semester students may retake all four knowledge and skills courses. These re-examinations take place within the period of the semester. In the second semester, the student can only choose one course of the four knowledge and skills courses for a re-examination. The projects and study career coaching cannot be re-sat.
- The students are allowed to compensate some results, so they don't need to do a re-examination of each course they failed. Students may pass their first year with a minimum result 4.5 (out of 10) for up to 5 ECTS in the knowledge courses; Material and Production, Construction and Mathematics (see Figure 2 for an overview of the first-year curriculum in the academic year 2015-2016).

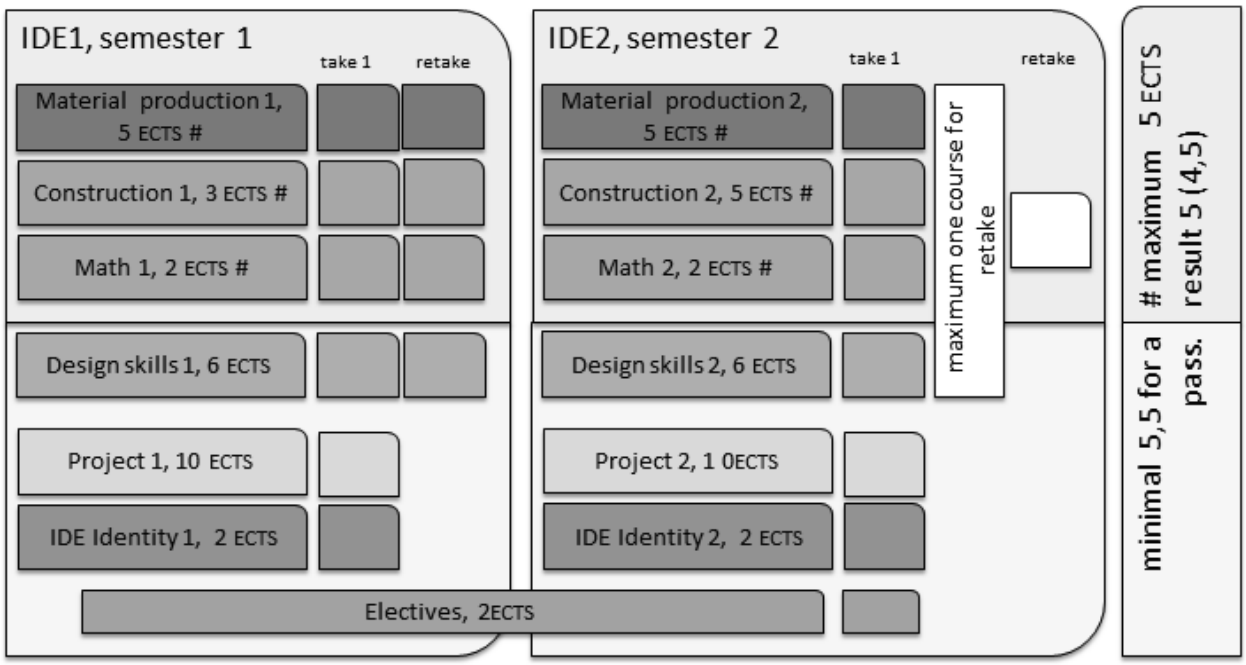

Figure 2. Summary measures propedeuse IDE in the cohort 2015-2016

The aim of the introduction of the combination of the above measures in 2015 is to increase the number of credits earned by a larger group of students. In addition, the aim is that students who transfer to the second year do this with less open boxes, so competition between first- and second-year courses is prevented. Good progress in the first year expects to also give a better bachelor's efficiency.

2.2 Experiment considerations

Important to mention is that the education program in the 2015-2016 curriculum has not been adjusted from the 2014-2015 curriculum. The content, lessons and assessment are therefore unchanged.
Besides the introduction of the increased BSA standard, limiting the number of resits and the introduction of compensatory testing, in 2015-2016 IDE started with the introduction of a selection of new first year students to start with the program. The selection includes tests and a personal interview. Tests and interview focus in a positive manner whether or not the student can be further developed within IDE and has the right motivation. The selection consists of a creativity test (develop ability), technical knowledge test (develop ability), an interview of 20 minutes with two teachers about the motivation, interest in product design and the expectation regarding the courses. Tests and interview lead to an advice from two teachers on the suitability of the student for the IDE program. The introduction of the selection can certainly have an impact on the results presented in this report.

3 FINDINGS

3.1 Impact on propaedeutic yields

What is the impact of the implementation of measures on the 2015 IDE first-year efficiency?
To answer this question the historical propaedeutic yields (efficiency after one and two years) are compared with the achieved propaedeutic yields of the initial cohort (2015) after the introduction of the combination of measures in September 2015.
Table 1. shows the historical propaedeutic yields of IDE students after one and after two years studying, and the first-year propaedeutic yields of student's cohort 2015 (first cohort after the introduction of educational reforms) after one year.

