NSW Department of Education

Evaluation of the Numeracy Content Endorsed Course (CEC) in NSW Government secondary schools

Interim report

Centre for Education Statistics and Evaluation

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NSW GOVERNMENT

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Executive summary

What did we evaluate?

We evaluated the implementation and effectiveness of the Numeracy Content Endorsed Course (CEC), as of September 2020. The Numeracy CEC is an additional option for studying mathematics in Stage 6, focused on functional numeracy and supporting achievement of the HSC minimum standard in numeracy. The Numeracy CEC has so far been piloted in 2 waves:

- Pilot 1 was made up of Year 11 students in 2019 and Year 11 and Year 12 students in 2020 across 39 NSW Government schools.
- Pilot 2 was made up of Year 11 and Year 12 students in 2020 across an additional 49 NSW Government schools.

How did we evaluate it?

Our **process evaluation** examined the effectiveness of the implementation of the course.

Our **outcome evaluation** estimated the impact of the course on mathematics course-taking in Stage 6 and achievement of the HSC minimum standard in numeracy. This used a difference-in-differences method, where we compared cohorts of students in pilot and comparison schools before and after the pilots.

What did we find?

We found that the course was implemented well. Teachers reported high levels of engagement and satisfaction with the support provided by the NSW Education Standards Authority (NESA). Teachers and stakeholders considered the syllabus suitable for supporting students' numeracy needs. However, the course was communicated to pilot 1 schools late in Term 4 of 2018. This had the consequence of schools needing to target students for participation in the course, rather than communicating it through usual subject selection processes which typically occur earlier in the year.

We found that the course increased Stage 6 mathematics participation among Year 11 students by approximately 2-5 percentage points, except for the first cohort of students in pilot 1 schools in 2019, who are Year 12 students in 2020. We found no impact of the course on their mathematics participation, possibly due to the late communication of the course.

We also found that the course resulted in substantial increases in Stage 6 mathematics participation among students enrolled in Vocational Education and Training (VET) courses (8-11 percentage points), Aboriginal or Torres Strait Islander students (4-8 percentage points) and students in rural and remote areas (5-9 percentage points). We also found that the course increased Stage 6 mathematics participation for students from low socio-educational advantage backgrounds (4 percentage points), although only for Year 11 students starting in 2020 in both pilots 1 and 2.

We found a concurrent reduction in the proportion of students undertaking mathematics standard, indicating that some schools position the course as a more appropriate mathematics option for some of their students. However, we cannot verify whether these reductions were justified as Higher School Certificate (HSC) results were not available for any of these cohorts at the time of publication.

We found no evidence that the course impacted achievement of the HSC minimum standard in numeracy among students in the first cohort (pilot 1 Year 12 2020). We found limited evidence of its impact in this regard among students in Year 11 in 2020. However, we cannot rule out that some of this is caused by different testing patterns in pilot and comparison schools, as schools can choose when to test students. This may be worth investigating in a future evaluation.

What are the limitations of this evaluation?

Our process evaluation was largely informed by surveys of small groups of teachers participating in the Numeracy CEC pilot and a small set of interviews with pilot schools and stakeholders. It is possible that there may be views conflicting to those we have reported here that we did not obtain due to sampling.

Our outcome evaluation only covers the 2 groups of pilot schools that have implemented the course to date, and student outcomes that had been assessed by September 2020. We have assumed that there were no other changes occurring to the pilot or non-pilot group of schools at the introduction of the course pilots. This may be an unrealistic assumption as the changes to the HSC eligibility requirements (students having to demonstrate minimum standards from 2020) may have meant that schools who were not in pilot schools offered other mechanisms of support to help students achieve the HSC minimum standard in numeracy. Finally, we cannot evaluate at this stage whether any shifts of students from mathematics standard or advanced into Numeracy CEC were appropriate as HSC results for the first pilot cohort were not available at the time of publication.

What do our findings suggest?

Continuing and expanding the course statewide could have important benefits for students whose needs have not been met by other mathematics curriculum offerings in Stage 6. Key challenges in doing this include maintaining the quality of support to teachers without face-to-face conferences, and managing how the course is positioned so it is perceived as a tool for developing functional numeracy and not only as a tool for supporting students who have yet to meet the HSC minimum standard.

Chapter 1: **Introduction**

While NSW students can choose from a range of courses in Stage 6 (Years 11 and 12), not all students continue studying mathematics during this stage. In 2019, 82.1% of NSW Government school students undertook at least one mathematics course in their HSC. This has increased slightly from 80.9% in 2015[1].

A substantial number of students do not take mathematics, despite increasing evidence of the benefits of mathematics study for students' post-school outcomes. Poorer numeracy skills have been associated with lower levels of full-time employment (Parsons & Bynner 2006). Additionally, several studies find that mathematics study in secondary school positively impacts tertiary education participation and future earnings (Goodman 2017, Joensen & Nielsen 2009).

