

# Planning for Mathematics Learning Renewal Amongst Ontario's Elementary Students: Comparing Item-Level Student Performance Pre- and Post-Pandemic

## Research Brief

APRIL 2024

The 2021–2022 school year was the first chance for Ontarians to see how the interruptions to in-person learning caused by the COVID-19 pandemic had affected student achievement on EQAO assessments.<sup>1</sup> Across North America, many jurisdictions have reported marked decreases in student achievement in mathematics (California Department of Education, 2022; Massachusetts Department of Education, 2022; New York Department of Education, 2022). How were Ontario students faring in their mathematics learning?

The 2021–2022 school year was also the first time the EQAO assessments had been delivered online to students. Because of the online format, the mathematics assessments also used new types of questions and a new adaptive assessment model for the first time (EQAO, 2020, 2021). In addition, the 2021–2022 school year was the first time students had been assessed on the new elementary mathematics curriculum introduced in 2020.

These changes mean that it is difficult to know whether differences between pre-COVID-19 and 2021–2022 results are due to pandemic-related learning loss, to adjustments to the new mathematics curriculum or to new assessment formats and measurement model. This is a challenge for educators working with students post-2022, because an understanding of the magnitude and kinds of learning loss is necessary to plan for rapid learning renewal (UNICEF, 2022).

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<sup>1</sup> In Ontario, schools were closed to in-person learning for 28 weeks between March 2020 and June 2021.

## How Can We Understand the Impact of COVID-19 on Mathematics Achievement in Ontario?

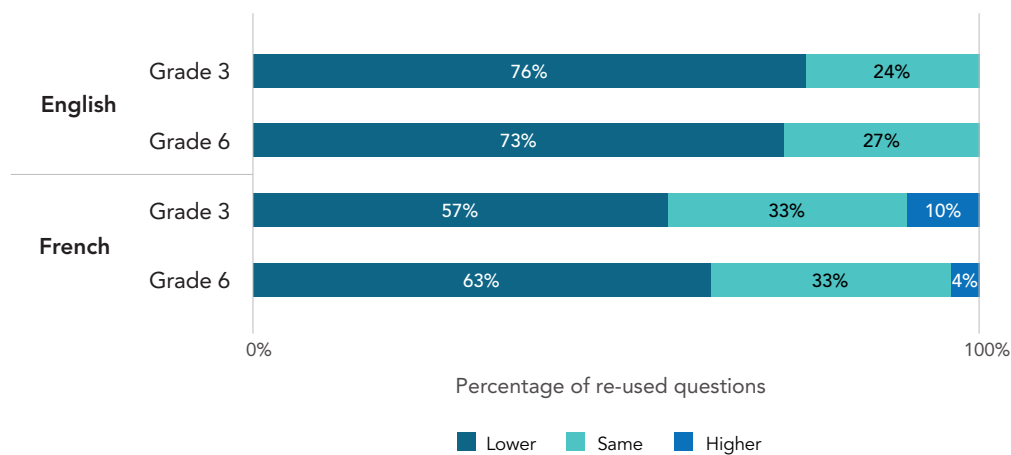
To contribute to this discussion, EQAO compared student performance only on the mathematics questions that had been used in 2021–2022 and had been last used in 2018–2019 or earlier.<sup>2</sup> This brief refers to these questions as the re-used questions. In the analysis, ‘student performance on a question’ was defined as the percentage of students who responded correctly to the question.

Students in Grades 3 and 6 were included in the analysis.<sup>3</sup> Several steps were taken to make sure that a direct comparison was possible between the sets of student responses used to determine student performance in 2021–2022 and those in previous years.<sup>4</sup> Analysis was conducted separately for students in English-language and French-language school boards. The final set of re-used questions included 29 Grade 3 and 51 Grade 6 English-language questions, and 21 Grade 3 and 27 Grade 6 French-language questions.<sup>5</sup> We do not know for sure whether the changes reported below are due to COVID-19-related learning loss or due to the other factors mentioned above, but because the analysis focused on re-used questions, learning loss is the most plausible explanation.