Table 1. Historical propaedeutic yields of IDE students 2013-2015 [11]

		propaedeutic yields after first year						propaedeutic yields after 2years of study	
Cohort	N	60 ECTS	VPOS	BO	Stopped before Feb 1	Neg BSA	Missing	60 ECTS	Neg BSA
2013	99	22.2%	3.,4%	2.0%	17.2%	21.2%	2.0%	58.6%	41.4%
2014	89	46.1%	20.2%	0.0%	6.7%	27.0%	0.0%	62.9%	37.1%
2015	91	70.3%	9.9%	2.2%	3.3%	14.3%	0.0%	----	----

N = Number of students.
60 ECTS credits = All ECTS obtained in the first-year program.
VPOS = Positive Preliminary BSA; Students may continue studying after one year study (enough credits, but not 60). In cohort 2013 and 2014, the limit was at 48ECTS in 2015 the limit was 52ECTS
ECTS; in 2015, the cohort was lower at 52 ECTS.
BO = Special circumstances; Students may still continue studying even though they have not met the requirement of ECTS in the first year.
Stopped before Feb 1 = Has voluntarily withdrawn of the study at the latest by February 1.
Neg BSA= Negative Binding Study Advice, students are forced to stop the IDE course.

3.2 Conclusions on the propadeutic yields

It can be said that the first-year efficiency has been greatly improved after the introduction of educational reforms in 2015. Previously, in 2013 and 2014, 22.2% and 46.1% of students completed the first-year with 60 ECTS. Following the introduction of measures in 2015 the first-year yield of study is 70.3%, meaning that 70.3 % of all students have 60 ECTS. The one year efficiency is now even higher than propaedeutic yield after 2 years in 2014. As a result of the increase of the first-year efficiency, the students who did not succeed and stopped before 1st of February (after 1 semester) decreased to 3.3% and the students who scored less than 52 ECTS (Neg BSA) decreased to 14.3%. Both numbers are very positive results. We are very pleased with the low number of students, 9.9% (VPOS), who did not succeed to complete the first year, but scored 52 ECTS or more. This means 80.2% of the students will start in the second year of the IDE program and only 9.9 % of them have 1 or 2 small first year courses to attend in their second year of IDE. As we are now in the second year of the experiment we must wait to see the results of this small group for their first-year program [11].

3.3 Results of teacher focus group.

In this section, we discuss the results of the teacher focus group [11]. As first the teacher focus group addresses the positive experience in the educational reforms (the 'tops'). Then they look at criticisms regarding the experiences with the educational reforms ('challenges and tips'). The teacher focus group who are responsible for the first-year program were asked to answer questions regarding the possibilities for compensation, less resits and the clear and ambitious standards for the first-year program.

In two interviews (after the 1st and 2nd semester) the focus group concludes the tops. First are the possibilities for compensation, which seems to work well. Only 23.4 % of the students use the possibility for compensation. Second top is the reduction of the retakes. This proved to be an incentive for the students to start with their school work sooner than earlier cohorts, spent more time at school and requested more feedback. Therefore, more students passed the first tests. The measures have a positive effect on the propaedeutic yields. The teachers suspect the learnt study behaviour has a positive effect in the second year. It is also important that preparing for students who have to do a re-examination ask better guidance from the teachers. The test program has become clearer by the smaller number of test moments ('less is more') for both students and teachers. This reduces the workload of the teachers. The focus group participants were satisfied with the increased BSA standard of 52 ECTS.

The challenges and tips formed by the focus group are that the team must be very clear to the students about what, how and when to learn. The team must live up to the ambitious standards they ask from the students. The team must also deliver and work as a team all the time. The students asked more feedback and guidance than in the years before. Standards can also be clarified further by providing concrete examples of components (such as portfolio, design file, poster). This may also be important in connection with managing expectations in the context of selection (interviews) as examples for gaining insight into the standard of the courses.

4 EVALUATION

4.1 Ready for success

Overall the experiment was very successful. The propaedeutic yield increased from 46.1 to 70.3% in the first year. The teacher team and students are satisfied. More students start in the second year of IDE with less open first year courses. The first semester in the second year of the experiment shows similar results. The board of the Rotterdam University of applied sciences has decided to promote this experiment to common policy for the whole university from September 2017.

4.2 Future research

The IDE team continues with improving the program, with new experiments and research in the future. First research question is if this experiment will also give positive results in the main phase (year 2, 3 and 4) of the bachelor curriculum. The second research question concerns the belonging of student's groups and the role of rituals that create more connectedness with the program, the teachers and the students. We suppose that the process of the selection and high standards in the first year become rituals. These rituals work as an accelerator of the process of belonging/connectedness. The third research question is how we can use and organize student peer feedback, within the triple helix of profound learning [3], in the most effective way.

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