From 2020, all students must demonstrate that they meet a minimum standard in writing, reading and numeracy to obtain a HSC[2]. Improving numeracy skills among Stage 6 students who need support the most – a key student cohort targeted by the Numeracy CEC – could therefore increase rates of HSC completion in the state.

On 15 October 2018, NSW Premier Gladys Berejiklian announced the NSW Mathematics Strategy[3]. The vision stated in this strategy was for 'every child in NSW to have the necessary maths skills to succeed in life'. A key initiative under the NSW Mathematics Strategy is a new mathematics course, the **Numeracy Content Endorsed Course** (the Numeracy CEC), developed by NESA.

The Numeracy CEC pilot

NESA developed the Numeracy CEC in response to the Premier's announcement, as an alternative mathematics offering in Stage 6. The course was piloted in 2019 and 2020. The Numeracy CEC is focused on the development and consolidation of core numeracy skills through authentic and relevant learning scenarios. These include budgeting, shopping, record and account keeping, and a range of real-life activities requiring numeracy skills. The course is also aligned to the Australian Core Skills Framework (ACSF) Level 3, a nationally agreed level of functional numeracy (NESA, 2019). The course is available for study as a standalone course or in conjunction with a mathematics standard course.

The Numeracy CEC is structured as a 2-unit course. It can be delivered as a 120-hour course for Year 11, or as a 240-hour course across Year 11 and 12. The course can count towards the attainment of the HSC (but is not externally examined and does not contribute to an Australian Tertiary Admissions Rank (ATAR) calculation) and appears on the student's Record of School Achievement (RoSA). Where students request a RoSA, the Numeracy CEC will be listed with their other Stage 6 courses.

1 Statistics provided by the Centre for Education Statistics and Evaluation.

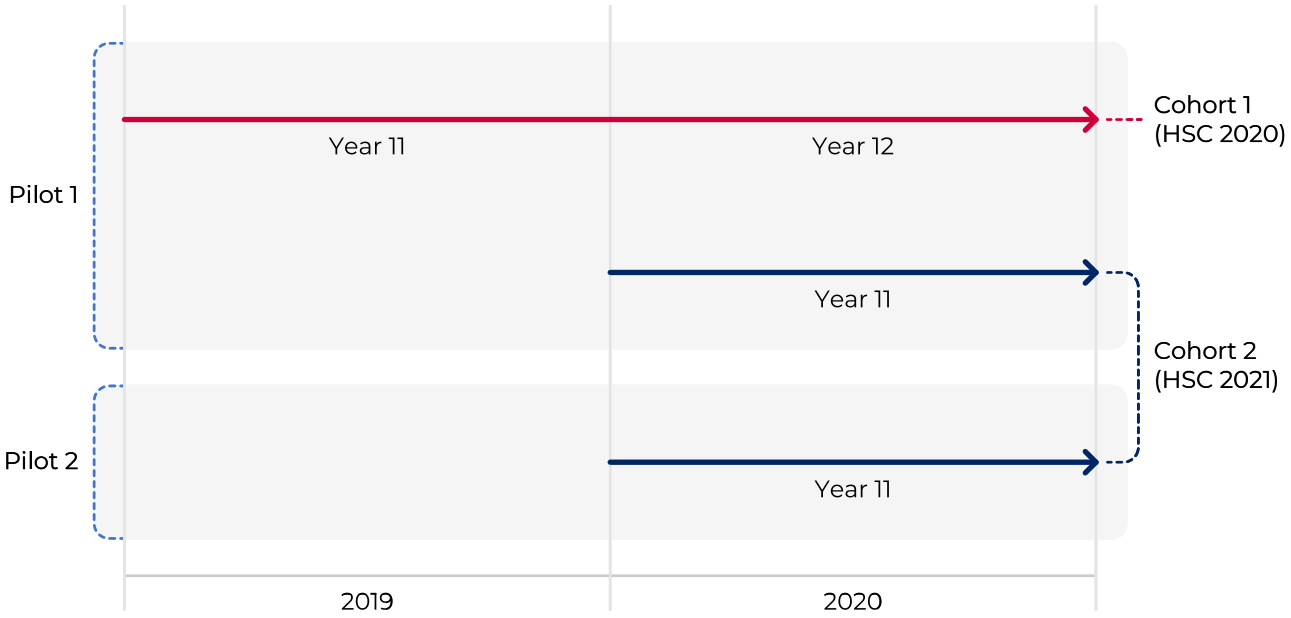
2 For more information on changes to HSC eligibility requirements, refer to: educationstandards.nsw.edu.au/wps/portal/nesa/11-12/hsc/hsc-minimum-standard

3 For more information on the NSW Mathematics Strategy, refer to: education.nsw.gov.au/about-us/strategies-and-reports/nsw-mathematics-strategy

The Numeracy CEC was piloted in 39 NSW Government schools in 2019[4] (pilot 1 schools) and a further 49 schools in 2020[5] (pilot 2 schools).

