EFFECTS OF A FALL READING BREAK ON FIRST YEAR STUDENTS’ COURSE PERFORMANCE IN PROGRAMMING

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Abstract - This paper presents a mixed methods study into the effects of a fall break on course performance in a first semester programming course in Mechatronics Engineering at the University of Waterloo.

In 2016, the University of Waterloo instituted a two-day fall break immediately following Thanksgiving Monday, on a three-year pilot. The stated rationale for this break was to address student wellness and mental health issues, especially as this pertains to students transitioning from high school and their “looming midterms”. As of October 2017, there are now 20 institutions in Ontario with a fall break of between one and five days in length after the Thanksgiving holiday.

A linear regression model was calculated to examine the impact of the fall break on students. This model predicts students who regretted how they spent the fall break will earn 6% less in their first programming course. A logistic regression model was calculated which predicted inexperienced, struggling students have the highest odds of regretting how they spent the break.

Three focus groups were conducted with students who experienced the fall break in fall of 2016 or 2017. These focus groups examined student perceptions of the fall break, how they recalled using their time during the break, and their reflections on the break.

Keywords: First year, Mental health, Mixed methods research, Performance, Study behaviours

1 INTRODUCTION

In 2016, the University of Waterloo instituted a two-day fall break immediately following Thanksgiving Monday, on a three-year pilot [1]. The stated rationale for this break was to address student wellness and mental health issues, especially as this pertains to students transitioning from high school and their “looming midterms”. As of October 2017, there are 20 institutions in Ontario who have implemented a fall break of between one and five days in length [2]. All 20 institutions start their break after Thanksgiving, and of these institutions, 14 of them (including Waterloo) start their break on Thanksgiving Monday, with the rest occurring later in October. To make space for the fall break, the University of Waterloo changed the structure of Orientation Week and started classes two days earlier in September, on the Thursday following the Labour Day holiday. While studying the effects of the shorter Orientation Week fall outside the scope of this paper, prior research at UWaterloo has shown the importance of Orientation Week events for meeting classmates [3].

There is very little existing literature studying the effects of a fall break on the undergraduate student population. Some institutions have made available their internal studies into fall breaks [2]. The impact of a fall break on students’ stress levels and mental health was studied by Cramer and Pschibul at the University of Windsor. They found that the break may increase students’ perceived stress levels if:
1. They were stressed before the break
2. They were stressed during the break
3. They had high workload following the break
4. They spent more time recreating [4].

The same topic was studied by Poole et al. from McMaster University through surveys and focus groups. The researchers reported that the majority of students found that fall break to be a positive experience, but that their perceived stress level was higher after the break. In addition, a substantial number of other students reported negative effects of the fall break experience [5] [6].

An ongoing study into the impacts of a fall break at Brock University has shown the majority of students perceive a reduction in stress after a fall break, however approximately one third of students surveyed (in primarily first and fourth year) report higher stress going in to the break [7]. Moreover, researchers across the country have shared their concerns about the effect of the fall break on students’ academic performance as well as students’ mental health. It was highlighted in [8] that there is a need to carefully keep an eye on students’ grades, retention rates and surveys that report on student satisfaction.
1.1 Mechatronics Engineering Overview

In the first semester (1A) of Mechatronics Engineering (MTE), students are enrolled in 5 courses: MTE 100 (Introduction to Mechatronics), GENE 121 (Digital Computation, an introductory programming course), CHE 102 (Chemistry for Engineers), Math 115 (Algebra for Engineers), and Math 116 (Calculus I for Engineers). The 1A MTE semester has had a very stable group of instructors from 2010-2017\(^1\). Students in Mechatronics are enrolled in either eight-stream or four-stream upon entry to the program. Four-stream refers to students who have a single study term in the fall of first year before seeking co-op employment, while eight-stream students will have consecutive study terms in first year before a co-op work term.

