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Do Diligent Students Perform Better?

Complex Relations between Student and Course Characteristics, Study Time, and Academic Performance in Higher Education

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Abstract

Research has reported equivocal results regarding the relationship between study time investment and academic performance in higher education. In the setting of the active, assignment-based teaching approach at Hasselt University (Belgium), the present study aimed (a) to further clarify the role of study time in academic performance, while taking into account student characteristics (e.g., gender, prior domain knowledge), and (b) to examine the relation between a number of student and course characteristics and study time. Data included course-specific study time recordings across the entire term, grades for 14 courses, expert ratings of six course characteristics, and other data from the records of 168 freshmen in business economics. For most courses, study time predicted grades, even beyond student characteristics. However, there were differential results depending on the course considered, stressing the importance of examining relations at course-level instead of globally across courses. As to study time, course characteristics were strong predictors.

Keywords: study time, academic performance, higher education, self-regulated learning, student characteristics, learning environment.

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A growing number of institutions of higher education around the globe claim that active approaches to teaching and learning are key features of their educational strategy. Fortunately, from an educational psychologist's point of view, this shift to active teaching and learning is not just a trend in educational marketing. It is rooted, among other things, in the conviction that preparing students for lifelong learning and, therefore, developing their learning competencies is a priority for (higher) education. The worldwide call for self-regulated learning is also rooted in the widespread adoption of social constructivist conceptions of learning (e.g., Pintrich, 2004).

Building on these ideas, our university has adopted an educational approach in which students are expected to engage in active and self-regulated learning by completing self-study tasks and by participating in lectures, response sessions, and workshops. Self-study tasks are described in study itineraries and consist of reading and application assignments by which classes are to be prepared or further elaborated and processed. Throughout the degree program self-study assignments gradually become more complex, while the guidance provided by teaching staff becomes less detailed, less directive and more open-ended. In sum, the educational approach adopted emphasizes the active role of students in learning, and as a consequence, relies on students' time allocations to self-study assignments and class attendance. In this context, the need has been felt for a model that clarifies the role of students' study time (ST) investment, and its interplay with other variables, in learning processes and results. Moreover, in spite of different measures, since the recent introduction of a credit system[1] in higher education in Flanders, the number of students of business economics at Hasselt University repeating one or more bachelor courses has grown from 41% in the academic year 2006-2007 to 56% in the academic year 2010-2011. In this context it has become even more important to monitor and stimulate the amount of time that students invest in their study.

An additional reason for focusing on the role of ST in academic performance in higher education lies in the available research findings. Although the assumption that higher effort results in higher grades is intuitively appealing, the available research findings have been equivocal: Whereas some studies reported a significant, positive association between ST and academic performance (e.g., Brint & Cantwell, 2010; Gortner Lahmers & Zulauf, 2000; Hofman & van den Berg, 2000; Masui & Peters, 2004; Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008), others did not (Diseth, 2007; Kember, Jamieson, Pomfret & Wong, 1995; Kolari, Savander-Ranne, & Viskari, 2008; Okpala, Okpala & Ellis, 2000; van den Hurk, Wolfhagen, Dolmans & van der Vleuten, 1998; Zuriff, 2003). These findings call for a further understanding of the role of ST in academic performance and of factors that may have contributed to these inconsistencies.

Study time and academic performance in higher education: factors that may explain equivocal findings

Research evaluating the relation between ST and academic performance in higher education has been conducted in many different discipline areas (e.g., sociology; Rau & Durand, 2000; agricultural economics; Gortner Lahmers & Zulauf, 2000), with various operationalizations of academic performance and –especially– of ST, and after controlling to a varied extent for other relevant variables such as high school grade point average (GPA) and gender. Each of these factors may have contributed to inconsistent findings.

Along with the various discipline areas involved come *differences between colleges and faculties* with respect to required pre-entry qualifications (Arum & Roksa, 2011, p. 70; Rau &

Durand, 2000), curriculum organisation (e.g., Jansen, 2004), and educational approaches (e.g., problem-based versus case instruction method; Admiraal, Wubbels, & Pilot, 1999).

Moreover, the *operationalizations of ST* have often been criticized and emphasized as one of the factors contributing to a low or non-significant association between ST and academic performance (e.g., Stinebrickner & Stinebrickner, 2004). Some studies have measured ST by asking students to provide a global estimation of the time invested in studying (in general or for a specific course) during a (typical) term week (e.g., Diseth, Pallesen, Brunborg, & Larsen, 2010; Rau & Durand, 2000; Torenbeek, Jansen, & Hofman, 2010). This retrospective estimation may be quite sensitive to arbitrary answers, especially if students are required to aggregate across longer time periods (Stinebrickner & Stinebrickner, 2004; Zuriff, 2003). Also, there are risks of over- and underestimation linked to variables such as study motivation and emotional attachment to the study choice made. In other studies, students have been requested to record their ST continuously. Whereas this operationalization may provide more accurate estimations than retrospective estimation, this type of assessment usually spans not more than one week (e.g., George, Dixon, Stansal, Lund Gelb, & Pheri, 2008; Plant, Ericsson, Hill, & Asberg, 2005). Its representativeness for the entire term or academic year is therefore questionable (Dickinson & O’Connell, 1990; Stinebrickner & Stinebrickner, 2004). Another variation across operationalizations concerns what exactly is considered as “studying”. In some cases ST included time spent in class (e.g., Diseth et al., 2010), whereas in other cases it did not (e.g., Okpala et al., 2000; Stinebrickner & Stinebrickner, 2004). In addition, some studies have avoided the registration of ST in specific periods of the academic year, such as the first weeks of a term and exam periods (e.g., Dollinger, Matyja & Huber, 2008; Nonis, Philhours, & Hudson, 2006). This choice is justifiable as these specific periods are not representative for the rest of the term. On the other hand, these are specific moments in time and fluctuations in study efforts throughout the term could be relevant. In sum, the various operationalizations of ST and their limitations may have contributed to equivocal results regarding the relation between ST and academic performance.