Figure 1:

Pilots and cohorts of Numeracy CEC



The first group of schools opted into pilot 1 through an expression of interest, which commenced in late 2018 and was available to all NSW Government schools. The syllabus was delivered to successful schools on 14 December 2018, close to the end of Term 4, so teachers had little time to prepare to teach the course and recruit students. In comparison the expression of interest for pilot 2 commenced on 2 September 2019. Confirmations of participation were sent to pilot 2 schools on 27 September 2019.

In addition to the course being new in NSW schools, secondary school teachers may not be accustomed to teaching numeracy, as opposed to mathematics. Consequently, NESA supported the implementation of the Numeracy CEC by providing the following to all pilot schools across the sectors (NESA, 2019):

- dedicated project officer support
- professional learning sessions via video and face-to-face conferences, focusing on pedagogical approaches for differentiation of teaching and learning strategies using the National Numeracy Learning Progression
- facilitation of a professional learning community among participants for resource sharing and collaborative development
- provision of teaching and learning programs, support materials and assessment resources
- opportunities for participants to provide feedback on the pilot course and support materials, and to shape the development and publication of the final course.

4 Some of these schools were part of the Western Access Program. Thus, 42 schools effectively had access to the course.

5 Effectively, students from 52 schools could access the course in pilot 2 as a school from the Northern Border Access Program signed up to the course. A NSW TAFE location also piloted the course in 2020.

This is a marked departure from NESA's traditional role in syllabus delivery. NESA ordinarily produces syllabus materials and leaves the sectors to guide schools in their implementation. However, in this case, NESA partnered with the sectors to provide direct support to schools. This included developing resources, assessment guides and activities for teachers to use in teaching the course. In addition to that, NESA funded professional learning conferences for pilot teachers[6].

The schools participating in the pilot were responsible for delivering the Numeracy CEC course to 2 cohorts (refer to Figure 1). This included:

- identification and selection of appropriate students for the course
- allocation of a teacher/s with suitable numeracy/mathematics expertise to teach the course.

The pilots are designed as a proof of concept for the validity, reliability and usability of the Numeracy Content Endorsed Course (CEC) Stage 6 Syllabus and associated support materials to improve students' numeracy skills.

Evaluation aims

The Numeracy CEC is expected to contribute to the following outcomes of the NSW Mathematics Strategy:

- All Stage 6 students choose to do mathematics.
- Teachers of mathematics have improved access to and participate in quality professional learning opportunities for teaching mathematics.

This evaluation aims to:

1. assess the implementation of the Numeracy CEC in NSW Government schools
2. estimate the impact of the Numeracy CEC on participation in Stage 6 mathematics
3. estimate the impact of the Numeracy CEC on the achievement of the HSC minimum standard in numeracy.

6 These were face-to-face professional learning conferences. However, the face-to-face conference planned for pilot 1 teachers in 25 and 26 May 2020 was cancelled due to COVID-19.

Chapter 2: **Method**

Data

Data sources

We used the following data sources to evaluate the implementation and effectiveness of the Numeracy CEC.

1. Surveys of teachers of the Numeracy CEC

We administered surveys to teachers of the Numeracy CEC to collect information on teachers' satisfaction with the support materials provided, the appropriateness and acceptability of the course, and various aspects of professional development. Three surveys were distributed:

- Pilot 1 Year 11 survey: We we distributed a survey via an anonymous link on the Numeracy CEC SharePoint site (the main platform where teachers of the course accessed resources) between 29 April and 22 May 2020. We received 20 responses[7].
- Pilot 1 Year 12 survey: We we invited 59 contacts[8] from 38 pilot 1 schools to participate in a survey between 7 September and 23 September 2020. We received 32 responses (response rate of 54.2%)[9].
- Pilot 2 Year 11 survey: We we invited 132 contacts from 49 pilot 2 schools, 20 pilot 1 schools, and a NSW TAFE location, to participate in a survey between 7 September and 25 September 2020. We received 66 responses (response rate of 49.2%)[10].

2. Interviews with stakeholders and teachers from pilot schools

We conducted interviews with:

- NESA project officers and course designers
- Numeracy CEC teachers and head teachers from 9 schools
- a representative from the Mathematical Association of NSW (MANSW)
- the department's leader of mathematics 7-12 and a department leader of vocational education and training.

Other stakeholders, including TAFE and the NSW Skills Board, were invited to be interviewed but could not be reached.

7 This survey was distributed as an anonymous link on the Numeracy CEC SharePoint site as data agreements to share teacher information had not been negotiated at the time. We do not know how many teachers of the Numeracy CEC course had access to the SharePoint site at the time.

8 The surveys were distributed to the entire list of Numeracy CEC pilot school staff provided by NESA. This includes teachers of the course, as well a school leaders or teachers who may have participated in the professional learning but not taught the course that year. We did not have information on which teachers actually taught the course from this list.

9 Out of these respondents, 25 were teachers of the Year 12 Numeracy CEC in 2020. The remainder were teachers who were on NESA's contact list but did not teach the course (such as principals, head teachers and coordinating teachers in pilot schools).

