IT'S ABOUT TIME: WHAT CAN WE LEARN BY HAVING UNIVERSITY DESIGN STUDENTS TRACK TIME?

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ABSTRACT
Ninety-one undergraduate students tracked time spent throughout the semester in entry-level design courses. The correlation between time and student performance was low, but data validity may be an issue due to the self-reporting nature of time tracking. In one course, students averaged the expected amount of time (given the course credit hours). Students fell below 75% of the time expectations in another course. The exercise of tracking time teaches students about themselves, helping them recognise opportunities for improvement. Most students do not like tracking time, but many admit it is beneficial. Time tracking empowers them to be personally accountable. Many conversations with students have shifted from "Tell me how to get a better grade." to "Help me improve time management so I can learn more and do better." Time-tracking data also provides additional context for professors to interpret student performance. When students are not performing well, time-tracking data can help clarify how to help: Do students need help recognising the discrepancy between time invested and expected results? Do they need guidance on learning strategies to help them be more effective and efficient with their time utilisation? Or do they need additional help understanding and applying course content?

Keywords: Time management, student performance, personal responsibility, design education

1 INTRODUCTION
How does time management affect a college student's performance? Students often must determine how to manage academic, work, social, familial, and other responsibilities and interests. Students coming straight out of the public education system usually have to learn how to juggle all these things for the first time when beginning university studies. Time management skills may be one of the main determining factors of student success. The two primary purposes of this study are as follows.

- Better understand to what degree the amount of time a student invests in a course correlates with their overall performance in a course. (In other words, is doing well in a course mainly a function of the time a student invests?)
- Observe if time tracking has any other effects on student learning and development.

2 THE STRUGGLE TO MANAGE TIME
Irrespective of the field of study, students grapple with unique challenges in time management. Majors differ in workloads, assignment types, and demands. For example, students studying design and its emphases encounter many project-based learning activities. Project-based learning is "an active student-centred form of instruction characterised by students' autonomy, constructive investigations, goal setting, collaboration, communication and reflection within real-world practices" [1]. This pedagogical approach provides students with the opportunity to work on authentic projects and the development of products [2]. Project-based learning is distinct from problem-based learning, which shares similarities but focuses on the learning process, whereas project-based learning emphasises the culmination of an end product [3]. Project-based learning stretches students by requiring them to actively engage in an assignment over an extensive period [4]. In the context of a Design class, a Project-based learning assignment requires a heavy workload as students spend time researching, ideating, prototyping, revising, and polishing an elegant final product to submit for a grade.
Participating in this real-world process provides Design students with experience for their future careers. It often requires students to use more soft skills (e.g., communication, collaboration, and time management) than traditional pedagogy. In project-based learning, self-regulated learning readiness

(i.e., the ability to learn independently) and self-management skills are paramount to a student's success and result in increased learning outcomes [5]. Conversely, this same learning method leaves room for students who need more self-regulated learning skills and motivation to fall behind in a particular project. Fortunately, research shows that these skills aren't personal traits that students have or don't have but are character traits that can be taught and developed. Zimmerman explains that a student's level of learning varies based on their ability to personally adapt the following self-regulated learning skills to each learning task.

- setting specific proximal goals for oneself,
- adopting powerful strategies for attaining the goals,
- monitoring one's performance selectively for signs of progress,
- restructuring one's physical and social context to make it compatible with one's goals,
- managing one's time use efficiently,
- self-evaluating one's methods,
- attributing causation to results, and
- adapting future methods [6].

This study focuses on the component skill of managing one's time use. Good time management is the ability to "[schedule] sufficient time, spread consistently throughout the designated learning duration, to complete the learning tasks that are tied to the learning goals set" [7]. Multiple studies indicate a positive correlation between effective time management and academic performance [8] [9] [10].

One aspect of time management is "perceived control of time." A 1990 study by Macan et al. found that out of four relatively independent factors of time management:

1. setting goals and priorities
2. planning and scheduling
3. perceived control of time
4. and preference for disorganisation,

the most predictive was perceived control of time—the extent to which an individual believes they can affect time spent. The study found that "students who perceived control of their time reported significantly greater evaluations of their performance, greater work and life satisfaction, less role ambiguity, less role overload, and fewer job-induced and somatic tensions" [11]. A 2019 study by Adams and Blair added confirmatory evidence to the research done by Macan et al. They found that student perceptions (regardless of gender, age, and semesters in the degree program) of their time positively correlate with academic performance [12].

3 TIME TRACKING AS A WAY TO HELP TIME MANAGEMENT

Time tracking is a method that might help students improve their time management abilities and increase their perceived control of time. Time tracking is the term used to describe the process of logging time spent completing a particular task. In the digital age, this can be accomplished using a variety of dedicated time-tracking applications such as Toggl Track, Clockify, Harvest, Timely, and more. Using one of these digital tools to track time spent on project-based learning activities could help students improve the self-regulated learning skills necessary to be successful in project-based learning activities. However, there is limited research regarding the effect of time-tracking tools on student performance.

