Research Project Four – Executive Summary

Title: Grade 7 Mathematics Achievement Study

In 2023–2024, STEM Collegiate undertook an externally reviewed quantitative research study to examine whether students' mathematics achievement improved after one year in the Grade 7 STEM program. This study was approved by the Vancouver Island University Research Ethics Board (REB File No. 103200) and used existing, anonymized achievement data only. The inaugural Grade 7 cohort (N = 143) was included if they had both a Grade 6 Mathematics Provincial Achievement Test (PAT) score from June 2023 and a Grade 7 final mathematics exam score from June 2024. Students attended a variety of schools across Alberta in Grade 6 and then completed Grade 7 at STEM Collegiate.

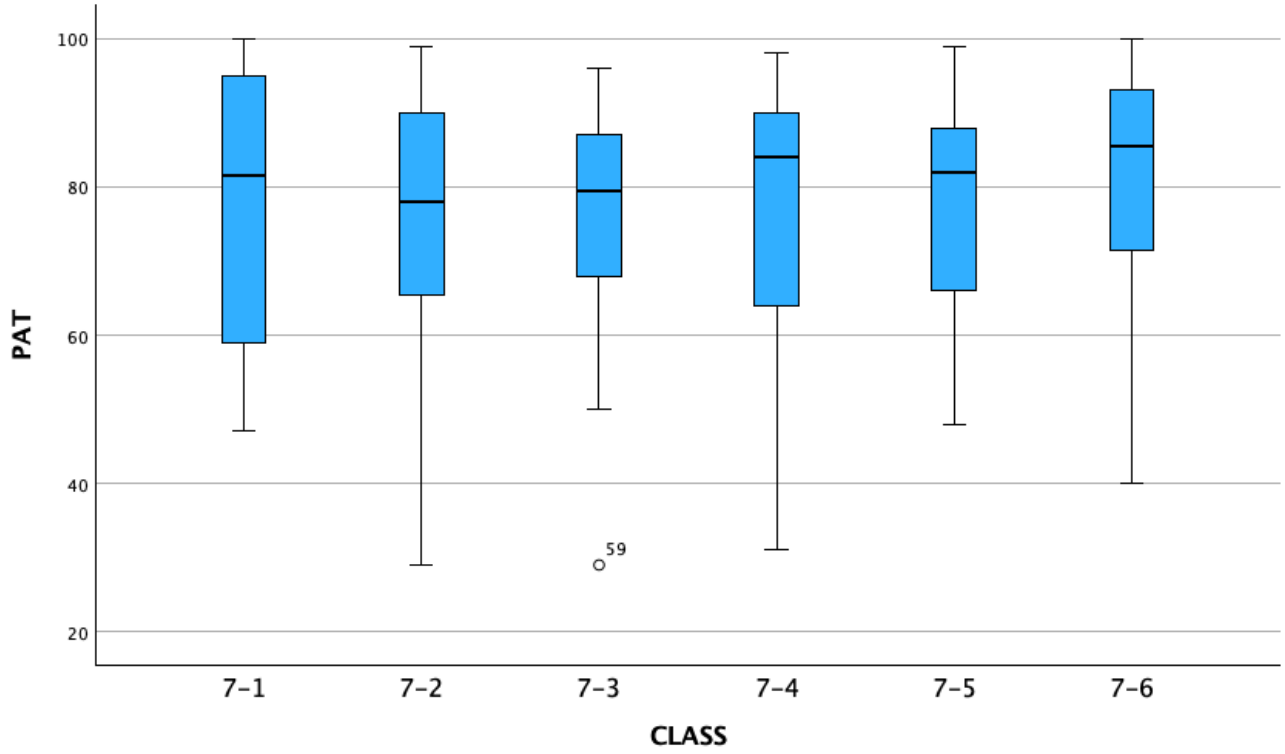