Another factor contributing to equivocal findings may be the study's underlying rationale, resulting in different *operationalizations of academic performance*. A first line of research has emphasized the link between the general study approach of a student, which is assumed to apply to all courses, and academic performance (cf. Pintrich, 2004). The idea is that the more students study in general (irrespective of the courses at hand), the higher their academic performance will be. This has resulted in operationalizations of academic performance in terms of global measures (such as GPA or number of credits obtained throughout the academic year; e.g., Plant et al., 2005; Torenbeek et al., 2010). Inconsistent findings have also been reported within this line of research. Whereas numerous studies have documented a positive association with ST (e.g., Brint & Cantwell, 2010; George et al., 2008; Jereb, Ferjan, & Jesenko, 2009; Kuh et al., 2008; Gortner Lahmers & Zulauf, 2000; Michaels & Miethe, 1989; Plant et al., 2005; Rau & Durand, 2000; Stinebrickner & Stinebrickner, 2004; Torenbeek et al., 2010), other studies have reported no association at all (e.g., Gortner & Zulauf, 2000; Kember et al., 1995). Moreover, statistically significant associations were generally weak. A critique on these studies is, however, that GPA, or a similar global measure of academic performance, is likely to miss important differences between courses with respect to obtained grades and assessment practices (Svanum & Bigatti, 2006), quantity and quality of study activities, features of the learning environment, and interplays between these factors. This risk is even stronger when ST is measured by means of continuous records during a brief time period (e.g., George et al., 2008; Plant et al., 2005).

These studies rely heavily on the idea of a general study approach, in that they assume that the ST recorded is not only representative for the remainder of the term or academic year but also for all courses involved. Support for the position that global measures of academic performance may mask important course-related differences has come from studies including course grades as the outcome variable. This line of research focuses on identifying factors that may explain students' grades for specific courses. Whereas some studies found that ST did not predict course grade (e.g., Delucchi, Rohwer, & Thomas, 1987; Diseth, 2007; Okpala et al., 2000; Study 2 of Schuman, Walsh, Olson, & Etheridge, 1985; Zuriff, 2003), other studies did find such a relation, even when controlling for a number of other predictor variables (e.g., Diseth et al., 2010; Svanum & Bigatti, 2006). These results suggest that the relation between ST and academic performance may be sample and/or context specific, which implies that the importance of ST for academic performance may vary across courses. For some courses, more ST per credit point may be required to master the subject. For other courses, a critical factor for success may be, for example, prior domain knowledge. Hence, depending on the course(s) under study, a statistically significant association may or may not be found.

An additional reason for inconsistent results may be that some of the studies, in which no association between ST and academic performance was found, have not statistically corrected for other relevant predictors of academic performance, such as general abilities and gender (e.g., Delucchi et al., 1987; van den Hurk et al., 1998; Zuriff, 2003). These *omitted variables* may have acted as nuisance parameters and may have attenuated the relation between ST and academic performance (cf. Plant et al., 2005).

The present study

The general aim of the present study is to examine the role of ST for academic performance in higher education, while taking some of these critiques, as far as practically possible, into account. Moreover, the current study aims to go one step further than most research in this domain: If there is a relation between ST and grades, then which characteristics of the student and of the learning environment predict time investment?

Aim 1: The unique role of study time in academic performance beyond student characteristics. To assess ST investment as accurately and completely as possible, students recorded their ST throughout the term at least weekly. ST included both class attendance and time spent studying outside of class. This operationalization of ST is expected to maximize the relation between ST and academic performance. Moreover, ST and academic performance were operationalized at course-level. All fourteen first-year courses of business economics at Hasselt University were included. These courses are compulsory for all students. Eight of these courses are 4 pairs of partial courses, i.e., major courses taught across two terms for which the final grade depends on students' performance on separate exams after each term. This research design provided us with the opportunity to compare the predictive value of ST across courses. Furthermore, the interrelation between ST and academic performance was examined after taking a number of relevant student characteristics into account. Consistent with the work of Biggs (2001) and Plant et al. (2005), primarily intellective, educational student characteristics were selected (i.e., students' cognitive abilities, reading skills, and prior domain knowledge) because of their substantive predictive value for students' academic performance (e.g., Credé & Kuncel, 2008; Dochy, Segers, & Buehl, 1999; George et al., 2008; Van den Berg & Hofman, 2005) and their plausible implications for students' time investment (see further). More knowledgeable students were expected to have a higher probability of passing the first year of university studies, because of their previously acquired knowledge and skills, and/or because they may have more favourable academic self-beliefs (Hailikari, Nevgi, & Komulainen, 2008; Diseth, 2011). Prior study delay, i.e., having had to repeat one or more years in primary or secondary education, was included because it may result from a lower proficiency, lower motivation and/or less invested effort. Furthermore, prior study delay may lead to lower academic self-beliefs and/or less emotional and behavioural engagement (Martin, 2009). These factors may negatively affect academic performance. Finally, gender was selected, because women have been shown repeatedly to perform better than men (Barrow, Reilly, & Woodfield, 2009; Bruinsma & Jansen, 2009).

Aim 2: In search for factors predicting study time investment. As argued by many scholars, students' time is limited (e.g., Schmidt et al., 2009; Svanum & Bigatti, 2006), which makes the allocation of ST across concurrent courses crucial (cf. van der Drift and Vos, 1987). Both student and course characteristics may guide this allocation process. The second major aim of the present study was to evaluate the predictive value of a number of selected student and course characteristics.

Student characteristics. We aimed to evaluate whether the student characteristics described above also predict ST investment. We expected that more knowledgeable students (i.e., students demonstrating higher cognitive ability and reading skills at university entry and students with more prior domain knowledge) need to invest less ST to master a subject (Plant et al., 2005). Students with more prior domain knowledge, for example, may not only have more content-related knowledge, but also may have developed more efficient study strategies, both of which may reduce the ST required. Prior study delay was expected to negatively affect ST, primarily because it may be due to and result in a lower motivation and/or less effort. Based on the available literature, women were expected to be more diligent in their study work (Brint & Cantwell, 2010; Jereb et al., 2009; Howard, 2005; Masui & Peters, 2004). Additionally, for partial courses, the previous result for a course was expected to predict the efforts for a subsequent exam of the same course. More specifically, consistently with the work of Krohn and O'Connor (2005), we hypothesized that students with higher grades on the first end-of-term exam subsequently invest less time studying the remainder of the course.

