A waste of time?

Analyses of the study time of students in (Bio)Engineering Technology

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INTRODUCTION

It seems reasonable that the more time students spend on studying, the better their grades are. Unfortunately, the results of studies which used study time as a predictor for academic achievement are inconsistent [1,2,3,4]. There seems to be a difference depending on the type of time use analysed. In general, only weak or unreliable

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relationships are found between reported self-study time and academic performance [5,6]. Class attendance, however, does seem to have positive effects on academic achievement, both on its own and combined with student characteristics such as gender, self-discipline, motivation and prior achievement (e.g. high school GPA and high school rank) [4,6,7].

Moreover, students typically display strong intentions when asked to estimate beforehand how much time they will invest in their studies. In the end, it often turns out, they study less than they intended to and even spend less time on their courses than was allocated for in the curriculum [2].

This paper therefore has two aims: 1) Gain insight into the self-reported study time of undergraduate engineering students, its relationship to academic achievement, self-reported learning strategies, and student characteristics; 2) Examine if students obtain the required study time as allocated in the curriculum, based on the amount of ECTS the students subscribed for, so as to optimize the curriculum.

1 METHOD

Undergraduate students from Bridging programmes[2] (BR) in Engineering Technology (ET) on three different campuses of KU Leuven participated in the study, as well as students from both the Bachelor's programme (BA), Master's programmes (MA) and Bridging programmes in Bioengineering Technology (BioET) at KU Leuven.

Study time can be measured in several ways, ranging from daily time logs [1,3,6] and weekly time-use diaries [2,4] to general estimates or rankings at the end of term [7,8]. Some instruments are limited to academic time use, whereas others include a range of activities from studying to hobbies, housekeeping and commuting. Though instruments with shorter time frames are generally considered to result in more reliable data, they also require more efforts to keep students motivated, especially when used during a period of several months. Expecting students to give a retrospective estimate on study time, on the other hand, has the disadvantage of aggregating data across a long period of time, thereby obscuring potential associations [4].

In the present study, time use was registered by the students using a custom online application called KronosMetis (https://kronosmetis.associatie.kuleuven.be). The application was linked to each student's individual study programme so as to only display those courses the student was actually registered for. Once every three weeks during the first term of academic year 2015-2016, and twice more during the first examination period, students were asked to fill in the number of minutes they had spent on each course over the past weeks, resulting in seven measurement periods. For each course, students made a separate estimate of class attendance, time spent working on assignments, and time spent studying. Incentives to encourage students to fill in their study time included reminders by email, on-campus opportunities to register their use of time, and periodic feedback.

[2] Bridging programmes are an abridged form of Bachelor's programme which also grant access to a Master's programme.

For the bridging students the results of these study time measurements are linked with their answers given to two questionnaires organised in the context of parallel research [9]. The first survey (i.e. Learning And Study Strategies Inventory, LASSI [10]) was part of a non-compulsory and non-binding diagnostic test, organised before enrolment in the Bridging programme (academic year 2014-2015; N=66; response rate= 25%) [9]. The LASSI consists of 77 items, which can be divided into 10 scales: information processing, selecting main ideas, test strategies, attitude, anxiety, motivation, self-testing, concentration, time management, and study aids. Students were asked to rate each item on a five-point Likert scale (1='Not at all like me' – 5='Very much like me'). A high scale score on for example motivation suggests that a student possess enough motivation to exert the required efforts to successfully complete the chosen study programme. The second questionnaire was organised at the beginning of the academic year 2015-2016 and dealt with their educational background, study behaviour, and the transition to university (N=192; response rate= 46%). Of the second questionnaire only the questions related to study time are included in this study (i.e. "*I study more than 10h/week on an average week*" and "*I process the teaching material only during the study period*"). Students rated each item on a five-point Likert scale (1='Not at all like me' – 5='Very much like me').

The collected data was combined with other information gathered through the university's student administration system (SAP), allowing to analyse the self-reported study time whilst taking into account other characteristics such as gender, academic performance, study programme, and questionnaire results.