Figure 1: *Gr. 6 June 2022 Math PAT results by 2023-2024 Gr. 7 homeroom*

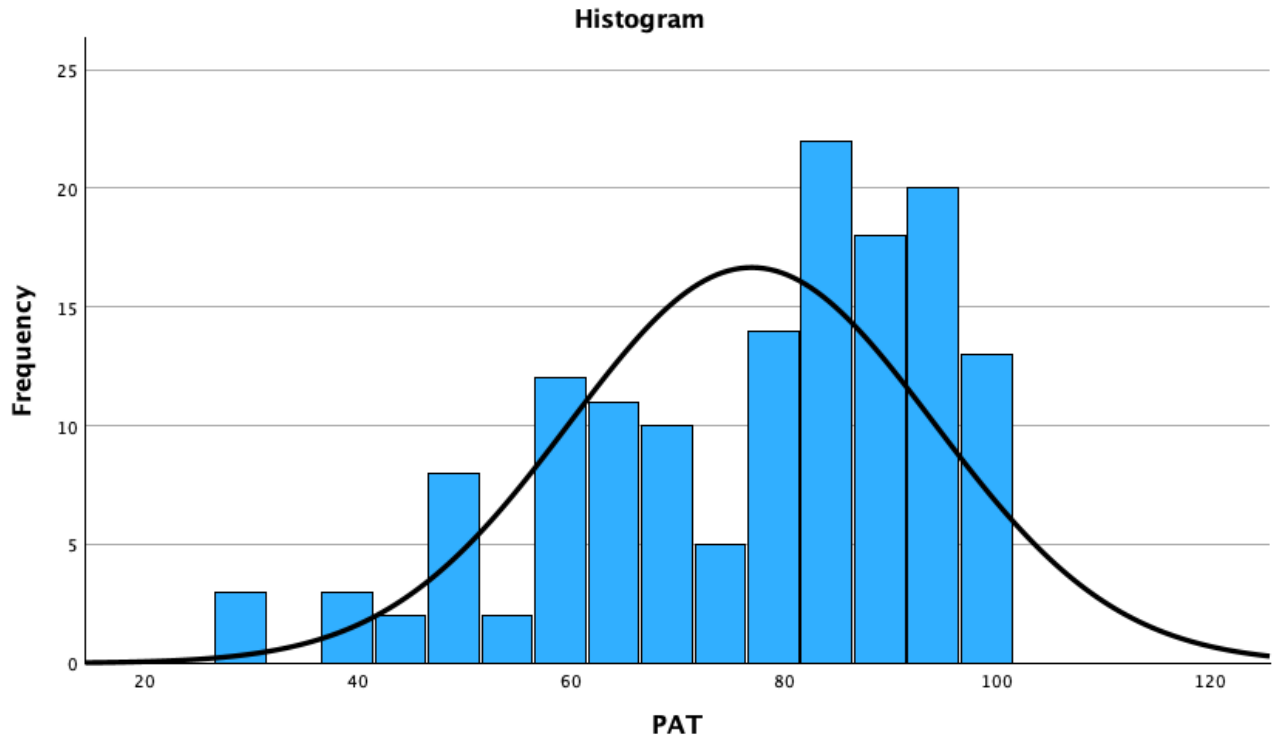

Figure 2: All Gr 6 June 2022 MATH PAT scores.

Methodology

The quantitative analysis first compared each student's Grade 6 PAT percentage to their Grade 7 final exam percentage using paired-samples t-tests. Before running inferential statistics, the data were examined extensively for normality and central tendency at three levels: by homeroom, by time of day of instruction (morning vs afternoon), and as a full cohort. In all cases, the distributions were approximately normal, allowing for the use of parametric tests. For the full cohort, the average Grade 6 PAT score was 76.97% (SD ≈ 17.12), and the average Grade 7 final exam score was 78.86% (SD ≈ 15.43), yielding an average gain of about 1.9 percentage points.