While standard learning management software systems, such as Instructure's Canvas, have metrics on how often and how long students are logged into and interacting with a page in the system, they are devoid of time-tracking functionality for students and instructors to gauge the length of time spent on an assignment or a project. There are some plugins that students can use to track time, but they are not well integrated into the learning management systems. The plugins only act as a shortcut to start and stop time and report it back into the third-party system. They do not automatically pull or associate assignment and project data with the logged time.

Of the few studies available regarding student time-tracking, the leading research, conducted in 2015, suggests that "using mobile devices to log and track the time devoted to study across contexts might lead to an improvement on time management skills" [13]. A 2020 study by Sorokina et al. also found that the implementation of time tracking increased project scores among a small sample size of higher education students [14]. In addition to these findings, one of time-tracking's benefits is its ability to measure time-on-task learning. With students' access to technology today, learning is "plagued by high levels of distraction and multitasking, which leads to negative effects on students' learning" [15].

Logging time spent on learning may help students avoid these distractions, introducing an aspect of self-awareness and accountability. Bowman et al. state that having students log time while they work "can help them to become more aware of what they are doing so they can make conscious choices about what they want to do" [16]. Prior research also demonstrates that students respond positively to time-on-task data visualisations [17], and migrant language learners became more motivated using a time-tracking app [18]. Given the findings of these studies, students may be open to tracking time spent on courses.
While the potential of time tracking to enhance student learning and performance is promising, more research is needed. The initial findings of Tabuenca et al. [19] and Sorokina et al. [20] provide a starting point. Still, additional, discipline-focused research might further establish the impact of time tracking on student performance across disciplines. This gap is particularly pronounced in the case of university-level design students. This study explores this research gap by analysing the effects of time tracking when implemented in two introductory design courses: 1) Design Thinking and 2) Product & User Experience Design.

4 METHODS

Undergraduate students in two introductory design courses were taught how to use the free version of the Toggl Track time tracking app and were instructed to use it to track their time spent on the course (including in-class and studio time). Students were reminded that the university expected them to invest at least three hours (including class and studio time) per credit hour into the course each week. The introductory courses, credit hours, expected hours per week, and number of student participants were as follows:

Table 1. Courses & Number of Student Participants

Course	Credit Hrs.	Expected Hrs./Week	# of Students
Design Thinking (DT)	1.5	4.5	43
Product & User Experience Design (P&UXD) - Section 1	3.0	9.0	21
Product & User Experience Design (P&UXD) - Section 2	3.0	9.0	27
		Total	**91**

Students submitted reports generated in the "reports" section of the Toggl Track application. It is important to note that when the lead author of this study began having students track their time, he did not intend to conduct a formal research study on the matter. Thus, there are some differences in how reporting occurred between the two courses. In the DT course, students submitted a weekly time report from the Toggl Track system, and the time reports were reviewed weekly. In the P&UXD course, students started tracking their time when we were one-third (i.e., five weeks) through the semester, and they only submitted two-time reports (each accounting for five weeks) for the remainder of the semester. In both courses, students were awarded points for tracking their time and submitting the report, not for how much time they spent. We did not award students points based on the amount of time spent so as not to incentivise dishonest, inaccurate, or inflated reporting of time. Students were reminded at the beginning of both courses and a couple of times throughout the semester that if they hoped to perform well in the course, they should anticipate investing at least three hours of work (including in-class time) per credit hour.
After the semester ended, we aggregated all time reports for each student and compared time spent to their final grade. We calculated the average time students spent on the course each week and the correlation strength (measured by the correlation coefficient r) between time spent and the student's final grade. The authors of this study reviewed time reports only after the semester was completed and grades were awarded to ensure that no grades were affected by knowing how much time a student spent on the course.
Due to slight differences in instructions given in both courses regarding time reporting, we could also calculate the average time explicitly spent in the DT class and studio sessions, where students could receive instruction and help from the instructor. With this additional data, we also explored if there was any relationship between in-class and studio time and students' final grades in the DT course.

5 STATISTICAL RESULTS

Karl Pearson's Coefficient of Correlation formula was used to determine the correlation between students' total time spent in a course and their final grades.

In the (DT) course (which students should have expected to spend at least 4.5 hours per week), students reported an average of 4.87 hours per week. The correlation between total time spent on the course and the final grade was low (r=0.33). However, the correlation between time spent in class and studio (where students could receive feedback and help from the instructor), and their final grade was moderate (r=0.50).