10 Out of these respondents, 53 were first time teachers of the Year 11 Numeracy CEC in 2020.

3. A linked student-level administrative dataset for use in our outcome analysis

The dataset was comprised of:

- NESA course enrolments database: all preliminary and HSC course enrolments data from 2014 to 2020. Note that for all years up to 2020, the data provided reflects enrolment status at the end of the year. The 2020 data reflects enrolments as of the end of September 2020.
- Student level NAPLAN data, including numeracy, reading and writing band results.
- Student level Year 10 mathematics results.
- ERN data, including: gender, Aboriginal or Torres Strait Islander status, language background other than English status (Australian Curriculum, Assessment and Reporting Authority (ACARA) 2017), socio-educational advantage (SEA) quartile (ACARA 2018), and schools' Australian Statistical Geography Standard (ASGS) Remoteness Area (Australian Bureau of Statistics 2016).
- 2020 HSC minimum standard test results up to August 2020.
- A list of pilot 1 and pilot 2 schools from NESA.

Preliminary and HSC course enrolments data were extracted in September 2020 from the NESA database. The data includes all course enrolments, including those that were not completed. Therefore we removed duplicate enrolments, keeping only the most recent enrolment for a student when they were enrolled in the same course more than once.

We created cohorts of Year 11 and Year 12 students from this data for each calendar year from 2015 to 2020. Some students have subject enrolments for the same grade across multiple calendar years (for example, they may take a Year 11 subject while in Year 10). We count students as being in a Year 11 or Year 12 cohort in the latest calendar year they have any enrolments at either year level[11]. Students are kept if their enrolments over time for either grade meet the HSC unit load requirement of 12 units in Year 11 and 10 units in Year 12[12]. Students who were enrolled in more than one main school were dropped from the sample[13].

11 Students, including those at compressed curriculum schools, are only counted in the last calendar year they are enrolled in a course for each grade. Therefore if a compressed curriculum student started Stage 6 in 2020 they would not be counted as a Year 11 or Year 12 student, since they would not meet the required unit load. On the other hand, a compressed curriculum student finishing their HSC in 2020 would be counted as Year 11 and Year 12 in 2020, since they are enrolled in both Preliminary and HSC subjects in 2020.

12 Applying this rule causes approximately 6% of students (4.6% in pilot 1 schools, 5.5% in pilot 2 schools and 6% in non-pilot schools) enrolled in any preliminary courses to be excluded from our sample. It also excludes approximately 4.2% of students (4.2% in non-pilot schools enrolled in HSC courses, and 3.9% of students in pilot schools) from our analysis.

13 This was to avoid potential issues with double counting students or crossover with students moving from pilot to non-pilot schools. It affected a small proportion (0.5%) of the sample.

Variables

We used the following variables from the linked dataset in our outcome analysis.

Outcome variables

- Whether a student was enrolled in Stage 6 mathematics
- Whether a student was enrolled in Stage 6 mathematics standard in Year 11, or mathematics standard 1 or standard 2 in Year 12
- Whether a student was enrolled in Stage 6 mathematics advanced in Year 11, or mathematics advanced or mathematics extension 1 or extension 2 in Year 12
- Whether a student met the HSC minimum standard in numeracy
    - From 2020, students need to pass an online HSC minimum standard tests in numeracy, reading and writing to attain their HSC. For the HSC 2020 cohort, students may demonstrate the minimum standard in each area if they have achieved at least a Band 8 in NAPLAN Year 9 Numeracy, Reading or Writing. While HSC cohorts prior to 2020 did not have to demonstrate achievement against the HSC minimum standard, for the purposes of analysis we consider their achievement of Band 8 in NAPLAN Year 9 Numeracy as a proxy for 'having achieved the minimum standard'.

Intervention variables

- Whether a student was in a pilot 1 school
- Whether a student was in a pilot 2 school

Control variables

- Indicator for gender
- Indicator for Aboriginal or Torres Strait Islander
- Indicator for language background other than English (LBOTE)
- Indicator for each SEA quartile
- Indicator for remoteness index of the school
- Year 10 mathematics result

Sample characteristics

Table 1 presents the characteristics of pilot 1 and pilot 2 schools compared to all other secondary and central schools. Overall, pilot 1 and pilot 2 schools are not systematically larger or smaller than other schools, nor are they geographically distributed differently. However, they have a larger proportion of Aboriginal or Torres Strait Islander students, especially pilot 2 schools, and have lower Index of Community Socio-Educational Advantage (ICSEA) compared to other schools. Summary statistics of student level characteristics are displayed in Appendix C. Students in pilot 1 and pilot 2 schools are more likely to come from Aboriginal and Torres Strait Islander backgrounds, and more likely to be in the lowest SEA quartile. They are less likely to come from a language background other than English, study mathematics advanced in Stage 6, and achieve a Band 8 or above in Year 9 NAPLAN.