GENE 121 is a typical first programming course for engineering programs where the students learn procedural C++ ending with an introduction to object-oriented programming. This course has contained a multi-week, open-ended project since fall 2011 (this project is shared with MTE100, see [9] for a full description). The 1A MTE term also has a high-intensity engineering design experience, dubbed “Tron Days” just before the fall break. Tron Days was offered for the first time in fall 2016 and is a two-day long design event which replaced all traditional lectures and labs for the Thursday and Friday right before Thanksgiving weekend. The problems given to students were designed to connect topics from all five of the courses students take in 1A (see [10] and [11]).

The goal of this research is to carefully analyze first year Mechatronics Engineering students\(^1\) performance in their programming course before and after the introduction of the fall break in 2016. This investigation was started when the course instructor of GENE121 noted a decline in Mechatronics students’ midterm exam scores since the University incorporated the fall break in 2016.

Table 1 below summarizes the midterm averages since 2013.

<table>
<thead>
<tr>
<th>TERM</th>
<th>N</th>
<th>MEAN</th>
<th>STD DEV.</th>
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<tbody>
<tr>
<td>2013</td>
<td>141</td>
<td>67.2</td>
<td>18.7</td>
</tr>
<tr>
<td>2014</td>
<td>193</td>
<td>73.8</td>
<td>14.8</td>
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<tr>
<td>2015</td>
<td>183</td>
<td>79.9</td>
<td>14.1</td>
</tr>
<tr>
<td>2016</td>
<td>202</td>
<td>73.5</td>
<td>16.5</td>
</tr>
<tr>
<td>2017</td>
<td>225</td>
<td>68.6</td>
<td>18.5</td>
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</tbody>
</table>

\(^1\) Fall 2014 and 2016 were taught by other instructors while the regular instructor was on leave.

The programming course was considered for this research for two reasons: first, the instructor noted the decline in performance; and second, there is a strong correlation between student performance in GENE121 and their semester average (Spearman’s rho = 0.83, p<0.001). This course has also been well-studied and so provides a rich source of past data.

2 METHODS

This study addresses the following research questions:
1) What impact does a fall break have on student performance in their first programming course?
2) Are the different student sub-populations reacting differently to the presence of a fall break?

To address these questions, an explanatory sequential mixed-methods study was conducted\(^2\) with the MTE class of 2022 (who began their studies in fall 2017). For the initial quantitative section of this study, students were asked to fill in a survey at the start and end of their first semester. These surveys were not anonymous to the researcher handling the initial data analysis and had high participation as a small bonus grade was awarded in MTE100 for completing each survey. To capture how they felt about the fall break, students were asked on the end of term survey to report how many hours per day they studied for each of their courses. They were also asked “Do you regret how you spent your time over the fall break”.

The student responses were combined with their course grades and imported to Stata 15 to conduct the statistical analysis. A multiple regression was predicted to isolate the effect of the fall break on student performance in GENE121 from identity, ability, time spent studying, and prior experience. A logistic regression was also predicted to better understand which students showed regret regarding the fall break.

For the secondary qualitative stage of this study, multiple focus groups were conducted with students from the first year and second year Mechatronics cohorts (the classes of 2022 and 2021, respectively). Both cohorts had a three-day fall break in their first semesters on campus. The researchers attempted to capture the experience of various at-risk sub-populations in these focus groups (e.g. weaker students, international students, female students, etc).

\(^2\) This study has received approval from the University of Waterloo Office of Research Ethics (ORE#19224)

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3 RESULTS

3.1 Quantitative Analysis

The end of term survey is given to students near the end of the lecture period and ends during final exams. In 2017, several questions relating to the fall break were asked, including how much time the students estimated they spent studying each course (students selected one of five options: from no time to 3+ hours per day), and whether they regretted how they spent their time over the fall break. Of the 194 who filled in the end of term survey students (out of a possible 219 students), 57 (29%) indicated that they regretted how they spent their time over the fall break.