2 RESULTS

Table 1 provides an overview of the number of students in every programme and the response rate. The three response groups are defined as 1) Non-response (i.e. students who did not fill in any measurement period); 2) Limited response (i.e. students who filled in one to four periods); and 3) Response (i.e. students who filled in five or more periods).

Response rate	Total N	Non-response	Limited response	Response
BA	105	27% (N=28)	23% (N=24)	50% (N=53)
MA	77	52% (N=40)	4% (N=3)	44% (N=34)
BR	418	55% (N=231)	35% (N=146)	10% (N=41)

Table 1. Number of respondents and response rates.

The highest response rate was obtained in the Bachelor's programmes (where 50% of the students filled in five or more periods), followed by the Master's programmes (44%). The response rate in the Bridging programmes was markedly lower (10%). For the analyses in this paper, only data from response and non-response groups was retained. Students with limited response were excluded through listwise deletion as their reported study effort only offers a partial and inconclusive account of their learning strategies.

To check whether the respondents were representative for the total population, four variables (i.e. gender, number of courses, number of enrolled ECTS, and academic achievement) were used to compare response groups (see *Table 2*). In all programmes, respondents typically had a more comprehensive study programme than

non-respondents, as evidenced by higher number of courses and ECTS. Differences in gender proportion (higher female proportion in response group compared to the profile of the total population) were present in Bachelor's ($\chi^2(1)=4.464$, $p=.035$) and Bridging programmes ($\chi^2(1)=6.571$, $p=.010$), but not in Master's programmes ($\chi^2(1)=2.730$, $p=.098$). Comparisons between academic achievement of the response group and non-respondents revealed no marked differences in Bridging nor in Master's programmes. In Bachelor's programmes, on the other hand, respondents had higher grades after the first term than non-respondents. Considering these differences between respondents and non-respondents, results are to be treated with caution.

		Courses (Count)		Enrolled ECTS (Count)		Academic achievement (%)	
		Response	Non-response	Response	Non-response	Response	Non-response
BA	Mean	14	10	57	41	62%	54%
	SD	2	6	8	25	11%	11%
	F	16.801		18.799		7.385	
	p	<.001		<.001		.008	
MA	Mean	8	4	41	29	68%	68%
	SD	3	4	15	18	12%	6%
	F	18.067		8.937		.013	
	p	<.001		.004		.909 (n.s.)	
BR	Mean	10	7	42	29	53%	48%
	SD	5	5	21	21	19%	17%
	F	10.936		11.547		2.789	
	p	.001		.001		.096 (n.s.)	

Table 2. Comparison between response and non-response group

The paragraphs below explore six research questions:

1. Are there significant differences in study time between the different types of study programmes?
2. Are there significant differences in study time through the academic year?
3. Are there significant correlations between the types of activities students spend time on, the total study time, and academic achievement?
4. Are there significant differences in study time regarding gender?
5. Are there significant correlations between self-reported questions and study time?
6. Are there significant differences between the allocated study time and the study time reported by the students?

The first five research questions intend to provide insight into the self-reported study time of undergraduate engineering students. The last question is related to the second aim of this paper: to examine if students obtain the required study time as allocated in the curriculum.

2.1 Differences between types of programmes

A between-subjects ANOVA was conducted to compare the mean study time in the different programmes. It revealed a significant difference in the mean number of hours spent per ECTS credit ($F(2,124)=5.118$, $p=.007$). T-tests for equality of means registered only a significant difference between Bachelor's ($M=22$, $SD=8$) and Master's programmes ($M=30$, $SD=13$; $t(84)=3.415$, $p=.001$). No significant differences were apparent between Bridging programmes ($M=24$, $SD=13$) and Bachelor's ($t(92)=1.019$,

p>.05) or Master's programmes (t(72)=1.884, p>.05). The results showed a higher study effort in advanced programmes as compared to initial trajectories. Students in Bridging programmes reported a study effort that was somewhere in between.

2.2 Differences through the academic year

Graphical representations of the collected data suggest a general tendency for increasing study time throughout the academic year (*Figure 1*). *Table 3* shows the average study per period and the corresponding standard deviations.

