Confidence in and beliefs about first-year engineering student success

Case study from KU Leuven, TU Delft, and TU Graz

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ABSTRACT

This paper explores the confidence freshman engineering students have in being successful in the first study year and which study-related behaviour they believe to be important to this end. Additionally, this paper studies which feedback these students would like to receive and compares it with the experiences of second-year students regarding feedback. To this end, two questionnaires were administered: one with freshman engineering students to measure their expectations regarding study success and expected feedback and one with second-year engineering students to evaluate their first year feedback experience.

The results show that starting first-year engineering students are confident regarding their study success. This confidence is however higher than the observed first-year students success. Not surprisingly, first-year students have good intentions and believe that most academic activities are important for student success. When second-year students look back on their first year, their beliefs in the importance of these activities have strongly decreased, especially regarding the importance of preparing classes and following communication through email and the virtual learning environment. First-year students expect feedback regarding their academic performance and engagement. They expect that this feedback primarily focuses on the impact on their future study pathway rather than on comparison to peer students. Second-year students indicate that the amount of feedback they receive could be improved, but agree with the first-year students that comparative feedback is less important.

1 GENERAL

The transition from secondary to higher education is challenging both from the academic and social perspective [1]. Students have to adapt their study and learning strategies to the new context of higher education, but , a priori it is often not clear for students how and to what extend they have to adapt. The social-comparison theory [2] states that people evaluate their abilities through comparison to others when they are lacking objective means of comparison. As students enter a new social group when starting in higher education, they lack a comparison framework, which induces uncertainty about their abilities.

This paper explores the self-reported confidence of starting first-year engineering students in being successful in the first study year of higher education. Additionally, the paper explores what students belief to be important study-related behaviours to obtain study success. Finally, as feedback is considered a powerful tool for improving student achievement [3], the paper explores what feedback students would like to receive during their first year in higher education.

Self-efficacy, or the expectation to be successful for a specific task, can be considered as a situation-specific self-confidence [4], as such academic self-confidence can be

viewed as self-efficacy in an academic context [5]. A person's self-confidence in the context of academic achievement is different from general self-confidence.

Earlier research showed that self-efficacy is significantly related to academic performance [6] but that the effect depends on the timing of the self-efficacy measurement [7] and might only be important for students with high intelligence [7]. The impact of students' academic self-confidence on student performance also exists for engineering students [5].

Feedback has been a proven powerful tool for improving student achievement, but its effectiveness depends on the type of feedback and the circumstances under which feedback is given [3]. During the transition from secondary to higher education this feedback is considered pivotal regarding student motivation, confidence, retention, and success [8], [9].

2   DATA COLLECTION AND METHODOLOGY

2.1 Data collection

In the academic year 2016-2017 data was collected from **first-year** engineering science students at three higher education institutes: KU Leuven, Delft University of Technology (TU Delft) and Graz (TU Graz). The survey contained 16 questions regarding confidence in and beliefs about first-year student success, expectations regarding feedback, and experiences regarding feedback in the transition from secondary to higher education. At KU Leuven a paper-and-pencil questionnaire (in Dutch) was administered in the first weeks of the academic year. TU Delft performed an online questionnaire (in Dutch) in the first weeks of the academic year, in which four of the 16 questions of the survey were included. TU Graz organized a paper-and-pencil questionnaire (in German) during the welcome days within the first study week.

2,127 students completed the questionnaire (KU Leuven n=409 from Engineering Science bachelor, TU Delft n=777 from 12 Bachelor of Science programs, all with a technological focus (e.g. Computer Science, Mathematics, etc.,) TU Graz n=941 from all Engineering Science bachelors).

In the academic year of 2016-2017 data was collected from **second-year** engineering science students at the KU Leuven using a Dutch paper-and-pencil questionnaire during a lecture in the first week of the academic year. The survey contained 41 questions regarding the activities and behaviours students believed to be important for first-year student success, and their experiences regarding feedback in the first year. 271 students completed the questionnaire.

The two questionnaires used a five-point Likert scale ranging from not at all typical, over not typical, somewhat typical, typical, to very typical.