### Student Performance Was Lower in 2021–2022

The analysis showed that student performance decreased for most of the re-used questions among the Grade 3 and 6 student population of Ontario (see **Figure 1**).

**Figure 1. Percentage of Re-Used Questions on Which Students in 2021–2022 Performed Lower, the Same or Higher**



<sup>2</sup> Depending on the question, they were last used between 2015–2016 and 2018–2019. The question pool included field-tested questions and questions actively used in scoring (also known as ‘operational’ questions).

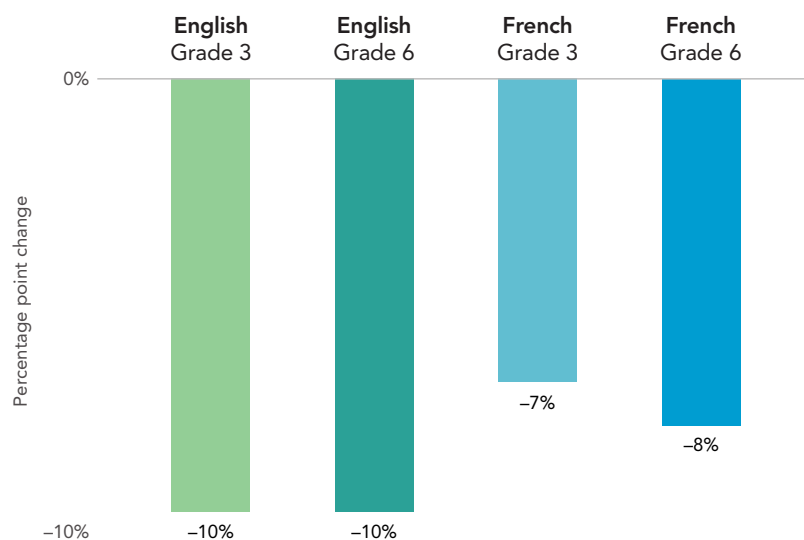
<sup>3</sup> Prior to 2021–2022, Grade 9 math courses in Ontario were streamed as either Academic or Applied, and students wrote the version of the assessment that was applicable to the streamed course in which they were enrolled. With the implementation of the new de-streamed curriculum in the 2021–2022 school year, these streams no longer applied from 2021–2022 onward. As a result, student performance on the Grade 9 assessments was not included in this analysis because there was no comparable student group between 2021–2022 and earlier years of EQAO assessments.

<sup>4</sup> Until 2018–2019, students at English-language and French-language boards wrote different mathematics assessments because the mathematics curricula were different. Therefore, English-language question responses from 2021–2022 were compared only with responses to the same English-language question in a prior year (between 2015–2016 and 2018–2019). French-language question responses from 2021–2022 were compared only with responses to the same French-language question in a prior year (between 2015–2016 and 2018–2019). Only multiple-choice questions were compared because technology-enhanced questions were new in 2021–2022. No questions were used from the ‘no calculator or manipulatives’ section of the previous Primary division assessments because from 2021–2022 onward, students could choose to use manipulatives or a calculator for all questions. For 2021–2022, only question responses provided by students during the first and fourth stages in the multi-stage computer adaptive testing architecture were included in the analysis, to ensure that the descriptive statistics from each question that were subsequently used in the analysis represented the general population in Ontario.

<sup>5</sup> Students at English-language boards respond to English-language questions, and students at French-language boards respond to French-language questions.

Across the re-used questions, student performance (that is, the percentage of students who responded correctly to a question) decreased for both Grades 3 and 6 in 2021–2022 (see **Figure 2**). English-language student performance on re-used questions decreased on average by 10 percentage points. French-language student performance decreased on average by seven and eight percentage points for Grades 3 and 6, respectively.

**Figure 2. Average Change in Percentage of Students Who Answered Re-Used Questions Correctly**



### Grade 3 Students Decreased Most on the Spatial Sense Strand and the Thinking Category of Knowledge and Skills, and Least on the Number Strand

Regarding specific grades, Grade 3 student performance decreased differently across questions assessing different curriculum strands and categories of knowledge and skills (see **Figures 3 and 4**).<sup>6, 7, 8, 9</sup> The trends were similar for students at English- and French-language boards, although the magnitude of the decrease may have been somewhat greater for students at English-language boards.