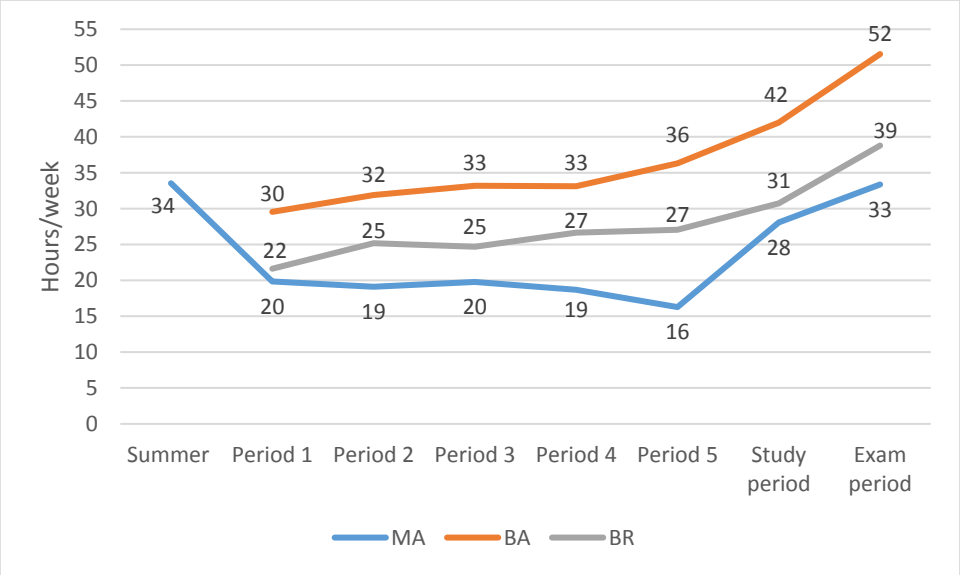

Figure 1: Average study time during the first term in different programmes.

		Summer	Period 1	Period 2	Period 3	Period 4	Period 5	Study period	Exam period
BA	M		30	32	33	33	36	42	52
	SD		10	10	11	12	16	18	19
MA	M	34	20	19	20	19	16	28	33
	SD	25	8	9	9	8	11	18	19
BR	M		22	25	25	27	27	31	39
	SD		15	18	16	16	19	18	21

Table 3: Average study time during the first term in different programmes.

In all programmes, paired comparisons of subsequent measurement periods revealed no systematic differences between the five measurement periods during which students have lectures (p>.05), indicating that the rise is moderate at best in the first months. On the other hand, comparisons did confirm differences in all programmes between the last teaching week (period 5) and the study period (MA: t(28)=3.629, p=.001) or between the study and examination period (BA: t(40)=2.906, p=.006; BR: t(27)=2.691, p=.012), indicating a higher study effort closer to the examination period.

Master's students' study time is somewhat different because they expend substantial effort in preparation of their master's thesis during the summer period, which accounts for the high total number of hours spent by students in these programmes (cfr. paragraph 2.1). When the lectures start after the summer holiday, their study time declines to a lower level (t(15)=2.191, p=.045), and from that point on shows a trend similar to the ones in the Bachelor's and Bridging programmes.

2.3 Interrelationships and predictive value of study activities

In-depth analysis offered insights into the relationships between types of study activities. In both the Bachelor's and Bridging programmes, time spent on class attendance correlated positively with time spent studying (BA: r=.376, N=53, p=.006; BR: r=.502, N=40, p=.001). In Bridging programmes, there was additionally a positive correlation between class attendance and time spent working on assignments (r=.466, N=40, p=.002) and between time spent working on assignments and time spent studying (r=.372, N=40, p=.018). There were no significant linear relationships between activities in the Master's programmes, nor between the other types of activities in the Bachelor's and Bridging programmes, and no negative correlations were detected.

The distinct activities did not correlate significantly with the grades obtained at the end of the first term, with two exceptions. In Bridging programmes time spent studying was associated with higher grades (r=.450, N=40, p=.004), and in Master's programmes the same was true for time spent working on assignments (r=.492, N=27, p=.009).