Course characteristics. Similar to some lines of research regarding study progress or academic performance in higher education, such as educational effectiveness research (e.g., Van den Berg & Hofman, 2005) and research including students' perceptions of the learning environment in the prediction of performance (e.g., Diseth, 2007; Diseth et al., 2010), the amount of ST was expected to be related to characteristics of the course. A first set of course characteristics is related to course assessment. Included were the final or "partial" status of the end of the term evaluation and the transparency of the assessment method. Because students may economize on ST (i.e., obtain the largest exchange value for the smallest investment of time; Labaree in Arum & Roksa, 2011, p. 16; see also Krohn & O'Connor, 2005), it was expected that ST was less for partial exams than for final exams (cf. Van den Berg & Hofman, 2005). The transparency of the assessment in terms of content coverage and format of the exam questions was hypothesized to negatively affect ST, because more transparency may lead to more efficient time use. Next to these measures, variables related to the a priori expected quantity and quality of learning activities were selected. Practical experiences have suggested that for courses with a larger credit point load, students spend relatively less ST. To examine this hypothesis, credit point load was included in our model. Furthermore, characteristics of course-specific assignments for self-study may also be of importance to students' ST investment. More specifically, it was expected that ST increases (a) as assignments become more directive and hence more detailed with respect to the type of learning activity that students are expected to engage in, and (b) as the cognitive level of the learning activities suggested increases. Finally, a higher (perceived) difficulty of the course was also expected to increase ST.

In sum, the second aim of the study was to evaluate the contribution of several student and course characteristics in the prediction of ST.

Method

Participants

Participants were 168 (104 men and 64 women) of 196 freshmen of the Faculty of Business Economics at Hasselt University, Belgium. Twenty-eight students were excluded because they either dropped out from the degree program (*n* = 12) or because they did not systematically record their ST (*n* = 16). In Belgium, for most degree programs, a high school diploma is sufficient to start university education. Students were, thus, unselected with respect to high school GPA. Participants were on average 18.11 years old, with a range of 17 to 20. Ten percent were ethnic minority students. Eleven percent had incurred study delay before entering higher education. Most students had completed an economics option in high school (65%) and had had at least 6 hours of mathematics per week in the final years of high school (81.5%).

To avoid extensive workload for the students – ST registration also costs time – the sample was randomly divided into three groups. Each group recorded their ST for all courses during one term. The three groups contained 62, 52, and 54 students, respectively. The latter two groups were somewhat smaller than the first group, primarily due to student drop out from the degree program after the first term (see above). Comparison of the three groups by means of one-way ANOVAs or chi-square tests revealed no systematic differences with respect to gender, age/prior study delay, cognitive abilities, and prior domain knowledge in economics and mathematics.

ST was recorded for 14 courses (i.e., 5, 4, and 5 courses per term, respectively; see Table 1). This study design resulted in 15 different datasets: 14 datasets for the 14 courses, varying from 49 to 62 cases, and 1 dataset for the entire academic year with 786 cases (multiple ratings of ST per student included). Only few ST data were missing: In the third term, one student followed only 3 of the 5 courses. Sample sizes per course, however, may be smaller than those for the term, because not all students following a course (and supplying ST data for it), wrote the exam[2], and/or because student characteristics occasionally were not available.

Measures

Study time. The ST data were collected using the web-based tool RESET (REgistration of Study time Electronic Tool). This instrument has been developed at our university within the framework of quality control (Masui et al., 2005; Peters, Saenen, & Masui, 2007) and is used to inform curriculum boards, teaching staff, and students on the ST invested per course. With this tool[3], each student recorded throughout the term at least once a week the time (in minutes) spent on the different types of classes and self-study activities. Submitting these ST records was compulsory for students: It was a condition for obtaining credits for one of the first-year courses. ST registration was monitored by a student counsellor. Reminders were sent to students who did not submit weekly. The ST recorded for each course closely adhered to the workload reported by students and staff in formal course evaluations, which supports the validity of our measurement. Moreover, in an evaluation of the instrument with 148 students, only 5% reported that the ST data supplied were not in agreement with their actual invested ST (Masui et al., 2005). As noted above, each student rated his/her ST for all courses within a term. Because some courses had different credit point loads, the relative ST was included in all analyses, i.e., the ratio of the actual ST in minutes and the ST "budget" allocated in the curricula (the number of credit points * 27 hours "expected workload" * 60 minutes). This ratio indicates whether the actual total ST invested by a student for the course concerned is less than (ST < 1) or more than budgeted (ST > 1).

Grades. Grades were the end of term marks for each course, as retrieved from the academic records.

Student characteristics. Gender, prior study delay, and prior domain knowledge (in this case with respect to economics and mathematics) were retrieved from the administrative records. Items in the registration forms included, besides gender and year of birth, the option followed in the final years of secondary school (some of which included economics, whereas others did not), and the number of weekly hours of mathematics classes in the final years of secondary school. Students' age was used as an indicator of study delay incurred before entering university.

The "previous result" on the first end-of-term exam for the 4 pairs of partial courses was available in the academic records. Moreover, all first-year students had completed two cognitive ability tests at university entry, i.e., an intelligence test and a reading skills test. The intelligence test applied was the AH56-L (Minnaert & Janssen, 1999). This test is an adaptation and a translation to Dutch of the group test for highly intelligent persons developed by Heim, Watts, and Simmonds (1982). It consists of a verbal, a numeric, and a graphic part. Subscores were added up to an overall score. The AH56-L has been reported to have an internal consistency coefficient of .78 (N = 592). Its predictive validity with respect to freshmen's overall academic performance has been established in several samples (R^2=.12 to.16; e.g., Masui, 2002, p. 197; Minnaert & Janssen, 1999). Reading skills were measured by means of three subtests of the

Diagnostic Test of Reading Skills for Economics developed by Hacquebord and De Vos (2002). Besides a vocabulary test with 75 items, two silent reading texts were selected. One dealt with a general topic, the other one with an economic topic. Students completed multiple choice questions about these texts. The different subtests of the reading test have been reported to have an internal consistency between .85 and .90 (N = 101; Hacquebord & van der Westen, 2010). An overall score was calculated.