In the two sections of the (P&UXD) course, students spent an average of 6.81 hours per week in section 1 and 6.17 hours per week in section 2 (which is significantly below the minimum of 9 hours per week that they should have been spending on the course). The correlation between time spent on the course and the final grade was low for section 1 (r=.41) and very low for section 2 (r=.02).

6 LIMITATIONS

Students self-reported their time. Though they were reminded and encouraged to track their time in real-time using the Toggl Track application, it was apparent in some time reports that students went back and manually entered times after the fact right before submitting their report. Students guessing how much time they spent on the course could significantly affect the reliability of the results.

Students received no course points for the time they spent on the course. However, some might have overestimated their time for various reasons, including being concerned about being judged. As mentioned earlier in this paper, the principal author explored the effect of time tracking on student performance after gathering time reports as part of the course's requirements. In the future, with the intent to more systematically and accurately capture the effect that time invested in learning and doing has on student performance, the authors aim to reduce the number of limitations of results and findings in subsequent studies.

7 DISCUSSIONS

Before aggregating and running a statistical analysis on the time reporting data, we suspected we might find a strong correlation between the time spent on the course and the student's final grade. However, this was not the case. So, either the amount of time a student puts in has less effect on student performance (as measured by the final grade) than we anticipated, or the data is not reliable enough (due to the self-tracking and self-reporting nature of time tracking) to draw a firm conclusion at this time. We intend to do additional studies where we take measures to increase the reliability of the data, such as

1. utilising a time management software platform built for teams that allows the authors to more easily distinguish between real-time tracking and tracking that occurs after the fact.
2. make sure to gather reports and award students points for tracking their time weekly (at a minimum), as frequency helps students not to procrastinate manually logging time, thus reducing guestimates and increasing the accuracy of time reported.

Though the macro relationship between time invested in a course and the final grade was not what we thought it would be, having students track their time yielded some interesting insights, results, and ideas. When students come to the instructor and are concerned about their grades, the instructor can review assignment scores to evaluate the quality of their work AND review the time and effort the student is investing. When students are not performing well, time-tracking data can help clarify how to help: Do students need help recognising the discrepancy between time invested and expected results? Do they need guidance on learning strategies to help them be more effective and efficient with their time utilisation? Or do they need additional help understanding and applying course content?

This data changed many conversations the instructor had with individual students from "Why am I getting a bad grade?" to something often more pertinent and at the root of the problem, like "How might I establish more time for myself to work on this course?" Most students don't like tracking their time. However, like eating vegetables, many realise it is healthy and helpful by the end of the semester or soon after. Several students have reported using Toggl Track or other time-tracking software to measure how much time they spend on something else. The most common application of time tracking that students report after my classes is for freelance work.

When beginning the experiment of having students track their time, I wanted to help students learn how to better account for and manage their time. However, the data provided some interesting insights about

the actual course load of these two courses. In the DT course, many students complained in their student ratings that the time required by the course far exceeded the one-and-a-half credit hours of the course. However, the 4.86 hours average time spent per week per student is right on the money for how much time students should have expected to put in the course. Similarly, some students in the P&UXD course complained that there was too much work. However, on average, students put in much less time per week (e.g., 6.81 hours in section one and 6.17 hours in section two) than they should have given that it was a three-credit course that expects at least nine hours of work per week.

When time reports were required weekly, students better spread their time across several weeks for large projects. When time reports were required every five weeks, most students put in much less time during the first couple of weeks and increasingly more time during the final three weeks.

Interestingly, the correlation between time spent in class and studio (where students could receive feedback and help from the instructor), and their final grade was moderate and much higher than any other correlating factor measured by this study. We want to explore that further.

One thing lacking in these time-tracking experiments was self-reflection. The original intent of having students track their time was to become more self-aware about how they use and manage their time. However, we need to implement regular reflections for students to move away from the view that this is just some tedious exercise required of them by the course towards the view that this is an opportunity to learn about themselves. Collecting data about themselves and reflecting on that data regularly through thoughtful prompts may help students become more independent, accountable, and self-aware learners.

8 CONCLUSIONS

Soft skills, like time management, are often not explicitly taught in primary, secondary, or university education. Most students understand the concept that practice makes perfect. However, when stressed and juggling multiple responsibilities, they often try to cut corners in their learning processes. This study does not establish a strong correlation between the final grade and the time spent in these two courses; however, it has had some unintended results. Some students have actively sought help from the instructor when realising they were struggling to balance the demands on their time, which suggests that Time tracking has been a way to help students hold themselves accountable, reflect, and troubleshoot time management issues affecting their learning and performance This study has also yielded valuable insights regarding actual course load, course cadence, and student project progress cadence, which suggests that time tracking (as pedagogical practice) might help other instructors looking to hone their courses and improve student learning experiences.

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