The predictive value of total study time for grades obtained after the first term was also analysed. Two measures of study time were included: the total study time reported by the student for all activities and courses (TST), and the total study time divided by the number of related ECTS credits (TSTpC). The results revealed inconsistent effects. In Bachelor's programmes, neither measure resulted in a significant correlation (TST: r=.089 N=53, p>.05; TSTpC: r=.099, N=53, p>.05;). In the Bridging programmes, TSTpC was positively correlated with the total percentage obtained by the student (r=.379, N=41, p<.001), but TST was not (TST: r=.196, N=41, p>.05). In the Master's programmes, there was also a positive correlation with total percentage, but in this case with TST (r=.400, N=32, p<.05) and not with TSTpC (r=.188, N=31, p>.05).

2.4 Gender

Table 4 contains the average study time per ECTS credit for both male and female students. Comparisons revealed no significant differences between male and female students in any of the programme types with regard to their study time per ECTS credit (BA: F(1, 51)=.025, p>.05; BR: F(1, 39)=.429, p>.05; MA: F(1, 31)=1.545, p>.05).

		Male	Female
BA	M	22	22
	SD	10	7
MA	M	33	28
	SD	15	11
BR	M	23	26
	SD	14	7

Table 4: Study time per ECTS credit

2.5 LASSI and questionnaire

Due to the limited number of bridging students that filled in one or both questionnaires as well as the measurement periods (LASSI N=8; Questionnaire N=26), the decision was made to not correlate the questionnaires to the reported study time but instead to

compare the results of the response group to those of the non-response group (LASSI N=15; Questionnaire N=58).

Table 5 shows the LASSI results of both the response and non-response group. Overall, the response group obtains higher scale scores than the non-response group. However, ANOVA analyses revealed no significant differences.

LASSI		ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST
Response	M	33.1	29.9	25.5	28.8	30.0	29.8	19.0	24.7	25.4	31.9
	SD	2.9	3.4	5.3	5.2	4.2	5.7	2.9	3.8	3.6	3.8
Non-response	M	32.9	28.5	25.4	27.3	27.3	30.0	18.5	24.9	25.0	29.5
	SD	3.7	4.7	5.3	5.7	4.7	4.0	2.6	4.9	4.2	4.6

Note. The maximum scale score is 40, except for SMI the maximum is 25. Scales: Attitude (ATT), Motivation (MOT), Time management (TMT), Anxiety (ANX), Concentration (CON), Information processing (INP), Selecting main ideas (SMI), Study aids (STA), Self-testing (SFT), Test strategies (TST).

Table 5. LASSI results

Table 6 presents the results for the questionnaire. The students of the response group agree on average more with question 1 (*"I study more than 10h/week on an average week"*) and less with question 2 (*"I process the teaching material only during the study period*").

Questionnaire		1. I study more than 10h/week on an average week	2. I process the teaching material only during the study period
Response	M	3.5	2.1
	SD	1.3	1.1
Non-response	M	2.9	2.6
	SD	1.2	1.2

Note. Scores need to be interpreted on a scale from one to five.

Table 6. Questionnaire results

ANOVA analyses showed only a significant difference between the two response groups for the question "*I study more than 10h/week on an average week.*" ($F(1,83)=4.669$, $p=.034$).

2.6 Allocated and measured time

Based on the ECTS guidelines, the study load is expected to range between on average 25 and 30 hours per credit, resulting in 750 to 900 hours for each term. In the present study, students appeared to spend less time than was expected of them in the Bachelor's programmes (BA: M=22; SD=8; $t_{25}(52)=2.552$, $p_{25}=.014$; $t_{30}(52)=6.965$, $p_{30}<.001$). The study load in the Bridging Programmes was not significantly below the 25 hour norm but did fall short of the upper limit (BR: M=24; SD=13; $t_{25}(40)=0.358$, $p_{25}>.05$; $t_{30}(40)=2.912$, $p_{30}=.006$). Students in the Master's programme, on the other hand, significantly exceeded the lower limit but not the upper limit (MA: M=30; SD=13; $t_{25}(32)=2.176$, $p_{25}=.037$; $t_{30}(32)=.043$, $p_{30}>.05$).