2.2 Methodology

This paper uses descriptive statistics visualized using diverging stacked bar charts to present the survey results [10]. To assess the significance of the differences between the different institutes a two-step analysis was performed. First, a Kruskal-Wallis rank sum test was used to test the overall significance of differences between groups. Second, a pairwise Wilcoxon test was used to test the significance between different groups. For the pairwise Wilcoxon test a correction was used to accommodate for multiple testing [11].

3 RESULTS

3.1 Confidence in and beliefs about first-year student success

On the question "I feel very confident to successfully complete the first year.", 71% of the **first-year students** reply this is typical or very typical for them, while 7% of the students indicate this is not typical or not at all typical for them.

Fig. 1 shows the responses for the different institutes. The Kruskal-Wallis test indicated statistically significant differences between the responses on the survey question by the students in the different institutes (chi-squared=477.81, df=2, p-value < 2.2e-16). The pairwise Wilcoxon-test showed significant differences between all three institutes. The survey questions regarding the reasons for success was formulated as a main question "To be successful in the first year it is important that I will" with four subquestions: "study hard, attend classes, prepare classes, and meticulously follow the communication of teachers and faculty staff through email and the virtual learning environment.". Overall 93% of the students believe that studying hard is important for study success. For attending classes this is 91%, for preparing classes this is 80%, and for meticulously following the communication of teachers and faculty staff through email and the virtual learning environment this drops to 50%.
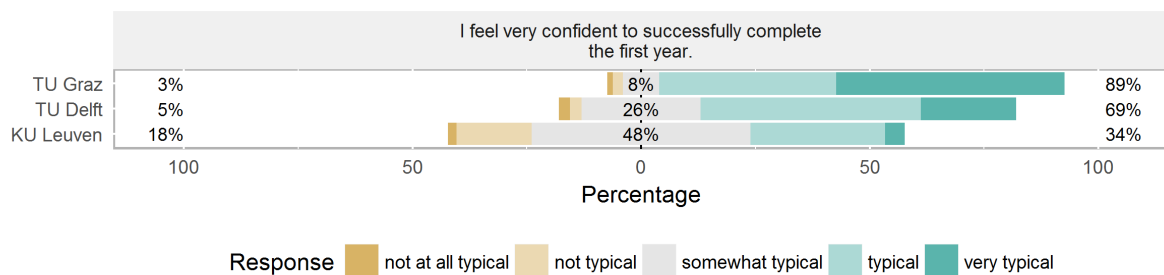

Fig. 1. Stacked boxplot for first-year student responses on "I feel very confident to successfully complete the first year." for different institutes.

The Kruskal-Wallis test indicated statistically significant differences between the responses in the different institutes on all above subquestions (Table 1).

Table 1. Table showing the statistically significant differences between institutes for on the first-year student responses regarding the question for reasons for study success. Institutes sharing a letter are not significantly different (Wilcoxon test, p-value threshold 0.05).

To be successful in the first year it is important that I will …	KU Leuven	TU Delft	TU Graz	Kruskal-Wallis
study hard	a	a	b	χ^2=17.9, df=2, p=1.31e-4
attend classes	a	b	c	χ^2=264, df=2, p < 2.2e-16
prepare classes	a	b	a	χ^2=331, df=2, p < 2.2e-16
meticulously follow the communication of teachers and faculty staff through email and the virtual learning environment.	a	-	b	χ^2=81.6, df=1, p < 2.2e-16

For all questioned reasons regarding activities underlying first-year success the differences between the institutes are significant. KU Leuven and TU Delft students believe "studying hard" is more essential than TU Graz students. KU Leuven students agree most that attending class is important for study success, with the TU Delft

students on the other end. KU Leuven and TU Graz students believe preparing classes is more important for study success than TU Delft students. Finally, KU Leuven students believe that following the communication through email and the virtual learning environment is more important for study success than TU Graz students (TU Delft students did not receive this question).