June 2023 Grade Six Provincial Achievement Test (PAT) results in Mathematics by Grade Seven Homeroom			
G7 Homerooms 23/24	Measures of Central Tendency:	Measures of Variability (Dispersion):	Measures of Distribution:
7-1	N = 24 Mean = 77.50 Median = 81.50 Mode = 59	Standard Deviation (SD): 17.927 Variance (s^2): 321.491 Range: 53	Skewness: - 0.316 Kurtosis: - 1.517

		(IQR) Middle 50% of data, reducing outlier effect: 36	
7-2	N = 24 Mean = 74.92 Median = 78.00 Mode = 46[a]	Standard Deviation (SD): 18.488 Variance (s^2): 341.819 Range: 70 (IQR) Middle 50% of data, reducing outlier effect: 26.25	Skewness: - 0.780 Kurtosis: 0.191
7-3	N = 24 Mean = 76.46 Median = 79.50 Mode = 78[a]	Standard Deviation (SD): 16.516 Variance (s^2): 272.781 Range: 67 (IQR) Middle 50% of data, reducing outlier effect: 20	Skewness: - 1.274 Kurtosis: 1.631
7-4	N = 26 Mean = 75.73 Median = 84.00 Mode = 84[a]	Standard Deviation (SD): 19.189 Variance (s^2): 368.205 Range: 67 (IQR) Middle 50% of data, reducing outlier effect: 27	Skewness: - 0.959 Kurtosis: 0.002
7-5	N = 25 Mean = 76.56 Median = 82.00 Mode = 56[a]	Standard Deviation (SD): 15.392 Variance (s^2): 236.923 Range: 51 (IQR) Middle 50% of data, reducing outlier effect: 24	Skewness: - 0.274 Kurtosis: - 1.121
7-6	N = 20 Mean = 81.50 Median = 85.50 Mode = 84[a]	Standard Deviation (SD): 15.585 Variance (s^2): 242.895 Range: 60 (IQR) Middle 50% of data, reducing outlier effect: 24.25	Skewness: - 1.162 Kurtosis: 1.107

Finding One

A paired-samples t-test on the full cohort (N = 143) showed that this gain, while positive, did not reach statistical significance at the conventional $p < 0.05$ threshold ($t(142) \approx 1.60$,

p = 0.113). The effect size (Cohen's d ≈ 0.13) was small, below the usual benchmark for a "small" effect. In practical terms, however, more than half of the students (about 55%) improved their mathematics performance from Grade 6 to Grade 7, and only about 42% declined sightly, with the remainder staying the same.