Course characteristics. Data on credit point load and final or partial status of the end of the term exam were retrieved from course and curriculum outlines. Data on the transparency of the assessment, the level of directivity of self-study assignments as to the type of learning activity, and the cognitive level of learning activities expected consisted of expert judgments of these aspects of the learning environment, based on the written information provided in the study itineraries for each of the 14 courses. One of the authors scored each course for each of these variables on 5-point scales. Intraclass correlation coefficients of these expert evaluations with ratings of all courses by another author ranged between .69 and .80 (good to excellent; Cicchetti et al., 2006; Cicchetti & Sparrow, 1981). As to the cognitive level of learning activities the scale was based on the taxonomy of Romiszwoski (1993). The meaning of the scores ranged from a focus on knowledge and comprehension to a focus on productive cognitive skills. The scales for the level of directivity of assignments and for the transparency of assessment were Likert type scales, with the score of 1 representing the lowest levels of directivity and transparency, respectively. Although the degree of difficulty of a course is in principle a subjective variable, an objective measure was used, i.e. the proportion of students failing the exam in the preceding academic year. For this measure, the preceding academic year was selected, because these were the data that freshmen could be assumed to be aware of. Course characteristics per course are presented in the left side of Table 1.

Statistical Analyses

For each of the two research questions, analyses were performed at two levels: per course and across courses. For the analyses per course, regression analyses with backward procedure were applied. For the analyses across courses (i.e., across the entire academic year), the correlation corrected regression analysis technique described by Verbeke and Molenberghs (2000) was applied. This technique belongs to the class of linear mixed models (or multilevel models) and enables the investigator to take the nesting of measurements within students into account. Students' ST registrations for different courses are not independent: Recordings of a particular student may be more similar than recordings from different students. This correlation among ST recordings by the same student is accounted for by correlation corrected regression. Because the dataset contained a large number of cases per student, there were many nuisance parameters in the covariance matrix, which caused convergence and variability problems. To overcome these, the compound symmetry covariance structure was applied. This covariance structure implies constant variance and an equal positive correlation between the ST recordings by the same student for any pair of courses. Additionally, the empirical option was used as the fixed effects standard estimation method. This technique corrects the corresponding inference (such as standard errors, F tests, and p-values), even if the covariance structure is not correct.

Results

Preliminary Analyses

Per course, the average invested ST and grade were calculated, as well as their correlation (right side of Table 1). Consistent with our expectations, differences were found between the courses in both respects. For most courses, mean ST is lower than the ST budgeted (i.e., below 1; range = 0.64 - 1.07; *Mdn* = .82). For Financial Accounting 1, for example, students use on average only 73% of the budgeted time. This finding is consistent with research by Arum and Roksa (2011, p. 97), which indicated that students spend relatively few time studying. The mean grade for most courses was above the passing level (i.e., above 10/20; range = 7.31 – 12.69; *Mdn* = 10.89). For four courses no statistically significant correlation between ST and grades was obtained. For the remaining ten courses, the correlation was low to moderate (Cohen, 1988, p. 79-80). In 1 of these 10 courses, the correlation between ST and grades reaches only borderline significance ($p < .10$).

Aim 1: The unique role of study time in academic performance beyond student characteristics

Analyses per course

First, the predictive value of ST was examined per course after taking other student variables into account. As is shown in Table 2, ST predicts exam results for nine of the 14 courses ($p < .10$). This is strong evidence that, in addition to prior abilities and other student characteristics, the amount of time spent studying matters to achievement. Overall, the impact of ST on grades seems to be strongest in the first and the third term, which may be explained by the features of the courses offered in different terms. Although this finding may also be explained by differences between the groups of students included each term, this is not very likely because a) students were randomly assigned to a group and b) the groups did not differ significantly on the variables studied (cf. supra). Additional support for our assumption that course characteristics matter is that even within the same group of students the importance of ST for academic performance relative to other student characteristics varied. This relation seems, for example, stronger if the first or only assessment for the course is at stake. Students who have good results at the first exam probably limit the ST invested in the second part, but still obtain relatively good results for the second exam. Students who have poor results for the first exam probably invest more ST in the second part and may improve their mark at the second exam, but then still only reach moderate grades.

Regarding the other student factors, the following conclusions can be drawn:

- After taking other student factors into account, gender only matters in an inconsistent way for two out of 14 courses, indicating that factors beyond gender (such as ST) are more important to academic achievement.
- The effect of prior study delay, when it is statistically significant, is consistently negative. Taking longer to get through the school system is inversely related to academic achievement at university.
- The effect of prior knowledge of economics is statistically significant for five courses. For two courses in term 3, prior knowledge of economics positively affects exam performance. On the other hand, for three first-term courses, having completed an economics option is a disadvantage. Especially the negative relation between prior knowledge in economics and achievement in Global Economics & Economic History is of note. Because, in term 1, students have not yet received feedback in terms of grades, a plausible reason for this finding may be that students overestimated their knowledge of economics in this domain. This may be due to the fact that the topics dealt with in Global Economics & Economic History do not receive much coverage in high school courses of economics.

- In contrast, prior knowledge of mathematics is positively related to achievement for seven of the 14 courses. This finding underscores the importance of pre-university mathematics instruction for students who wish to go into business studies.
- The intelligence test score is positively related to six out of 14 courses. This test score is especially predictive of exam performance for quantitatively oriented courses (vs. more text-based courses).
- Reading skills are clearly important for the text-based course Sociology & Demography, whereas it is inversely related to performance on Mathematics 2 and Statistics. These findings suggest that reading and math ability are independent of each other or even opposite to each other.

It should be kept in mind that these findings were obtained after taking other student factors into account.

In sum, for most courses, more ST predicts better grades, even after taking relevant student characteristics into account. Other significant predictors of grades are study delay incurred before entering university, prior knowledge of mathematics, and intelligence test scores. The other student characteristics, i.e., prior knowledge of economics, gender, and reading skills play a role only occasionally and inconsistently. For most courses where ST is not a significant predictor, a strong background in mathematics and/or a high score on the intelligence test is of importance.

Insert Table 2 about here

Analysis across courses

Second, analyses were performed including all courses across the academic year. Because in the analyses per course, ST in most cases was a significant predictor of exam performance after taking student characteristics into account, an association with academic performance was also expected in this “overall” analysis. The correlation corrected regression analysis shows that ST and three student characteristics significantly predict grades. Better grades are obtained by students who invest more ST ($F(1,567) = 8.86$, $p = .003$), by students without a study delay before entering university; $F(1,149) = 14.55$, $p < .001$), by students with a stronger background in mathematics ($F(1,148) = 7.20$, $p = .008$), and by students with higher scores on the intelligence test ($F(1,149) = 5.51$, $p = .020$). Gender has a borderline significant effect ($F(1,149) = 3.22$, $p = .075$): Overall, women tend to perform better than men.