Table 1:

School characteristics: pilot 1, pilot 2 and all other central and secondary schools

Factor	Pilot 1 schools	Pilot 2 schools	Other schools	p-value
n	42	49	379	.
School size (2019 FTE enrolments)	674.92 (381.52)	632.50 (390.30)	690.62 (374.41)	.591
ASGS Remoteness Area				.646
Inner Regional Australia	9 (21.4%)	10 (20.4%)	81 (21.4%)	.
Major Cities of Australia	22 (52.4%)	26 (53.1%)	226 (59.6%)	.
Not Defined	0 (0.0%)	0 (0.0%)	1 (0.3%)	.
Outer Regional Australia	10 (23.8%)	8 (16.3%)	57 (15.0%)	.
Remote Australia	1 (2.4%)	3 (6.1%)	9 (2.4%)	.
Very Remote Australia	0 (0.0%)	2 (4.1%)	5 (1.3%)	.
% Aboriginal or Torres Strait Islander, mean (SD)	16.43 (14.29)	23.81 (26.25)	12.75 (14.79)	<.001
% LBOTE mean (SD)	25.30 (31.00)	34.42 (33.08)	32.18 (32.00)	.393
ICSEA, mean (SD)	933.98 (49.17)	903.40 (90.10)	980.56 (92.53)	<.001

Note. p-value is calculated from analysis of variance (ANOVA) for continuous variables, and Pearson's Chi-squared test for categorical variables. FTE refers to full-time equivalent. SD refers to the standard deviation.

Source: ACARA School Profile 2019.

Process evaluation

The process evaluation assessed how well the course was implemented by NESA and whether the amount and type of support NESA provided pilot schools was in line with the aims of the course. We used an implementation outcomes approach to evaluate the quality of implementation. This approach looks for indicators of the success of implementation against several relevant domains (Proctor et al. 2011).

Table 2:

Implementation evaluation indicators, data sources and measures

Domain	Indicators of effective implementation	Data sources and measures
Adoption and fidelity	• Schools have adequately communicated the new course to relevant student groups. • There is demand for the course among NSW schools. • There is a high degree of uptake of support among participating teachers.	• Methods of communication reported by schools in interviews • Course enrolment statistics • Uptake of support as reported by NESA representatives in interviews • Survey responses from Numeracy CEC teachers on support used
Acceptability and appropriateness	• The syllabus and materials are considered appropriate for developing core numeracy skills. • Teachers are satisfied with the content of the course and the support provided by NESA. • The structure and delivery of support addresses teachers' needs.	• Interviews with stakeholders regarding the course's suitability for developing core numeracy skills • Survey responses from teachers of the Numeracy CEC regarding the appropriateness and their satisfaction with the content and support provided by NESA
Feasibility and sustainability	• The support model is perceived to be scalable and sustainable within NESA and schools' usual operations.	• NESA representatives' views on whether they can continue providing support (interviews) • Teachers' views on whether the course can continue in their school (interviews)

In addition to gathering data on the implementation of the Numeracy CEC against relevant domains, we also collected surveys on the implementation of the recent mathematics advanced and mathematics extension 1 syllabuses. This enabled us to compare the differences between NESA and the department's approaches to implementing new syllabuses, and which elements were perceived as more or less effective by schools. While we had anticipated that this could provide useful information about whether NESA could provide similar support to that provided by the department, the data we received suggested that teachers were not distinguishing between the delivery of the syllabus (provided by NESA) and the implementation of the support (provided by the department). Therefore we do not report on this data in this evaluation.

Limitations

There are several limitations of our process evaluation that are worth considering.

- First, the majority of our data is collected through surveys of relatively small groups of teachers (with the exception of the survey of the mathematics advanced and extension 1 teachers). Our surveys may not be representative of all teachers who took the course, and we cannot check this. However, we did find that the majority of pilot schools were represented in the surveys. Teachers from 32 out of 39 pilot 1 schools completed at least one survey, and teachers from 35 out of 49 pilot 2 schools completed the Year 11 2020 survey.
- Secondly, the measures we use are self-reported and not validated. It may be the case that there is minor measurement error.
- Finally, we interviewed a small sample of schools. While we attempted to ensure representativeness in the types of schools we spoke to, school availability and willingness means that these views may not reflect the experiences across the board.

Outcome evaluation

The major challenge in evaluating the effectiveness of the Numeracy CEC is that pilot schools may have poorer numeracy outcomes, or may have more students who do not find existing Stage 6 mathematics offerings suitable. Therefore simple comparisons of schools outcomes after the Numeracy CEC may be biased because pilot schools could have started with poorer outcomes, which the course may not entirely diminish.

To address this selection bias, we used a difference-in-differences (DID) analysis (Gertler et al., 2016). We essentially compared changes in student outcomes before and after the implementation of the Numeracy CEC pilot in pilot schools and comparison schools. Comparison schools are all other NSW Government schools with Stage 6 student enrolment.