A linear regression model was predicted to see what effect this regret had on course performance in GENE121. The model controlled for: elements of the student’s identity (gender and stream), prior experience with programming and robotics (taken from the start of term survey), hours spent studying during the break, and their score on assignment 9. Assignment 9 was included as a measure of individual programming ability at the end of term (this is the final assignment for the term and is very similar to the types of questions students will be answering on the final exam). This assignment is only worth about 0.8% of their final course grade. The results of the regression model are summarized in Table 2 below (n=167, p<0.001, R²=0.48). Statistically significant coefficients are displayed in bold.

Controlling for stream, gender, prior ability, time spent studying during the break, and their ability in programming at the end of term, if students regret how they spent the fall break, they are predicted to earn 6% less on their overall course grade in GENE121 (p<0.05). The other statistically significant terms predict that women will earn 5.6% less than men (p<0.05), that for every increase in prior programming experience students are predicted to earn 2.5% more overall (p=0.01), and that for every 1 point increase on assignment 9 (it was graded out of 20), students are predicted to earn 1.3% more on their course average (p<0.001). Figure 1 below shows the actual grades against the grades predicted by the model.

![Figure 1 Actual GENE121 final course grades vs. grades predicted from regression model (class of 2022)](image)

Table 2 Multiple regression coefficients, GENE121 final course grade - class of 2022 (R² = 0.48, n=167)

| GENE121 Final Grade | Coefficient | Std. Err. | t | P>|t|
|---------------------|-------------|-----------|---|-----|
| Female              | -5.60       | 2.64      | -2.12 | 0.035 |
| Four Stream         | -3.36       | 2.05      | -1.64 | 0.104 |
| Prior Programming Experience | 2.48 | 0.95 | 2.61 | 0.010 |
| Prior Robotics Experience: LEGO | 0.07 | 2.58 | 0.03 | 0.979 |
| Prior Robotics Experience: Custom Robotics | 0.94 | 2.31 | 0.41 | 0.686 |
| Regret how they spent the break | -6.12 | 2.60 | -2.36 | 0.020 |
| Time spent studying algebra: reading break | 0.53 | 1.64 | 0.32 | 0.747 |
| Time spent studying calculus: reading break | 0.95 | 1.34 | 0.72 | 0.476 |
| Time spent studying chemistry: reading break | -0.94 | 1.41 | -0.67 | 0.505 |
| Time spent studying graphics: reading break | 0.47 | 0.87 | 0.54 | 0.592 |
| Time spent studying MTE100: reading break | -0.14 | 1.13 | -0.12 | 0.905 |
| Time spent studying programming: reading break | -1.62 | 1.32 | -1.22 | 0.223 |
| GENE121 Assignment 9 grade | 1.34 | 0.25 | 5.35 | 0.000 |
| y-intercept          | 53.11       | 5.86      | 9.07 | 0.000 |
In an effort to better understand who the students are that showed regret for how they spent their break, a logistic regression model was predicted. This model included gender and stream, prior programming experience, time spent studying over the break for each course, performance on the midterm exam in GENE121 and CHE102, performance on the first quiz in MTE100 (which is comparable to a midterm), and performance on Assignment 9 in GENE121 (as a measure of ability in programming). The results are shown in Table 3 above (pseudo-$R^2 = 0.40$, p<0.001, n=161).

The resulting model has five statistically significant predictor variables. For every increase in prior programming experience, the odds of someone regretting how they spent the break are 40% lower (p<0.05). For every additional hour per day over the fall break that a student studied calculus, the odds of them regretting how they spent the break are 124% higher (p=0.055). For every additional hour spent studying chemistry, the odds of a student regretting how they spent the break are 40% lower (p<0.05). For every additional hour spent studying graphics, the odds of a student regretting how they spent the break are 124% higher (p=0.055). For every additional hour spent studying algebra, the odds of a student regretting how they spent the break are 9% lower (p<0.001).

This model suggests that those students with the least experience, who didn’t study programming over the break, and who performed poorly on their GENE121 midterm have a high likelihood of regretting how they spent the reading week. To verify that multicollinearity was not an issue with these variables – as one could expect inexperienced programmers who didn’t study to perform poorly on the midterm – variance inflation factors (VIF) were calculated for all variables. The VIF values for GENE121 midterm score, experience, and time spent studying programming are all less than 2.5. In general, VIF values greater than 4 require investigation, and values greater than 10 represent significant issues with collinearity (i.e. the variables are highly correlated) [12]. This means there are no issues of multicollinearity between the variables in this model.