Aim 2: In search for factors predicting study time investment

Analyses per course

Regarding our second research question, the multiple regression analyses per course show the following results (Table 3). As expected, women are more diligent, but only for 4 courses. Prior study delay is inversely related to ST investment for two courses. Prior domain knowledge in economic and mathematics, intelligence test scores, and the reading skills test score are also predictors of ST for a number of courses. Overall, ST does not appear to depend strongly on (intellective) student characteristics, especially at the start of the academic year. In that period, in contrast, student characteristics do have a strong effect on grades.

It is noteworthy that the interrelation of the intellective, educational factors may be positive or negative, depending on the course. These mixed findings may be due to two contrasting psychological mechanisms: Whereas more knowledgeable students may *need* to invest less ST to master a subject (Plant et al., 2005), they may *want* to invest more time because they enjoy the rewards of mastery so much. Support for this position was obtained by Arum and Roksa (2011, p.70) who reported that students in the top quintile for a standardised school achievement measure spent more time on their college homework than students in the bottom quintile. Which mechanism is predominant may depend on factors such as the type of content, the prerequisite knowledge and skills, the required learning activities, and the preferences and perceptions of students in these respects.

This can be illustrated with the following examples. Reading skills are positively related to grades for Research Methodology & Psychology 1. For Management Information Systems, this association is also significant, but negative. This difference may be due to the different levels of text processing requested for both courses. Compared to students with poorer reading skills, students with better reading skills may engage more in the deep level processing requested for Research Methodology & Psychology 1 on the one hand side and may need less time for the (relatively more) surface text processing requested for Management Information Systems on the other hand side. Also the type of learning activity requested for Research Methodology & Psychology 1 may call on the preferences of students with stronger reading skills. Similarly, students coming from an option with economics in secondary school may invest less ST in Macro-economics 2 because they feel they are already familiar with various topics covered by the course and because it concerns the second part of a course for which the average end-of-term exam grade for the first part was rather good (see Table 1). For Statistics on the other hand, which is considered to be one of the most difficult courses in the first-year curriculum, there is only one assessment. As a result, these students seem to feel the need to increase their efforts.

Finally, previous results predict ST only for Financial Accounting 2. Contrary to expectation, a higher previous result appears to give a “boost” to the ST invested. This finding may indicate that students with better grades want to invest more time because they enjoy the rewards of mastery. On the other hand, it may also be related to the fact that, overall, grades for

Financial Accounting 1 were low, which makes an increase in ST necessary, especially for students who nearly passed the first exam.

Insert Table 3 about here

Analysis across courses

Unlike in the multiple regression analyses per course, differences between courses could be included in the correlation corrected regression analysis across the entire academic year. A somewhat different pattern of results is obtained. Two student characteristics and three course characteristics significantly predict ST. More ST is not only invested by women ($F(1, 150) = 11.39$, $p < .001$), but there is also a trend that students without prior study delay work harder ($F(1,150) = 3.77$, $p = .054$). Moreover, the higher the credit point load of a course, the lower the ST per course credit ($F(1,574) = 43.66$, $p < .001$). The higher the (perceived) difficulty of a course, the more ST devoted to the course ($F(1,574) = 50.75$, $p < .001$). Finally, the more assignments are directive with respect to the type of learning activity that students are expected to engage in, the higher the amount of ST students invest ($F(1,574) = 87.02$, $p < .001$).

Discussion

The current study aimed to contribute to the literature on the relation between ST and academic performance (a) by further examining the unique role of ST in the prediction of course grades, beyond relevant student characteristics, and (b) by evaluating the predictive role of student and course characteristics in ST investment.

Our research design aimed to take into account some of the factors that may have contributed to inconsistent associations between ST and academic performance reported in the literature, i.e., the operationalization of ST and academic performance, and the omission of control variables. In previous research, ST usually was operationalized in two ways: by means of a retrospective question at the end of the term or by keeping a detailed record of ST for a short period of time. Both approaches have been criticized either because they expect students to give a retrospective estimation of ST while aggregating across a large period of time or because they assume that data continuously recorded during a short period of time are representative for the entire term. Moreover, some studies incorporated time attending lectures in their measure of ST, whereas other studies did not. In addition, in some cases, parts of the academic year were avoided for ST registration. All of these features of ST measurement may have attenuated the association between ST and academic performance. The current study aimed to rule out this plausible explanation for inconsistent findings by having students record course-specific ST throughout the term at least weekly, including all weeks of the term and incorporating time spent attending classes.

Moreover, in order to examine our primary hypothesis that the predictive value of ST may vary across courses, academic performance was operationalized at course level rather than globally across the academic year. In addition, the unique predictive value of ST for course-specific grades was evaluated after the effect of relevant student characteristics was accounted for (e.g., prior domain knowledge, prior study delay). Results supported our hypothesis: For the majority of courses, more ST predicts higher grades, even after taking prior abilities, study delay, and gender into account. These findings demonstrate that students' activities and effort matter in higher education, and that university is not just a mechanism to sort students based on pre-entry characteristics (such as prior abilities; cf. Arum & Roksa, 2011, p. 91-92). Given that students' ST has been shown to decline substantially since the 1960s (Babcock & Marks, 2011), it is of vital importance to inform students about this.

However, our findings also show differences between courses. For 5 courses, ST is not related to performance, which emphasizes the importance of examining relations at course-level. Besides ST, especially prior knowledge of mathematics, prior study delay, and intelligence test scores are predictive of grades in the first year of business economics. The role of reading skills and prior domain knowledge in economics, on the other hand, seems to depend on their match or mismatch with course requirements. Contrary to expectation, no convincing evidence was found that women performed better than men.

In the second research question, we examined whether ST investment was associated with student and course characteristics. In general, the best, consistent predictors of ST across analyses are gender and prior study delay: Women and students without prior study delay work harder. As compared to men, women are more committed (i.e., get involved rather than disengage; Sheard, 2009) and more open to experience (Farsides & Woodfield, 2007). They also invest less time in hobbies (work in progress) and probably also in part-time jobs. Each of these characteristics may increase the amount of ST invested. More openness to experience, for example, implies more proactive seeking and appreciation of experience for its own sake and more tolerance and exploration of the unfamiliar (Diseth, 2003). This personality trait relates positively to deep processing (Diseth, 2003) and may therefore foster ST investment in women. These hypothesized mechanisms call for further understanding, as are the processes assumed to underlie the effect of prior study delay on ST and grades (e.g., lower motivation).