The survey questions regarding the activities and behaviours **second-year students** believe to be important for first-year student success was formulated as a main question "To be successful in the first year it was important in my opinion to " with seven subquestions: "use good study techniques, study hard, attend classes, prepare classes, meticulously follow student email, regularly checking the virtual learning environment for new messages and content, and feel well in my studies (academic well-being)". Overall students agreed most that using good study techniques (82%), feeling well in the studies (76%) and studying hard (76%) was important (Fig. 2). Attending classes (45%) and regularly checking the virtual learning environment (38%) was considered important by less than half of the students. Preparing classes (22%) and meticulously following student email (15%) were considered least important.
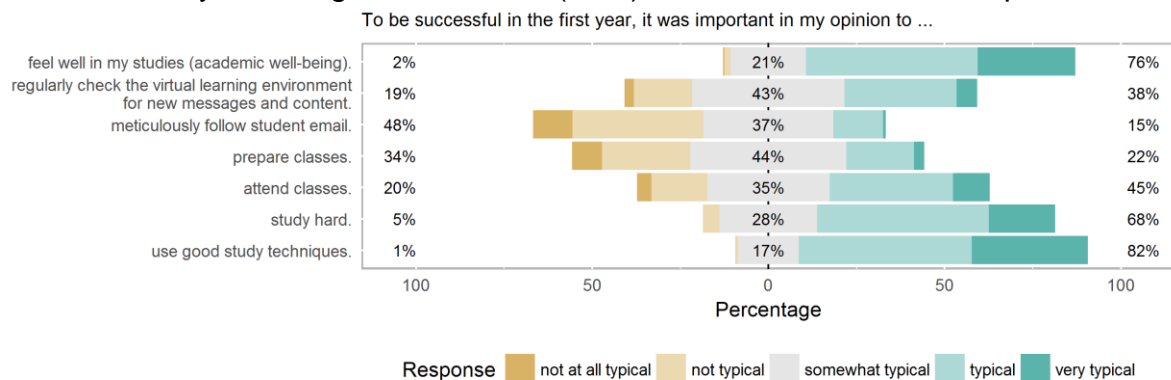

Fig. 2. Stacked boxplot for second-year student responses on possible reasons for first-year student success.

Discussion

Overall starting first-year engineering students are confident regarding their first-year student success. However, large differences exist between KU Leuven, TU Delft, and TU Graz. While cultural differences definitely impacts students' answers, the different university contexts including admission requirements also impact student confidence. Surprisingly this confidence does not correlate with the percentage of successful students in the first year (drop-out bachelor around: KU Leuven: 42%, TU Delft 24%, TU Graz 60%). A small elaboration is needed to explain the higher confidence of TU Graz students, despite the high drop-out rate. 40% of the beginners at TU Graz are coming from dedicated colleges providing them with a prior knowledge in the specific field of studies. While these beginners have strong domain knowledge, experience shows that they are often not successful in higher education as the difference between secondary and higher education is quite big and is often underestimated by those beginners. Another effect is that a lot of Austrian students are recruited by companies before obtaining a bachelor degree, so these students are dropping out, while they might have been successful.

Not surprisingly, first-year students initially have good intentions and believe that most academic activities are important for first-year student success (while some initial doubt is already observed concerning the importance of preparing classes and meticulously following communication). When student look back on their first year their beliefs in the importance of these activities and behaviours have strongly decreased.

While studying hard is still considered important by most students, attending and preparing classes and meticulously following communications are not considered essential.