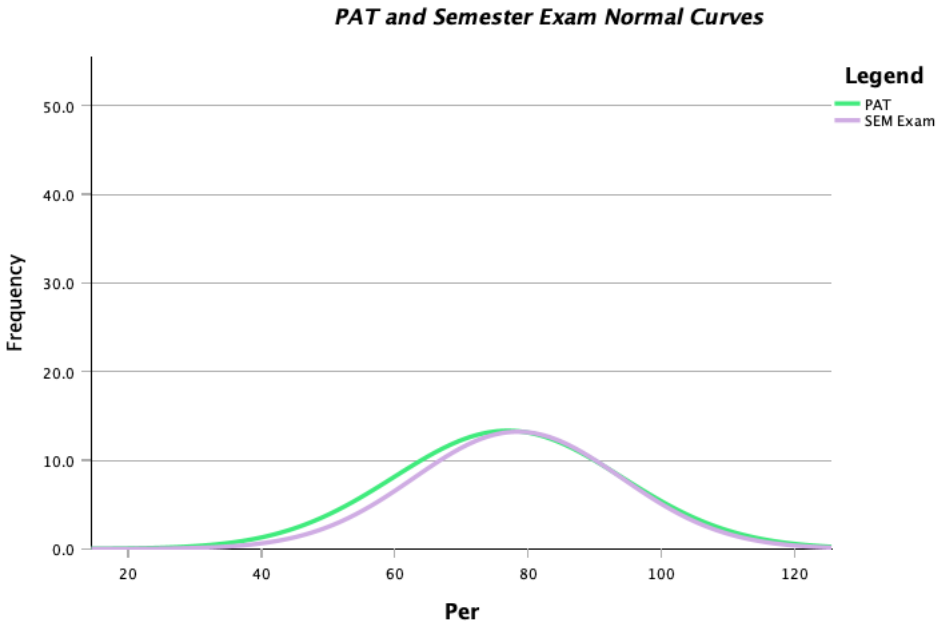

Figure 3: *Distribution of Gr. 6 June 2022 Math PAT results vs. Gr. 7*

In the context of mathematics learning., where achievement often plateaus or declines after Grade 6 as concepts become more complex and cumulative, this pattern of stable-to-slightly-improved performance for the cohort as a whole is encouraging. Rather than seeing the typical erosion of performance as curriculum difficulty increases, STEM Collegiate's students, on average, maintained and slightly improved their standing.

Finding Two

An unanticipated but notable aspect of this study was the pattern of results related to the time of day when Grade 7 mathematics was scheduled. There is a widely held belief among educators that students perform better in mathematics when it is scheduled before lunch, with the assumption that students are fresher and more focused in the morning. The findings from this study offer a more nuanced picture of that assumption.

June 2023 Grade Six Provincial Achievement Test (PAT) results in Math by Time of Day of Instruction (AM and PM) for Grade Seven Math Class in 2023-2024.			
G7 Homerooms 23/24	Measures of Central Tendency:	Measures of Variability (Dispersion):	Measures of Distribution:
7-4 7-1 7-3	N = 74 Mean = 76.54 Median = 82.00 Mode = 84[a]	Standard Deviation (SD): 17.716 Variance (s^2): 313.841 Range: 71 (IQR) Middle 50% of data, reducing outlier effect: 29.25	Skewness: - 0.806 Kurtosis: - 0.150
7-2 7-5 7-6	N = 69 Mean = 77.42 Median = 82.00 Mode = 86[a]	Standard Deviation (SD): 16.568 Variance (s^2): 274.483 Range: 71 (IQR) Middle 50% of data, reducing outlier effect: 24.50	Skewness: - 0.724 Kurtosis: - 0.71

When students were grouped by time of day of instruction, those who had mathematics in the morning (N = 74) showed a small but statistically significant improvement from their Grade 6 PAT scores to their Grade 7 final exam scores, with an average gain of approximately 3.6 percentage points and a p-value of 0.049. By contrast, students who had mathematics in the afternoon (N = 69) showed almost no change at all, with an average gain of only 0.1 percentage points and no statistically significant difference.

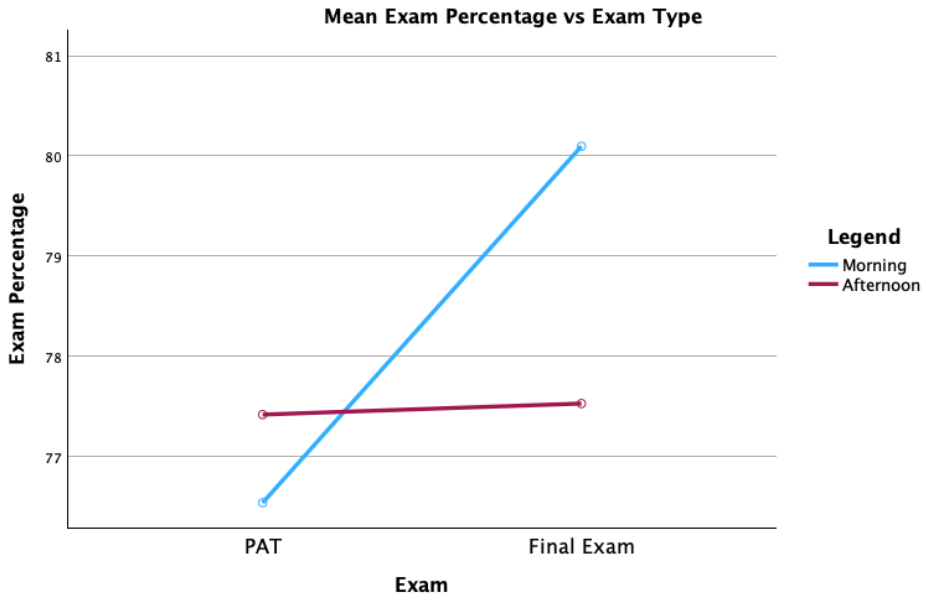

Figure 4: *Gr 6 June 2022 Math PAT results and Gr. 7 June 2023 Math Final Exam results by instructional time of day*