It is worthwhile mentioning that more knowledgeable students do not necessarily invest less ST. For some courses, strong intellective characteristics may enable students to cope with the learning activities required without spending too much ST or may give them the self-confidence to do so. For other courses, these intellective characteristics may qualify students to fully engage in the type of learning activity required or to make them eager to master the subject so that they invest more ST. Also these variables may be linked to students preferences as to type of content and/or learning activity which in turn may or may not be matched by the course.

Contrary to expectation, we did not find support for our assumption that students economize on ST in case of partial courses. However, this hypothesis, which was based on the available literature and on extensive counseling experience with freshmen, should not be merely discarded. This mechanism may still play a role, but may have been difficult to detect in our study because of the rather small sample and/or because its effect may be intertwined with the effect of other factors (such as prior knowledge).

Our findings suggest that it is quite well possible to influence the ST invested by students by means of features of the learning environment. This applies especially to first term courses. For these courses, ST is not too dependent on student variables such as general abilities and prior knowledge, while it has a considerable impact on academic performance. It could be recommended, therefore, to explore possibilities of stimulating study efforts from the start of the academic year onwards. Three features of the learning environment were related to differences in ST across courses: Directivity of assignments with respect to the type of learning activities involved and the course's reputation regarding its difficulty increase ST, whereas for courses with a higher credit point load relatively less ST is invested. In practice, especially the directivity of self-study assignments with respect to required learning activities may provide an instrument to enhance ST investment: When presented with more specific assignments, students invest more time in the course at hand. This finding is consistent with the argument that the capacity for self-regulation only gradually emerges (Admiraal et al., 1999) and that first-year students need to be introduced in self-regulatory skills (Kolari et al., 2008; van der Meer, Jansen, & Torenbeek, 2010). Moreover, this finding underscores the value of study itineraries in guiding students through this process.

Also, attention should be paid to the finding that students may economize on ST if they feel already familiar with the course-content or if the type of content or learning activity does not match with their preferences. Pointing out differences in level of mastery required at secondary school level and at university may help to overcome the former effect. Application of diverse assessment methods across courses and differentiation in the learning activities suggested in the “itineraries” (i.e., offering alternative learning routes for students with different profiles) may help to deal with the latter effect.

Limitations and suggestions for further research

Although our findings emphasize the importance of a number of the student and course characteristics for the prediction of ST invested and/or grades, the focus was on characteristics that were present before the actual educational and learning processes started. Further research including factors such as students’ experience of the learning environment (e.g., Diseth, 2007) and qualitative aspects of the actual learning process involved (e.g., Diseth et al., 2010) is needed to further identify predictors of ST and/or to clarify the role of ST for academic performance in this complex set of interrelated factors. Regarding the qualitative aspects of learning processes, metacognitive, self-regulative aspects such as time management and monitoring one’s comprehension of a particular course may be included (e.g. van den Hurk, 2006), as well as depth-of-processing (Diseth et al., 2010) and cognitive and affective-motivational learning processes (e.g., motivation, self-efficacy, volition; Credé & Kuncel, 2008; Masui & Decorte, 2005; Vermunt, 2005). Students with more self-regulation are, for example, likely to spend less time studying, because they know that they will have done enough to get the grade they want and therefore switch to something else.

When analyzing the impact of these factors, attention should be paid to interaction effects. Research by Vollmeyer and Rheinberg (2006), for instance, has shown that motivation is an important predictor of the persistence of study efforts, but this effect is moderated by students' prior knowledge. Highly motivated students with less prior knowledge were more persistent in their study efforts than highly motivated learners with more prior knowledge. In addition, in the current study, there were differences between courses as to which combinations of student characteristics had an influence on ST and grades, and also as to the direction of the relationships (see, for example, the results regarding reading skills in the prediction of ST). Examination of interaction effects with characteristics of the learning environment and characteristics of students may further clarify these relationships. As noted above, these effects may relate to (mis)matches between the type of content, the prerequisite knowledge and skills, and the required learning activities on the one hand side and students' general abilities and preferences on the other hand side. Additional research needs to further clarify the role of these interactive effects in the prediction of ST and/or grades. This further research may also include additional course characteristics, such as the perceived relevance of a course to the curriculum.

A methodological issue is the compulsory nature of our ST registration. Voluntary participation may lead to more accurate ST reports, but suffers from lack of representativeness. Still, as discussed in the Method section, there are strong indications for the validity of our ST data. The ST recorded for each course was consistent with workload reported by students and staff in formal course evaluations. Moreover, only a limited number of students reported that the ST data supplied were not in agreement with their actual invested ST (Masui et al., 2005).

Another methodological issue was that age was used as an indicator of prior study delay. Although we attributed prior study delay to a lower proficiency, lower motivation and/or less invested effort, alternative reasons may also apply (e.g., ethnic minority students may have been retained because they may have a lower proficiency in Dutch, which is the school language, but not their native tongue). Future research may include the reasons why students are older/study delayed at university entry.

An additional remark from a theoretical point of view concerns the dependent variable used in this study, i.e., the end of term marks per course. It is not evident that the assessment formats actually in use do measure types of learning results that are preferred from a social-constructivist viewpoint. Since neither changing actual assessment practices, nor developing more adequate measures of learning results present a manageable solution in the short run, it is recommended to include relevant features of the assessment procedures as confounding variables in future analyses. Finally, to further strengthen the validity of our conclusions, replication in other settings implying a larger sample and other learning environments remains necessary. In a larger sample, model testing by means of structural equation modeling can be applied.

In spite of these limitations, the present study showed that academic performance in higher education is not predetermined by “traits”. It is influenced to a large degree by at least one controllable variable, i.e. study time. This, in turn, may be stimulated by increasing the directivity of self-study assignments. In sum, a well-designed learning environment may make a difference.

References

Admiraal, W., Wubbels, T, & Pilot, A. (1999). College teaching in legal education: Teaching method, students' time-on-task, and achievement. *Research in Higher Education, 40,* 687-704.

Arum, R., & Roksa, J. (2011). *Academically adrift: Limited learning on college campuses.* Chicago: The University of Chicago Press.

Babcock, P., & Marks, M. (2011). The falling time cost of college: Evidence from half a century of time use data. *Review of Economics and Statistics, 93,* 468-478.

Barrow, M., Reilly, B., & Woodfield, R. (2009). The determinants of undergraduate degree performance: how important is gender? *British Educational Research Journal, 35,* 575-597.