### 3.2 Qualitative Analysis

Three focus groups were conducted in the winter 2018 semester. The first focus group had two second-year, female students – one of whom did not go home for the fall break – from the class of 2021. These students experienced the fall break in their first semester on campus in fall 2016. The second focus group had three eight-stream first-year, male students from the class of 2022 who were on academic term in winter 2018. The final focus group had three male, four-stream, first-year students from the class of 2022 who were on work term in winter 2018. This final focus group had one American student who was unable to go home during the fall break.

The focus group participants represented a small sample of students, and while there were both males and females represented, and a range of prior experience with programming, all of the students had passed GENE121 and passed their first semester. Even though the researchers were unable to speak to students who identified themselves as having regretted the time spent...
during the fall break, several interesting points of view were raised during the focus group sessions.

All students were in agreement that the fall break was a good thing and that it should continue in future fall terms, with one of the second-year students adding: “Having that extra two study days... definitely, I’d say, improved my [midterm] marks”. Likewise all students had similar expectations – or had received explicit messaging from their instructors – that the break should be used to study:

**Interviewer:** “Who told you or what made it clear that it was a study break and not vacation?”

**Student A:** “midterms were like, the week after”

**Student B:** “the looming ‘Hell Week’”

**Interviewer:** “so the idea of calling it Hell Week”

A: “yeah, essentially... and I think our TAs and our profs were like, oh you have two study breaks”

B: “I think they were referred to as study days instead of like ‘reading break’”

**Interviewer:** “Do you think that made a difference?”

A & B: “yeah”

Three of the students did not go home during the fall break because home was too far away. One of the second-year students who stayed on campus, found it isolating:

**Interviewer:** “Did you go home?”

**Student:** “no. I’m from BC. There was no way I could make it home and back”

**Interviewer:** “So what did you do?”

**Student:** “No, I... like I said, I pretty much studied the entire time. And then had a very lonely Thanksgiving.”

**Interviewer:** “Did you have any classmates that were around?”

**Student:** “probably, but I didn’t meet up with anyone”

The University of Waterloo did not have any classes during the fall break, but the University itself was open, and student support groups on campus were fully operational throughout the break. The interviewer asked the second-year students if they used any on-campus resources during the fall break:

**Interviewer:** “How available were your TAs over the study break? Did they tell you they were going to be here?”

**Student A:** “I think they said they were here and they were around, if we needed them. They were pretty available”

**Student B:** “they put up a schedule for help sessions for certain courses and it was throughout the break”

A: “yeah, they were good TAs”

**Interviewer:** “So they were around, but you didn’t use them?”

A & B: “yeah”

This wasn’t universally true for all students. Some of the four-stream, first-year students accessed campus resources during the break:

**Interviewer:** “Did any of you access help? TAs or any profs?”

**Student A:** “Both. I reached out to a few profs, in particular linear algebra ‘cause that was something I was struggling with. Their extended office hours during that week were definitely appreciated, and again the WEEF TAs, [I spoke to] fairly frequently, at least once per day with a stack of questions on different topics”

**Student B:** “The help sessions that they had were really helpful”

A: “yes. They [the TAs] were great.”

When asked, the students were generally in agreement that there should not be assignments due immediately following the break. However, the second-year students struggled to articulate the purpose of course assignments:

**Interviewer:** “Should there be homework assigned?”

**Student B:** “If [the break] is before midterms, then [the purpose of it] is to study. I don’t think there should be homework”

**Student A:** “yeah for sure. It’s kinda like on you if you want to use it as a break versus if you actually want to do productive work”

**Interviewer:** “should there be assignment deadlines right after fall break?”

A & B: “no”

B: “because that means that you have homework for fall break”

A: “You wouldn’t be studying, you’d be doing the assignments”