Looking at the graph shown in Figure 4, it is clear that the afternoon group showed very little change in mean scores between their PAT test and Grade 7 Mathematics Final

Exam. The morning group has a clear but small increase in mean score. It is clear from the data that the intervention of teaching students in the morning more likely to lead to higher results.

On its face, this pattern appears to support the common belief that "math before lunch is better." However, several factors suggest that this interpretation should be made with caution.

2023/2024 GRADE 7 MATH CLASS SCHEDULE	
Period One	7-4 Teacher A
Period Two	7-1 Teacher A
Period Three	7-3 Teacher A
Period Four	7-6 Teacher B & 7-2 Teacher A
Period Five	7-5 Teacher A
Period Six	No grade seven math taught P6 in 23/24 (Teacher A Prep)

First, although the morning group's improvement reached statistical significance, the effect size was small (Cohen's d ≈ 0.23), indicating that the practical difference in achievement was modest. Second, this was a quasi-experimental design in a real school context, not a randomized controlled trial. Students were not randomly assigned to morning or afternoon math; time of day is confounded with other variables such as specific teacher, class composition, and possibly subtle scheduling or support differences. As a result, we cannot confidently attribute the difference in gains solely to the time of day. Third, when all six classes were combined into a single cohort, the overall improvement (about +1.9 percentage points) was not statistically significant, and the effect size was very small. This suggests that, at the cohort level, the STEM Collegiate Grade 7 program appears to be stabilizing and slightly improving mathematics achievement, but not in a way that strongly differentiates morning instruction from afternoon instruction.

Taken together, these findings are provocative rather than definitive. They do not provide strong evidence that "learning math before lunch" is universally better, but they do raise important questions about how scheduling, teacher assignment, and classroom context might interact to influence student achievement in mathematics. For STEM Collegiate, the time-of-day results highlight a potential area for further inquiry and internal experimentation, rather than a simple confirmation of an existing belief.

Recommendations

This study represents the first phase of a longitudinal analysis of the inaugural Grade 7 cohort's mathematics achievement. As a next step, the same group of students, now in Grade 8, will continue to be tracked over the next two years. Their performance on internal assessments and, ultimately, their Grade 9 Mathematics PAT results (written in June 2027 as STEM Collegiate students) will be compared to their Grade 6 PAT results (written in June 2022 in their prior non-STEM school). This will allow for a more robust, multi-year evaluation of the impact of the STEM Collegiate program on mathematics achievement overtime and will provide evidence of whether the school is closing long-standing gaps in mathematical understanding.

In addition, the preliminary indication that morning mathematics classes are associated with small but measurable gains suggests that timetabling and instructional scheduling may be a relevant lever for continued improvement. Future planning in the upcoming years will consider ways to align scheduling, instructional strategies, and supports to maximize mathematics learning, particularly for students who enter with lower prior achievement.

Conclusion

Overall, the Grade 7 mathematics study provides measurable, positive evidence that STEM Collegiate is not only preventing the common decline in mathematics achievement after Grade 6 but is beginning to close prior learning gaps for its inaugural cohort. The gains observed, though modest and not statistically significant at the whole-cohort level, point in the right direction and are consistent with the school's charter goal of building strong STEM foundations and improving mathematics outcomes over time. The statistically significant improvement in the morning group, along with the overall small upward shift, supports the conclusion that the program is helping students at least maintain and, for many, improve their performance in a subject where foundational concepts built from year to year, therefore further regression in grade 7 the typical the outcome for those who struggled with math in Grade 6.