Biggs, J. (2001). Enhancing learning: A matter of style or approach? In R. J. Sternberg & L. F. Zhang (Eds.), *Perspectives on thinking, learning, and cognitive styles* (pp. 73-102). London: Lawrence Erlbaum.

Brint, S., & Cantwell, A. M. (2010). Undergraduate time use and academic outcomes: Results from the University of California Undergraduate Experience Survey 2006. *Teachers College Record, 112*, 2441-2470.

Bruinsma, M., & Jansen, E. P. W. A. (2009). When will I succeed in my first-year diploma? Survival analysis in Dutch higher education. *Higher Education Research & Development*, *28,* 99-114.

Cicchetti, D., Bronen, R., Spencer, S., Haut, S., Berg, A., Oliver, P., & Tyrer, P. (2006). Rating scales, scales of measurement, issues of reliability: Resolving some critical issues for clinicians and researchers. *The Journal of Nervous and Mental Disease, 194,* 557-564.

Cicchetti, D. V. & Sparrow, S. S. (1981). Developing criteria for establishing interrater reliability of specific items: Applications to assessment of adaptive behavior. *American Journal of Mental Deficiency, 86,* 127-137.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (revised edition). Hillsdale, NJ: Erlbaum.

Credé, M., & Kuncel, N. R. (2008). Study habits, skills, and attitudes: The third pillar supporting collegiate academic performance. *Perspectives on Psychological Science, 3*, 425-453.

Delucchi, J. J., Rohwer, D. W., & Thomas, J. W. (1987). Study time allocation as a function of grade level and course characteristics. *Contemporary Educational Psychology*, *12,* 365-380.

Dickinson, D. J., & O'Connell, D. Q. (1990). Effect of quality and quantity of study on student grades. *Journal of Educational Research, 83,* 227-231.

Diseth, A. (2003). Personality and approaches to learning as predictors of academic achievement. *European Journal of Personality, 17,* 143-155.

Diseth, A. (2007). Approaches to learning, course experience and examination grade among undergraduate psychology students: testing of mediator effects and construct validity. *Studies in Higher Education, 32*, 373-388.

Diseth, A. (2011). Self-efficacy, goal orientations and learning strategies as mediators between preceding and subsequent academic achievement. *Learning and Individual Differences, 21,* 191-195.

Diseth, A., Pallesen, S., Brunborg, G. S., & Larsen, S. (2010). Academic achievement among first semester undergraduate psychology students: The role of course experience, effort, motives and learning strategies. *Higher Education*, *59,* 335-352.

Dochy, F., Segers, M. & Buehl, M. M. (1999). The relation between assessment practices and outcomes of studies: The case of research on prior knowledge. *Review of Educational Research, 69,* 145-186.

Dollinger, S.J., Matyja, A.M., & Huber, J.L. (2008). Which factors account for academic success: those which college students can control or those they cannot? *Journal of Research in Personality*, 42, 872-885.

Farsides, T., & Woodfield, R. (2007). Individual and gender differences in 'good' and 'first class' undergraduate degree performance. *British Journal of Psychology, 98,* 467-483.

George, D., Dixon, S., Stansal, E., Lund Gelb, S., & Pheri, T. (2008). Time diary and questionnaire assessment of factors associated with academic and personal success among university undergraduates. *Journal of American College Health, 56*, 706-715.

Gortner, A., & Zulauf, C. (2000). The use of time by undergraduate students. *NACTA Journal: the professional journal service college teachers of agricultural, environmental, natural, and life sciences, 44,* 22-30.

Gortner Lahmers, A. G., & Zulauf, C. R. (2000). Factors associated with academic time use and academic performance of college students: A recursive approach. *Journal of College Student Development, 41*, 544-556.

Hacquebord, H. & De Vos, S. (2002). *Diagnostische toets lees- en luistervaardigheid : economie.* [Diagnostic test of reading and listening comprehension skills for economics.]. Utrecht, The Netherlands: Expertisecentrum Allochtonen Hoger Onderwijs.

Hacquebord, H. & van der Westen, W. (2010). Taaltoetsing in het kader van taalbeleid in het hoger onderwijs. [Language testing within the context of language policy in higher education]. In E. Peters & T. Van Houtven (Eds.), *Taalbeleid in het hoger onderwijs: de* *hype voorbij?* [Language policy in higher education: Past the hype?] (pp. 37-49). Leuven, Belgium: Acco.

Hailikari, T., Nevgi, A., & Komulainenen, E. (2008). Academic self-beliefs and prior knowledge as predictors of student achievement in Mathematics: A structural model. *Educational Psychology, 28,* 59-71.

Heim, A. W., Watts, K. P., & Simmonds, V. (1982). *Manual for the AH 6 group tests of high-level intelligence*. Windsor, England: NFER-Nelson.

Hofman, A., & van den Berg, M. (2000). Determinants of study progress: the impact of student, curricular, and contextual factors on study progress in university education. *Higher Education in Europe, 25,* 93-110.

Howard, J. R. (2005). An examination of student learning in introductory sociology at a commuter campus. *Teaching Sociology, 33,* 195-205.

Jansen, E. P. W. A. (2004). The influence of the curriculum organization on study progress in higher education. *Higher Education, 47*, 411-435.

Jereb, E., Ferjan, M., & Jesenko, J. (2009). Conceptual model of study progress in higher education. *Didactica Slovenica, 24,* 168-184.

Kember, D., Jamieson, Q.W., Pomfret, M., & Wong, E.T.T. (1995). Learning approaches, study time and academic performance. *Higher Education, 29*, 329-343.

Kolari, S., Savander-Ranne, C., & Viskari, E.-L. (2008). Learning needs time and effort: a time-use study of engineering students. *European Journal of Engineering Education, 33,* 483-498.

Krohn, G. A., & O'Connor, C. M. (2005). Student effort and performance over the semester. *Journal of Economic Education, 36,* 3-28.

Kuh, G. D., Cruce, T. M., Shoup, R., Kinzie, J., & Gonyea, R. M. (2008). Unmasking the effects of student engagement on first-year college grades and persistence. *Journal of Higher Education, 79,* 540-563.

Martin, A. J. (2009). Age appropriateness and motivation, engagement, and performance in high school: Effects of age within cohort, grade retention, and delayed school entry. *Journal of Educational Psychology*, *101*,101-114.