**Interviewer:** “But are doing assignments studying?”

B: “Umm... Depending on the assignment”

While the students didn’t want anything with a due date, they did seem to like the idea of practice midterm questions that get released during the fall break:

**Interviewer:** “often at midterm time I will produce a curated list of ‘my favorite questions’ that will help students on their midterm”

**Student B:** “yeah, I’d definitely, I’d love that”

**Student A:** “yeah ’cause you’ll have that to kind of guide you on what you need to focus on and what you don’t need to. That would actually be really helpful”

B: “Yeah, like a guideline/questions to focus on and stuff”

The first and second-year students who were on academic term in winter 2018 experienced a week-long break. Unlike the fall break, the winter break in 2018 occurred after midterms are over. Students seem to prefer this timing, with some of the first-years
commenting specifically that the winter break was less stressful than the fall one:

**Interviewer:** “How did you treat the winter break differently from the fall break?”

**Student A:** “After midterms, I feel like most students didn’t do anything related to school work because we had absolutely nothing to do. We just relaxed for 9 days straight”

**Student B:** “I can’t recall too big a difference, because even in the fall, we weren’t really thinking too much about midterms either”

**Student A:** “In the fall I was relaxing stressfully, and this term I was just relaxing”.

Two other confounding factors were raised by the students. The first is that four-stream students are actively looking for their first work term during the fall semester. The first round of interviews takes place throughout the month of October. This process typically requires multiple iterations on their resumes, cover letters, and often means multiple interviews as well. The 8-stream students, speaking about their experience in winter 2018 did not find this process overly burdensome, but recognized that others may not feel the same way:

**Interviewer:** “This term you had to mix searching for a job with academics. How has that balance gone?”

**Student A:** “I honestly think it doesn’t affect our schedule or academics all that much. People were saying that it did [in the fall] but for us, it wasn’t like a huge time commitment where we saw a huge decrease in our grades.”

**Student B:** “At the same time, I can see for some people, each person puts in a very different amount of time. Some people need a lot more work to get their resume [written]”

The four-stream, first year students had a slightly different outlook:

**Interviewer:** “Did the fall break help four-stream students differently than eight-stream?”

**Student:** “I think it helps four-stream marginally more than 8-stream because we have a bit more going on at the start of term.”

The second potential confounding factor is the impact of Tron Days. Tron Days replaces traditional class activities for the two days immediately preceding the fall break. This break in the rhythm of the term could have an impact on study habits leading into the fall break. The second year students had very different experiences coming out of Tron Days, but both agreed it happens at a good point in the term:

**Interviewer:** “What about coming out of Tron Days, were you calm, this is done, let’s go to thanksgiving, or…?”

**Student B:** “less that and [more]: ‘oh god! Exams!’”

**Student A:** “yeah for me, it was like, oh great I’m done Tron Days, I need a break, and start studying. I took a day off, took Saturday off, and then started studying on Sunday. To kinda recuperate from the long nights, the stress”

**Student B:** “I don’t know if I took a day off, I can’t remember. I don’t think I really needed to recuperate from the stress of Tron Days”

**Interviewer:** “Would it be better if Tron Days happened at some other time?”

**Student A:** “no, I think it was good, it was right before... because you didn’t have to stress about Tron Days [before the event] and then, you like, take the weekend to maybe recuperate and then you’re back to class”

## 4 DISCUSSION

Based on the results, the authors have significant concerns with regards to the performance of first year Mechatronics Engineering students and the impact of the fall break on that performance, particularly with respect to their programming course. Further study is needed to determine whether these issues are unique to programming or whether they are more widespread.

Certainly, there are fundamental characteristics of GENE 121 as a university course that differ from students’ high school courses, and from some other university courses: programming is heavily skills-based as opposed to knowledge-based. Mastering GENE 121 requires practice with problem solving, software design, and coding. In addition, many have little or no experience with the subject, and even for those that have taken multiple prior programming courses they find that this course is very different because of the emphasis on software design as opposed to the mechanics of coding.