<sup>6</sup> Number of re-used English-language questions for each strand and category of knowledge and skills: *Grade 3* Number n=11, Algebra n=6, Data n=5, Spatial Sense n=7, Knowledge and Understanding n=12, Application n=13, Thinking n=4; *Grade 6* Number n=17, Algebra n=12, Data n=8, Spatial Sense n=14, Knowledge and Understanding n=11, Application n=23, Thinking n=17.

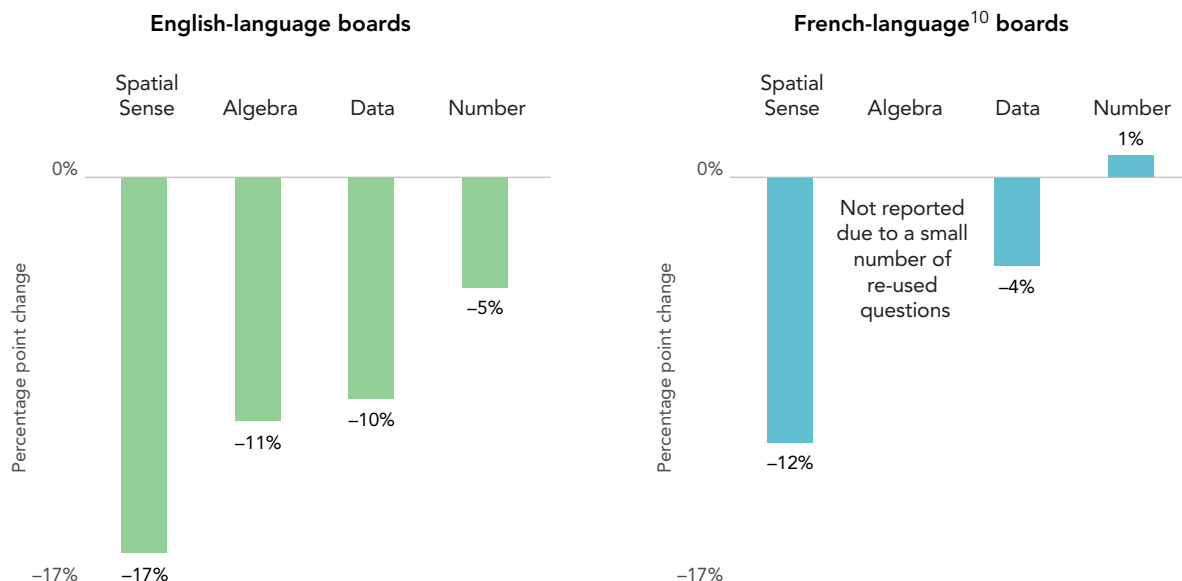
<sup>7</sup> Number of re-used French-language questions for each strand and category of knowledge and skills: *Grade 3* Number n=7, Algebra n=2, Data n=4, Spatial Sense n=8, Knowledge and Understanding n=5, Application n=8, Thinking n=8; *Grade 6* Number n=7, Algebra n=3, Data n=9, Spatial Sense n=8, Knowledge and Understanding n=4, Application n=16, Thinking n=7.

<sup>8</sup> The mathematics curriculum strands are described in *The Ontario Curriculum*. Five are assessed on EQAO assessments: Number, Algebra, Data, Spatial Sense/Geometry and Measurement, and Financial Literacy. Financial Literacy is a new strand introduced in 2020 (Grades 1–8) and 2021 (Grade 9) that therefore could not be included in this analysis. The strands not explicitly assessed are known as Social-Emotional Learning Skills in Mathematics and the Mathematical Processes in Grades 3 and 6 and Social-Emotional Learning Skills in Mathematics and Mathematical Thinking and Making Connections in Grade 9 (Ontario Ministry of Education, 2020, p.78 and 2021, p.36).