The difference-in-differences analysis is valid provided 2 assumptions are met:

- **Common trends:** the intervention and comparison groups must have similar trends in the outcome absent any program or intervention.
- **Non-contamination:** there should be no concurrent interventions specific to the pilot or comparison schools that could affect the outcomes of interest, and no students in the comparison schools had access to the Numeracy CEC.

Overall, we found support for the common trends assumption when we tested prior trends in outcomes between pilot and comparison schools (refer to Appendix D for the results of our tests). Trends in Stage 6 mathematics participation (overall, and for mathematics standard and advanced/extension) between pilot and comparison schools before 2019 tend to be similar. However, trends in achievement in the HSC minimum standard in numeracy before the pilot (as measured by achievement of Band 8 in Year 9 NAPLAN Numeracy) were only similar between pilot and comparison schools when estimated using our simplest model[14].

14 We also supplement our analyses of the HSC minimum standard in numeracy with 'placebo tests' against the achievement of the HSC minimum standard in reading and writing. Theoretically, the Numeracy CEC should have no impact on the achievement of these. Thus we include these as a separate test of whether HSC minimum standard testing patterns are similar in pilot and other schools following the implementation of the pilot. These results are reported in the findings.

We implemented the difference-in-differences analysis using a regression model. Specifically, we estimated the following equation using ordinary least squares (OLS), where β_2 is our parameter of interest (the estimate of impact):

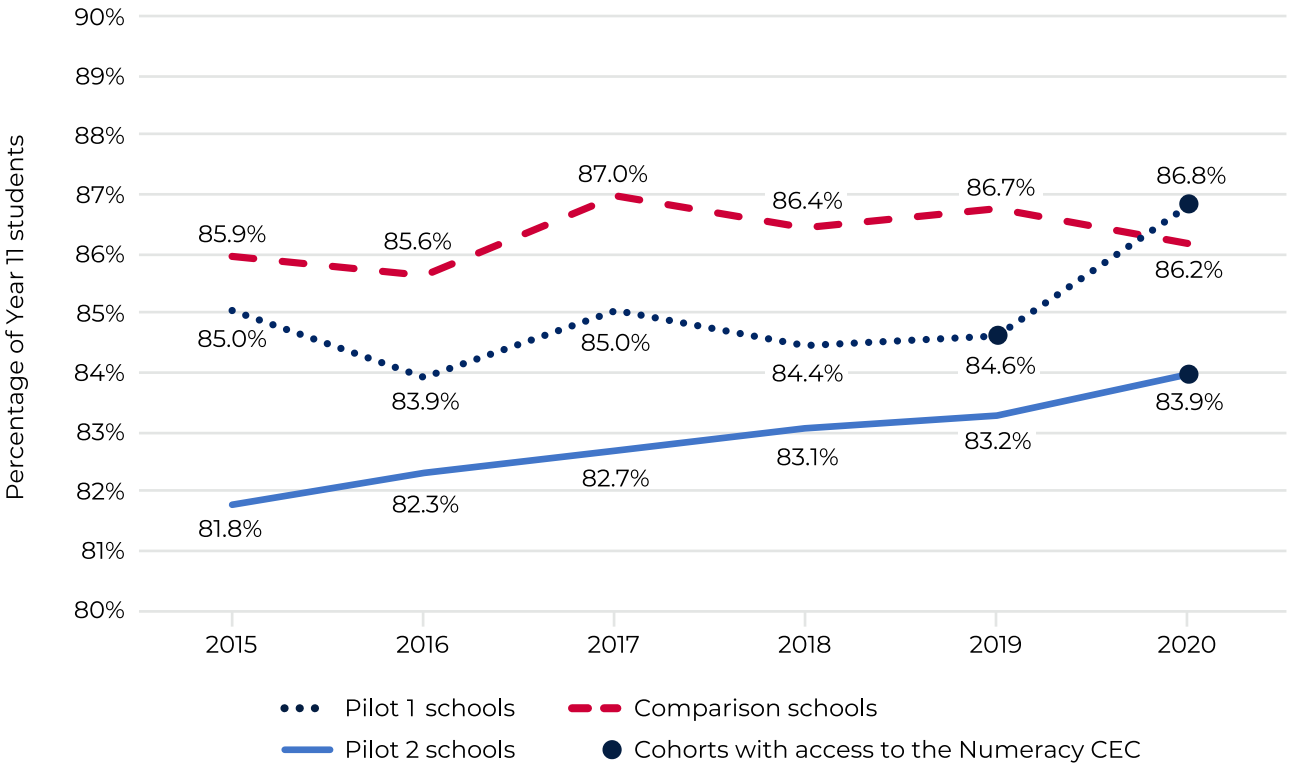
$$Y_{it} = \beta_0 + \beta_1 PILOT_{is} + \beta_2 (PILOT_{is} \times POST_{st}) + \beta X_{it} + \theta + \gamma + u_{ist}$$

In this model:

- Y_{it} is the outcome of interest for a student i in year t.
- $PILOT_{is}$ is an indicator for whether student i attended a pilot school s.
- $POST_{st}$ indicates whether year t is after the implementation of the Numeracy CEC pilot in school s.
- X_{it} is an optional vector of control variables.
- θ is a set of year fixed effects (a set of dummy variables for each year).
- γ is a set of school fixed effects.
- u_{ist} are a set of errors clustered at the school level.