3.2 Feedback

When asked which feedback **first-year students** would like to receive during the first year 87% agrees they want to receive feedback on their academic performance and 69% agrees with feedback concerning their academic engagement and activities (Fig. 3). Very few students respond negative on these questions (3% and 7%). 79% of the first-year students want to receive feedback showing the expected impact of their current academic performance and behaviour on their future study pathway or study success (Fig. 4). The demand for comparative feedback (position with respect to fellow students) is lower (58%) and more student do not agree they want to receive such comparative feedback (19%).
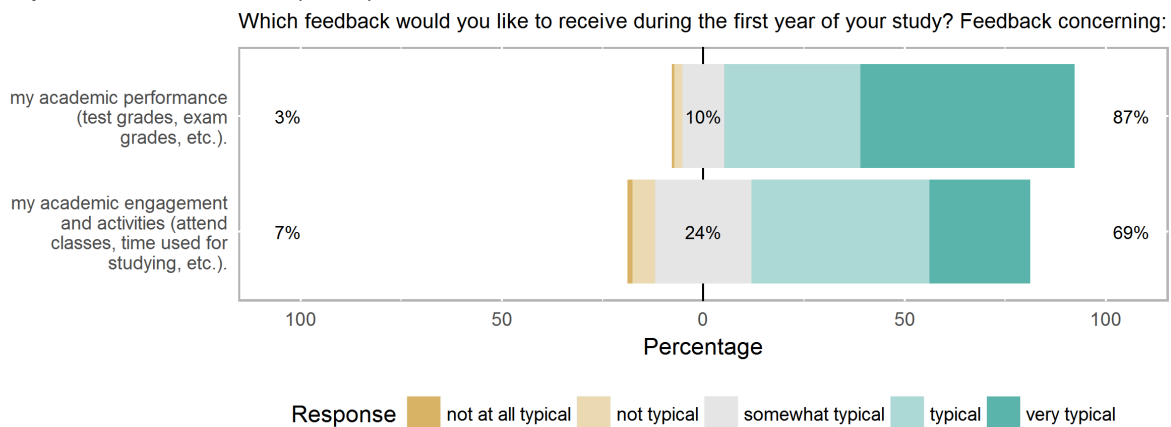

Fig. 3. Stacked boxplot for first-year student responses on expectations regarding topics of first-year feedback.
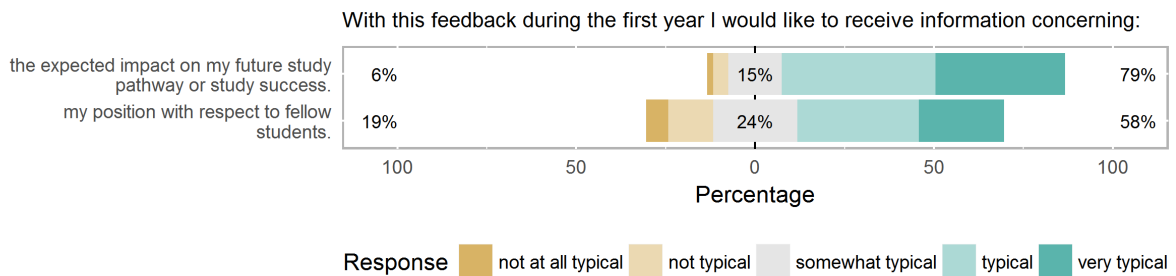

Fig. 4. Stacked boxplot for first-year student responses on expectations regarding content of first-year feedback.

When **second-year students** are asked whether they received sufficient feedback in their first year, 61% agrees for feedback regarding academic achievement, while only 38% agrees for feedback on study efforts, and even less 20% regarding feedback on academic well-being (Fig. 5).
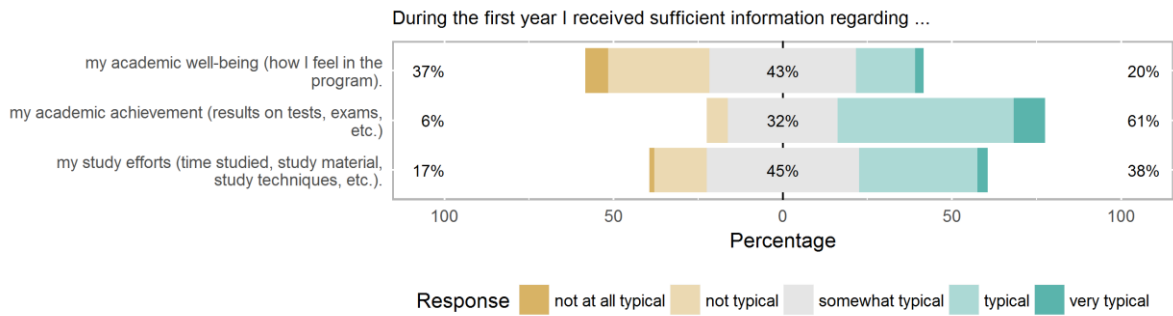
Fig. 5. Stacked boxplot for second-year student responses on experiences regarding content of first-year feedback.