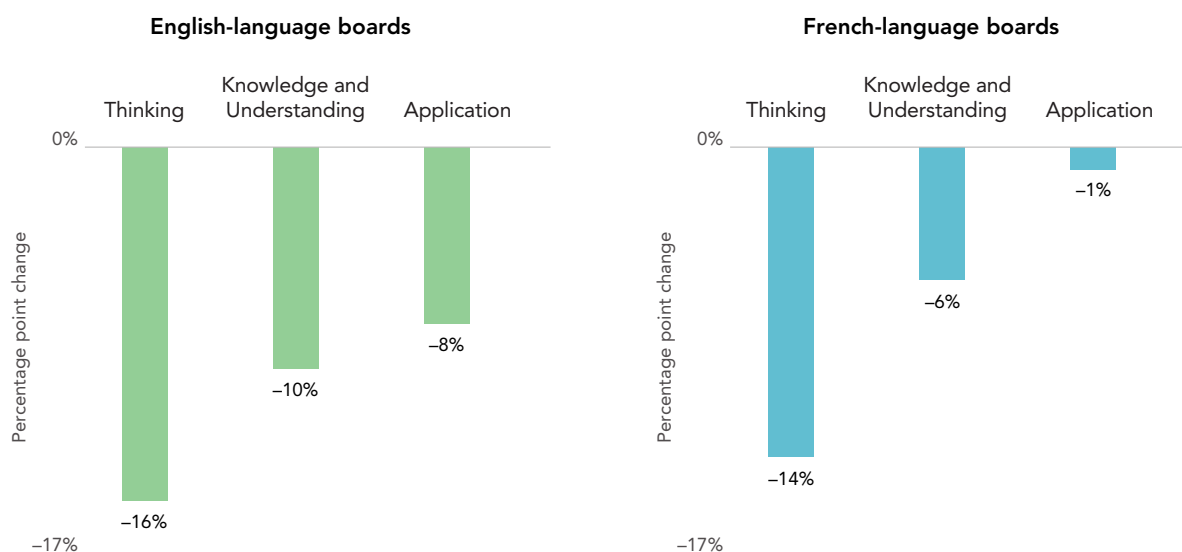
<sup>9</sup> Four categories of knowledge and skills are described in *The Ontario Curriculum*, three of which are assessed on EQAO mathematics assessments: Knowledge and Understanding: “Subject-specific content acquired in each grade or course (knowledge), and the comprehension of its meaning and significance (understanding)”; Application: “The use of knowledge and skills to make connections within and between various contexts”; and Thinking: “The use of critical and creative thinking skills and/or processes.” The category not explicitly assessed is Communication: “The conveying of meaning and expression through various forms.” (Ontario Ministry of Education, 2020, p.50)

First, student performance decreased least on re-used questions assessing the Number strand (see **Figure 3**). In contrast, Grade 3 student performance decreased particularly on re-used questions assessing the Spatial Sense strand (see **Figure 3**). Finally, Grade 3 student performance on re-used questions that assessed the Thinking category of knowledge and skills also notably decreased (see **Figure 4**).