Figure 2:

Percentage of Year 11 students enrolled in any mathematics course, pilot and non-pilot (comparison) schools



Note. The Numeracy CEC was available in pilot 1 schools in 2019 and 2020, and in pilot 2 schools in 2020.
Source: NESA preliminary course enrolments data, 2014-2020.

We ran several analyses across 3 outcome variables: Stage 6 mathematics participation, participation in mathematics standard and advanced/extension, and achievement of the HSC minimum standard. The key analyses we conducted for each outcome variable are outlined in Table 3.

Table 3:

Summary of outcome analyses

Outcome	Analyses
Stage 6 mathematics participation	• Year 11 students in pilot 1 schools in 2019 and 2020 to Year 11 students in comparison schools • Year 11 students in pilot 2 schools in 2020 to Year 11 students in comparison schools • Year 12 students in pilot 1 schools in 2020 to Year 12 students in comparison schools
Stage 6 mathematics participation in mathematics standard and advanced/extension	• Year 11 students in pilot 1 schools in 2019 and 2020 to Year 11 students in comparison schools • Year 11 students in pilot 2 schools in 2020 to Year 11 students in comparison schools • Year 12 students in pilot 1 schools in 2020 to Year 12 students in comparison schools
Achievement of the HSC minimum standard in numeracy	• Year 12 students in pilot schools in 2020 to Year 12 students in comparison schools (HSC 2020 cohort) • Year 11 students in pilot schools in 2020 to Year 11 students in comparison schools (HSC 2021 cohort)

We analysed the Numeracy CEC's impact on Stage 6 mathematics participation using regression models for each of the 3 treated groups: Year 11 students in pilot 1 schools, Year 11 students in pilot 2 schools, and Year 12 students in pilot 1 schools. We include 2 separate treatment indicators in the regression for Year 11 pilot 1 students, to separate the treatment effect for students in 2019 and 2020.

We also complement our analyses with by also conducting our analyses on a matched sample of pilot schools and other schools (Heckman, Ichimura, & Todd 1997). We created this matched sample using one-to-one propensity score matching[15], where pilot and comparison schools were matched on:

- the proportion of Stage 6 students who achieved a Band 8 or above in the Numeracy NAPLAN Year 9 tests in 2018
- the ASGS Remoteness Area
- the number of Stage 6 students in 2018
- the proportion of students in Stage 6 in each SEA quartile in 2018.

15 Schools were matched using psmatch2 in Stata.

We estimated the impact of the Numeracy CEC on rates of achievement of the HSC minimum for Stage 6 students in 2020. We matched pilot schools to similarly performing comparison schools using one-to-one propensity score matching. We matched schools using the following school level variables in 2019, prior to the introduction of the HSC minimum standard:

- the proportion of Stage 6 students enrolled in a mathematics course in 2019
- the proportion of Stage 6 students who achieved a Band 8 or above in each of the Numeracy, Reading and Writing Year 9 NAPLAN
- the ASGS Remoteness Area
- the number of Stage 6 students in 2019
- the proportion of students in Stage 6 in each SEA quartile.

Then, using student level data of students in matched schools, we estimated the DID regression on rates of achievement of the HSC minimum standards in numeracy, reading and writing.

For each of our analyses we run 3 model specifications to check the robustness of our estimates: firstly a simple differences-in-difference models, a second model that includes covariates, and a third model that includes covariates and school fixed effects. We mainly present estimates from the third model with control variables and school fixed effects, except for the analysis of achievement of the HSC minimum standards. Regression tables for all models are presented in Appendix E.

Limitations

Note that there are several limitations of this analysis. First, the definition of achievement of the HSC minimum standard changes over our analysis period. For students enrolled in Year 11 and Year 12 in 2020 (HSC 2021 and 2020 cohorts), we use achievement of the minimum standard as of August 2020. For HSC students prior to 2020 (when the HSC minimum standard requirement was introduced), we use achievement of a Band 8 or above in NAPLAN as a proxy for meeting the HSC minimum standard. While we demonstrated that trends in achievement of Band 8 or above in NAPLAN Year 9 Numeracy tests are similar in pilot and comparison schools prior to the pilot, this cannot provide evidence to whether trends in achievement of the HSC minimum standard through tests would be similar absent the Numeracy CEC. We have attempted to mitigate this by conducting concurrent analyses of achievement of the HSC minimum standard in reading and writing, in order to tell whether testing patterns are similar in pilot and other schools. However, this hinges on the assumption that schools undertake testing for all domains together. It could be the case that schools undertake more frequent testing for domains their schools are the weakest in. Thus, this supplementary test may not provide much further support for the common trends assumption.