When asked about the format of feedback 55% of second-year students agrees it showed the possible impact of their activities and achievements on their future study pathway way, few students (23%) agree it helped them to position themselves with respect to peer students (Fig. 6). On a positive note, students find the feedback useful (57%) and indicate that it made clear what was expected from them (54%), that it helped to make study-related decisions (44%), or even made them reflect on their studies (38%) or adapt their study behaviour (31%).
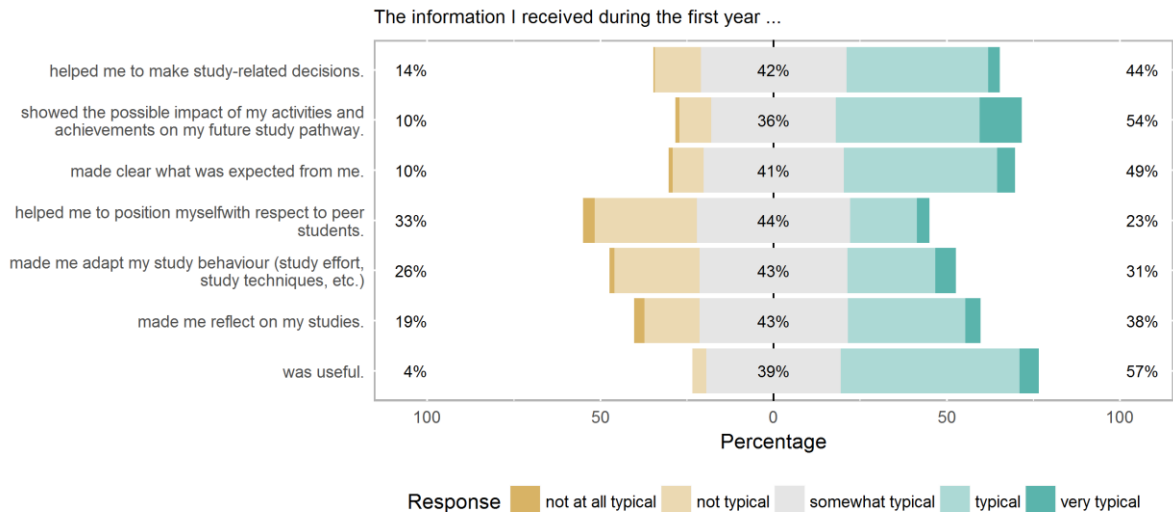

Fig. 6. Stacked boxplot for second-year student responses on experiences regarding format and effect of first-year feedback.

Discussion

A big difference exists regarding first-year student expectations on feedback and experiences of second-year students regarding the feedback they received during the first year. While 69% of the first-year students explicitly agreed they would like to receive feedback on their academic engagement only 38% of the second-year students agreed they received sufficient feedback on this topic. Similarly 79% of first-year students expect feedback on the impact on their future study pathway while 54% of second-year students agrees to have received such feedback sufficiently. Only 23% of the second-year students indicate that they could use the feedback to compare to peers (23%), but this was also believed to be less important by first-year students (58%).

4 CONCLUSION AND FUTURE WORK

The results show that starting first-year engineering students are confident regarding their success. This confidence is however higher than the observed first-year students success. Not surprisingly, the students have good intentions and believe that most academic activities are important for student success. When second-year student look back on their first year their beliefs in the importance of these activities and behaviours have strongly decreased, especially concerning the importance of preparing classes and following communication through email and the virtual learning environment. First-year students are expecting feedback regarding their academic performance and engagement. They expect that this feedback primarily focuses on the impact on their future study pathway rather than on comparison to peer students. Second-year students indicate that the amount of feedback could be improved, but agree with the first-year students that comparative feedback is less important.

With regards to future work, first of all, the results will be used to improve and shape feedback towards first-year students. Future feedback should rather focus on the impact on study pathway than on comparison to peers. Second-year students indicate the importance of academic well-being for student success. Therefore, this is another point of focus of feedback during the first-year. The results show that big differences exist between institutes, therefore feedback should always take into account the local context. As future work, the influence of gender and other background variables on the first-year experience will be studied. Finally, the obtained results will be used as a baseline measurement for studying the impact of newly designed feedback.

5 ACKNOWLEDGMENTS

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