**Figure 3. Grade 3 Student Performance Change on Curriculum Strands, in Percentage Points**



**Figure 4. Grade 3 Student Performance Change on Categories of Knowledge and Skills, in Percentage Points**

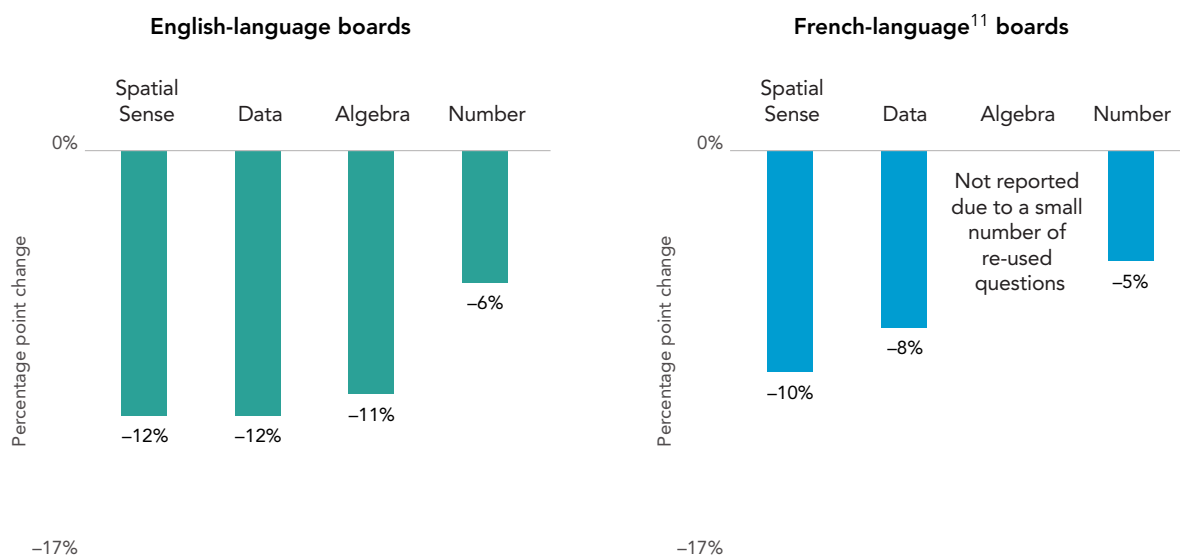


<sup>10</sup>Due to the small number of re-used French-language questions for Grade 3 Algebra (n=2), the change in average student performance is not reported. To report changes, the minimum number of re-used questions required for a strand (within grade and language) was four.

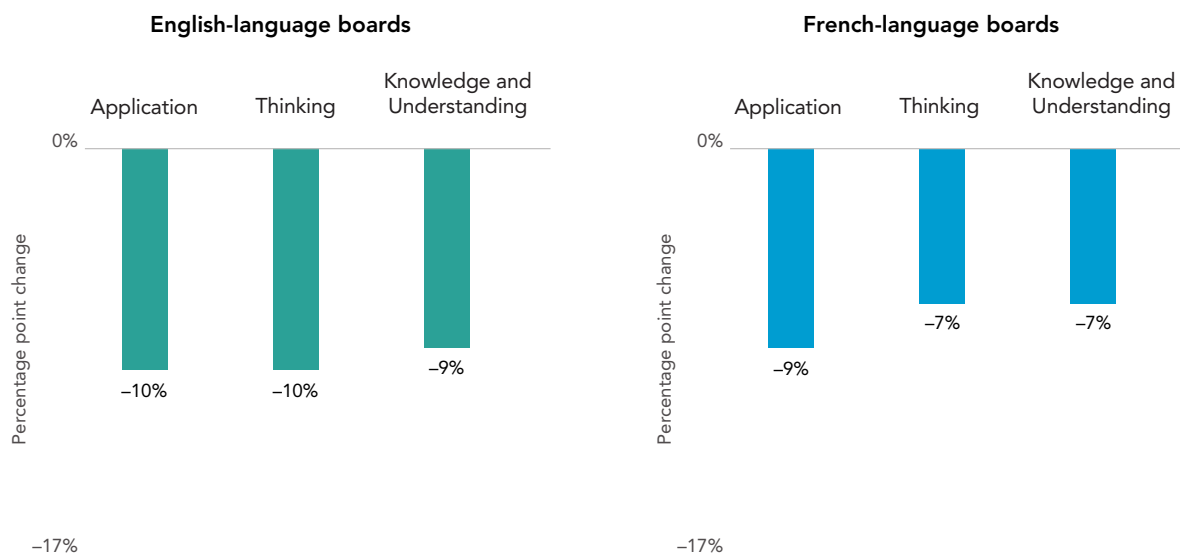
## Grade 6 Students Decreased Least on the Number Strand

Similar to Grade 3 student performance, Grade 6 student performance also decreased the least on re-used questions assessing the Number strand (see **Figure 5**). However, in contrast to the Grade 3 findings, decreases in student performance on the other strands were relatively consistent. Similarly, the decrease was also more or less the same across the categories of knowledge and skills (see **Figure 6**).