3 DISCUSSION

3.1 Conclusions

The results of the current study demonstrate that study time provides some interesting insights into the study habits of students, but that it is less useful as a predictor of academic achievement. Whereas previous studies have found class attendance to be a predictor of academic achievement [4,6,7], in the present study none of the distinct activities was significantly related to the grades obtained at the end of the first term, with two exceptions in specific settings. With regard to total study time, the results seem too inconsistent to provide a reliable predictor of short term academic achievement. It is still possible that a relationship exists, but it might not be a linear relationship or might only manifest itself on a different level (e.g. only on course level or in relation to certain types of modules).

Studying the relationship between different types of activities showed that students who spend more time on one type of activity are also more likely to spend more time on other activities. This suggests that learning does not imply a trade-off between different types of study activities within the limited time available, but rather that in certain circumstances one activity provides incentives for the other.

The current study also pertained to how study time evolves throughout the first term and how distinct types of programmes differ. In all programmes, students reported a relatively steady study load during the first months. Spending time on studies did, however, seem to reach a sudden higher importance when the examination drew near. Students in initial programmes invested less time in their studies than students in advanced programmes. This might be influenced by the curriculum, for example by the level of complexity and specialisation in the programme, yet also by student characteristics such as motivation and maturity levels. In line with previous studies [2], the reported study effort in Bachelor programmes was lower than the allocated study load. In Bridging and Master's programmes, on the other hand, the average students' study time seems to correspond to the assigned ECTS.

The conclusions of this study nevertheless need to be interpreted with caution as comparisons between respondents and non-respondents revealed some differences in their profile which might bias results. This is especially true for the difference with regard to academic achievement. It is possible that the most conscientious students were more willing to register their study time. The results of the questionnaire seem to provide support for this hypothesis. The differences between the response and non-response groups on the LASSI point in the same direction but did not reach significance, probably due to the small number of students. An alternative explanation is that registering their study time influenced students' study habits and indirectly the resulting grades.

3.2 Challenges with study time measurement

In-depth analysis needed to take into account 1) the amount of ECTS each individual student subscribed for, as this influences study time and might otherwise bias analyses at group level; 2) methodological effects (e.g. clearing data for students in case of

mistakenly filling in hours instead of minutes) and 3) drop-out of students throughout the study.

Different programmes adopted different approaches to motivate students to fill in their study time, with notable effects on the response rate ($\chi^2(12)=175.28$, $p<.001$). The highest and most sustained response rates (60-95%) were accomplished by allocating time during classes to fill in the application in a computer room on campus. Encouraging students by mail or during classes to register their study time at home generally only had a moderate effect (response rates 30-50%). The lowest response rates were registered in the Bridging programmes. After every measurement period, bridging students received feedback via mail about the reported study time including average hours of study, time spent on every course, and response rate. Further incentives included reminders via mail, Digital learning environment (DLE)or during classes. However, in comparison with the other study programmes the response rate was remarkably lower (6%). This might be due to the fact that a substantial number of bridging students are not new in the Bridging programme (N=160; 38%), and therefore might no longer be enrolled in the course used to communicate about the study time measurement. The high dropout rate during the Bridging programme (M=17.5%) might provide an additional explanation for the lower response rate.

3.3 Strengths and limitations

The current study offers insights in the study time of students in (Bio)Engineering Technology and its relationship to academic achievement, thereby extending existing research. The fact that students from different types of programmes registered their study time at several moments throughout the semester and for distinguished types of activities separately was a strength which allowed in-depth analysis from different perspectives.

Limitations included the drop-out of respondents throughout the study and a possible bias due to differences between respondents and non-respondents. Indeed, even though the burden for students was minimized by choosing a format where they did not have to register their study time each and every week, it remained difficult to keep students motivated. Further research on effective incentives could prove useful, both for empirical education research and for quality assurance systems in practice.

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