First year students are also different than their upper year counterparts. Few have yet struggled academically, and most have not experienced failure or challenges, particularly in STEM areas. In general, they have not learned effective study habits that are required to succeed at university: most study by re-reading and/or summarizing course notes. Even when doing practice problems, many students will opt to re-do old questions rather than tackle new problems. This gives students a false sense of security because their familiarity with the problem makes it easier to solve. In addition, many don’t yet have the maturity to complete assignments without the carrot/stick of course grades. So during an unstructured period of time, many students will not continue to regularly and systematically exercise their programming skills.
During the break, many students went home and reconnected with family and friends. Some of the focus group participants even indicated that they had gone to visit their former high school teachers. One question to further explore is whether returning to their high school environment influences their mindset to revert back to old habits and behaviours that may or may not lead to success in the university environment.

Going forward, further study is clearly needed with regards to the effectiveness of the fall break given the scarcity of any rigorous research in the area. There is an underlying assumption that any break will be helpful with regards to student stress levels, and that the break itself will cause no harm. The results from this study bring into question the validity of the latter assumption, and do not show any support for the former.

Discussions at UWaterloo suggest the fall break may switch to be a full week long to alleviate the scheduling headaches of the current format. In the event that fall breaks continue because of the momentum behind them, there needs to be thought put towards how to best mitigate any negative impacts on students.

Speaking more locally about GENE121, programming is a skill that requires frequent, deliberate practice, so incentives of some sort will be needed to keep students practicing during the break. This will need to be coupled with careful messaging as to how students should spend their time during the break (which seems to have partially succeeded in 2016 and 2017 based on student comments).

Lastly, although the First Year Engineering Office discusses study skills with the students at several times during the term, it may be that additional, or more explicit, study skills training is required before the fall break. This may include instructions with regards to effective studying that are repeatedly reinforced during students’ time away from campus. These instructions would be counter to the messaging coming from some of the student support groups at UWaterloo who emphasize the break should be used to relax, and not to study. This inconsistent messaging encourages some students to get out of the habit of regular practice and can break the study routines they have spent 5 weeks building.

5 CONCLUSIONS

A linear regression model controlling for identity, prior experience, hours of study, and programming ability at end of term predicts that students who regret how they spent the fall break earn 6% less on their GENE 121 course grade. A logistical regression model predicts that students with the least experience, who didn’t study programming over the break, and who performed poorly on their GENE 121 midterm have the highest odds of regretting how they spent the break. To reach this group of students who are some of the more vulnerable students in the class, there clearly needs to be more structure put in place to allow them to use the fall break more effectively.

In the three focus groups conducted with first and second year students, students agreed they had been told it was a study break rather than unstructured free time. However, use of campus resources during the break was mixed, even for students who remained in Waterloo. The comments implying that assignments or homework are not ways to study a course and so should not be given during the break are troubling. The students may not be recognizing the effectiveness of completing assignment problems, preferring activities such as re-reading and summarizing their notes. Alternatively, course instructors may need to look at the alignment of assessments with regards to the learning outcomes for their course(s).

A difference between fall and winter breaks was also noticed in terms of student relaxation. The fall break occurred before midterm week resulting in some stress even while away from campus. The winter break on the other hand, which occurred immediately following midterm week, provided a more relaxing break for students without concerns for upcoming exams.

Given the high number of students regretting the break, and the vulnerability of those students, further study is clearly needed to determine whether there are offsetting improvements in mental health and stress for the students. Students may need assistance with how to effectively study, particularly when left with unstructured time during the break.

The authors are calling for a wide-ranging discussion and further study on this issue to determine how widespread any impact might be in terms of program, year of student, etc., and to rigorously determine the advantages and disadvantages of a fall break. Lastly, given the likelihood of fall breaks becoming permanent fixtures in Ontario, effort needs to be spent on how to implement them so as to support and encourage student success in the University environment.
6 REFERENCES

[1] University of Waterloo Fall Break Task Force, "Consideration of a Fall Break at the University of Waterloo: Report to the Vice President and Provost," Waterloo, ON, 2014.