**Figure 5. Grade 6 Student Performance Change on Curriculum Strands, in Percentage Points**



**Figure 6. Grade 6 Student Performance Change on Categories of Knowledge and Skills, in Percentage Points**



<sup>11</sup> Due to the small number of re-used French-language questions for Grade 6 Algebra ( $n = 3$ ), the change in average student performance is not reported.

## Summary of Findings and Discussion

As educators in Ontario continue to assess learning losses resulting from the COVID-19 pandemic and strive to implement targeted support for learning recovery, these findings suggest some areas for reflection:

- For both Grade 3 and Grade 6 students, the smallest decreases in performance were observed for questions in the Number strand.

The relatively smaller decrease in performance across Ontario for Number questions may have been due to fewer curriculum changes in the Number strand, resulting in teachers being more familiar with the content and having more access to instructional resources during learning disruptions. Students may also have been more likely to possess the foundational skills from earlier grades. Other possibilities are that the Number strand was relatively well-suited to online teaching and learning, and/or that students regularly encounter aspects of the Number strand in their daily lives.<sup>12</sup> It is also possible that students received more support at home through activities such as worksheet practice that were accessible to parents and caregivers.

- For Grade 3 students, the largest decreases in performance were observed for questions in the Spatial Sense strand, although relatively large decreases were also seen for questions in the Algebra and Data strands.

The larger decrease in Spatial Sense may be rooted in instructional practices for Spatial Sense in Grades 1 to 3, which typically include the use of manipulatives, games and activities with concrete materials. The nature of learning strategies for Spatial Sense in the primary grades requires student engagement with physical materials and gives students the opportunity to develop a concrete understanding of many concepts within this strand. Concrete reference points are what students use to later move into diagrammatic and abstract understandings of the same concepts (Fyfe, McNeil & Borjas, 2015; Fyfe & Nathan, 2019). These learning opportunities may have been lessened during the pandemic.

- For Grade 6 students, substantial and similar decreases in performance were observed for questions in the Algebra, Data and Spatial Sense strands.

Again, the larger decrease for these three strands may be attributable to fewer opportunities to implement specific instructional practices during the pandemic. The Grade 6 curriculum includes increasingly abstract concepts and increased use of critical thinking and problem-solving skills. Social learning approaches such as access to others' work and sharing a variety of approaches to thinking through new concepts are known to effectively support learning in these areas (Cobb, 1995; Cobb et. al., 2003; Cobb, Wood & Yackel, 1993), and these opportunities may have been reduced during the pandemic.

- Regarding categories of knowledge and skills, findings suggest that for both Grade 3 and Grade 6 students, performance decreased across all categories. The largest decrease was observed for Grade 3 Thinking.

These findings might indicate that students in Grades 1 to 3 particularly rely on the classroom environment and consistent high-quality in-person teaching to effectively master more challenging mathematics concepts, more complex mathematics skills and new ways of thinking about problems.

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<sup>12</sup>Potential examples include estimating crowd sizes, adding and subtracting three digits, and using operations during household discussions about money and finance.

## Questions for Reflection

- How does this research impact my instruction? How can I use this information to further support students?
- What diagnostics are available to me within my school board and who is available to support my implementation of numeracy diagnostics and data review?
- How much of a gap can I close from multi-year learning loss with the school year that I have?
- How do I create a targeted gap-closing program within my class and school to support minimizing the long-term effects of learning loss for students?
- Who is the team I need around me to create an effective program plan to close gaps and support student future learning?
- What were the causes of learning loss for my students? Which students had less technological access or parental academic support? Which students had more time away from social and emotional development opportunities?
- If some learning loss is due to time away from social and emotional development, what time in my class and school should be spent on re-socializing students and training support staff who might not be familiar with those needs?
- What types of teaching strategies could be utilized to implement a social-emotional curriculum that supports re-socializing students while allowing me to move forward with closing academic learning gaps?

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