Masui, C. (2002). *Leervaardigheid bevorderen in het hoger onderwijs: Een ontwerponderzoek bij eerstejaarsstudemen [Enhancing learning competence in higher education: A design experiment with university freshmen]*. Leuven, Belgium: Universitaire Pers Leuven.

Masui, C., & De Corte, E. (2005). Learning to reflect and to attribute constructively as basic components of self-regulated learning. *British Journal of Educational Psychology, 75* (3), 351-372.

Masui, C., & Peters, I. (2004). *Verschillen in studiegedrag tussen mannen en vrouwen [Differences in study behaviour between men and women]*. Internal research report, Limburgs Universitair Centrum, Faculteit Toegepaste Economische Wetenschappen, Belgium.

Masui, C., Peters, I., Jacobs, I., Maelstaf, M., Vandenreyt, I., Vandersteen, M., Thys, I., Saenen, I., Lambrechts, D., Vandervorst, C., & Vossen, G. (2005). *Eindrapport:Project studietijdmeting. [Final report: project study time measurement]*. Internal research report, Limburgs Universitair Centrum, Faculteit Toegepaste Economische Wetenschappen, Belgium.

Michaels, J. W., & Miethe, T. D. (1989). Academic effort and college grades. *Social Forces, 68,* 309-319.

Minnaert, A. & Janssen, P. J. (1999). The additive effect of regulatory activities on top of intelligence in relation to academic performance in higher education. *Learning & Instruction, 9,* 77-91.

Nonis, S.A., Philhours, M. J., & Hudson, G.I. (2006). Academic performance of college students: influence of time spent studying and working. *Journal of Education for Business, 81*, 151-159.

Okpala, A.O., Okpala, C.O., & Ellis, R. (2000). Academic effort and study habits among students in a principles of macroeconomics course. *Journal of Education for Business, 75,* 219-224.

Peters, I., Saenen, I., & Masui, C. (2007, December). *Studietijdmetingen binnen de faculteit Toegepaste Economische Wetenschappen [Study time registration at the Faculty of Applied Economics]*. Paper presented at Dag van het Onderwijs, Associatie Universiteit-Hogescholen Limburg, Belgium.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16,* 385-407.

Plant, E. A., Ericsson, K. A., Hill, L., & Asberg, K. (2005). Why study time does not predict grade point average across college students: Implications of deliberate practice for academic performance. *Contemporary Educational Psychology, 30*, 96-116.

Rau, W., & Durand, A. (2000). The academic ethic and college grades: Does hard work help students to "make the grade"? *Sociology of Education, 73,* 19-38.

Romiszowski, A. J. (1993). *Designing Instructional Systems.* London/New York: Kogan Page/Nichols Publishing.

Schmidt, H. G., Cohen-Schotanus, J., van der Molen, H., Splinter, T. A. W., Bulte, J., Holdrinet, R., & van Rossum, H. J. M. (2010). Learning more by being taught less: a "time-for-self-study" theory explaining curricular effects on graduation rate and study duration. *Higher Education, 60,* 287-300.

Schuman, H., Walsh, E., Olson, C., & Etheridge, B. (1985). Effort and reward: The assumption that college grades are affected by quantity of study. *Social Forces, 63*, 945-966.

Sheard, M. (2009). Hardiness commitment, gender, and age differentiate university academic performance. *British Journal of Educational Psychology, 79, 189-204.*

Stinebrickner, R., & Stinebrickner, T. (2004). Time-use and college outcomes. *Journal of Econometrics, 121,* 243-269.

Svanum, S., & Bigatti, S. M. (2006). The influences of course effort and outside activities on grades in a college course. *Journal of College Student Development, 47,* 564-576.

Torenbeek, M., Jansen, E., & Hofman, A. (2010). The effect of the fit between secondary and university education on first-year student achievement. *Studies in Higher Education, 35,* 659-675.

Van Den Berg, M. N. and W. H. A. Hofman (2005). Student success in university education: A multi-measurement study of the impact of student and faculty factors on study progress. *Higher Education, 50,* 413-446.

van den Hurk, M. (2006). The relation between self-regulated strategies and individual study time, prepared participation and achievement in a problem-based curriculum. *Active Learning in Higher Education, 7,* 155-169.

van den Hurk, M.M., Wolfhagen, H.A.P., Dolmans, D.H.J.M., & van der Vleuten, C.P.M. (1998). The relation between time spent on individual study and academic achievement in a problem-based curriculum. *Advances in Health Science Education, 3,* 43-49.

van der Drift, K.D.J.M., & Vos, P. (1987). *Anatomie van een leeromgeving. Een onderwijseconomische analyse van universitair onderwijs* [Anatomy of a learning environment: An educational-economic analysis of university education]. Doctoral dissertation. Lisse: Swets & Zeitlinger.

van der Meer, J., Jansen, E., & Torenbeek, M. (2010). 'It's almost a mindset that teachers need to change': First-year students' need to be inducted into time management. *Studies in Higher Education*, *35*, 777-791.

Verbeke, G., & Molenberghs, G. (2000). *Linear Mixed Models for Longitudinal Data*. New York: Springer.

Vermunt, J.D. (2005). Relations between learning patterns and personal and contextual factors and academic performance. *Higher Education*, *49*, 205-234.

Vollmeyer, R., & Rheinberg, F. (2006). Motivational effects on self-regulated learning with different tasks. *Educational Psychology Review*, *18*, 239-253.

Zuriff, G.E. (2003). A method for measuring student study time and preliminary results. *College Student Journal*, *37*, 72-78.

Footnote

[1] In higher education in Flanders, Belgium, each year of a degree program counts 60 credits. It is determined by law that one credit should represent a study load of 25 to 30 hours (including time spent in class and on writing exams). At our university, the norm of 27 hours of study load per credit point is in use and is therefore applied in the current study. Unlike in other countries, courses may have different credit point loads. In most Flemish degree programs, several courses are scheduled concurrently.

[2] Supplying ST data was a condition for obtaining credits for one of the first-year courses (i.e., Research Methods and Psychology). Thus, although students decided not to take an exam, they still provided ST data. Students have the opportunity to withdraw from an exam up to the examination date. It is normal practice at our university that some students follow a course (and provide ST for it) and postpone the exam for different reasons.

[3] More information regarding this application can be obtained from the following (Dutch) website: http://www.uhasselt.be/UH/Help-Studenten/Toepassingen/Studietijdmeting.html