Second, the concurrent introduction of the HSC minimum standard may undermine our assumption that there were no other changes occurring to the pilot or comparison group of schools at the introduction of the pilot. While the introduction of the HSC minimum standard applied to all schools, schools who were not in the pilot are likely to have offered other support to help students achieve the HSC minimum standard in numeracy. If this is the case, the benefits of the Numeracy CEC towards achieving the HSC minimum standard in numeracy will be somewhat weakened by the coinciding efforts in other schools to help their students achieve it.

Third, our latest course enrolments data ends in September 2020, as opposed to the end of Term 4, 2020. Therefore our analyses may overestimate the impact on mathematics enrolment in Stage 6, especially if students who take the Numeracy CEC are also those who are more likely to leave school early. The HSC minimum standard data ends in August 2020, and this truncated analysis period for 2020 also disadvantages schools who may test later.

Fourth, we also do not have data on achievement of the HSC minimum standard at the start of Year 11, and could not analyse the impact of the course on mathematics participation among those who have not achieved the HSC minimum standard at the start of 2019 and 2020.

Fifth, this evaluation only covers 'one and a half' of the Numeracy pilots – we can only perceive impacts on Year 12 mathematics participation for the first cohort of pilot 1. If there are 'maturation effects' where participation only increases after a course is established in a school, we may observe no impact on Year 12 mathematics participation from this single cohort.

Finally, while we can evaluate the shift from higher mathematics subjects into the Numeracy CEC, we are unable at this juncture to evaluate whether that has had positive effects in terms of providing students with a more suitable option. When HSC results become available, for students in Year 12 2020 (pilot 1 students) we could examine whether average results in mathematics standard or advanced improve following the introduction of the Numeracy CEC.

Chapter 3: **Findings**

Process evaluation

There was demand for the course among students, and schools used it in various ways to support students who were less engaged with or adept in mathematics

While there were a substantial number of students enrolled in the course in NSW Government schools, pilot 1 schools were only confirmed in December 2018 after subject selection for the coming year was completed. For this reason, schools had to contact and identify students directly to participate in this course. In subsequent years, and for pilot 2, the course was included in schools' usual subject selection communications.

> "Yeah, well, the first time in the first year, because it was so late coming, we couldn't offer on the subject selection. I just interviewed [targeted students] all individually and told them about the course and then got the uptake through that way this year."
>
> **Head teacher, pilot 1 school**

There appears to be a need and demand for the course in schools. Schools implemented the course in various ways to support students who were less suited to existing mathematics offerings. We identified at least 4 models of implementation from interviews with schools:

- as an option for students currently not taking mathematics
- as an option to support students to achieve HSC minimum standard in numeracy
- as a more suitable option for students who would find mathematics standard too difficult
- as a complement to mathematics standard[16].

Teachers also reported that the course had positive impacts on the self-confidence of students who were previously disengaged with mathematics. This was corroborated by results of a 2019 NESA survey of Year 11 students in pilot 1, where 157 out of 239 students (65.7%) agreed that they felt confident working on activities their teacher set for them.

Nonetheless, teachers also reported explanations why the course did not appeal to some students. One reason was students pursuing other interests, such as the humanities, or leaving school to work. Another was some students could not enrol in it, due to subject selection constraints. In order to meet the HSC eligibility requirements students must have pattern of study that includes at least 6 units of board developed courses, of which numeracy is not.

16 Between 2019 and 2020, 48 students in Year 11 were concurrently enrolled in numeracy and mathematics standard.

There is a high degree of uptake of course materials and teaching support among participating teachers

Virtually all teachers attended the Numeracy CEC conferences (Table 4). They also engaged with the main materials produced by NESA (the Teaching and Learning Programs and the Teaching Guides) to a high extent. Notably, teachers engaged less with the virtual collaboration and sharing aspects of the support.

In both the surveys and interviews, teachers reported contacting NESA project officers when they needed help. However, only half of Numeracy CEC teachers surveyed reported always being able to access the site.

Table 4:

Key implementation statistics

Measure of implementation	Metric
Course enrolments among Year 11 students in NSW Government schools in 2019 (pilot 1)	528 (101 withdrawn)[<?>]
Course enrolments among Year 11 students in NSW Government schools in 2020 (pilot 1 and pilot 2)	858 (36 withdrawn)
Course enrolments among Year 12 students in NSW Government schools in 2020 (pilot 1)	382 (40 withdrawn)
Proportion of teachers surveyed who reported attending Numeracy CEC professional learning conferences (n=73)	84.9%
Percentage of teachers of the Numeracy CEC who reported being able to obtain support from NESA 'Every time' or 'Most times' (n=69)	88.4%
Percentage of teachers of the Numeracy CEC who reported always being able to access the SharePoint site (n=87)	54.0%
Teachers of the Numeracy CEC average ratings of satisfaction with the support provided by NESA (n=73)	7.5/10
Teachers of the Numeracy CEC average ratings of whether the professional learning in general throughout the course met their needs (n=73)	6.7/10
Percentage of teachers of the Numeracy CEC who strongly or completely agreed that the flexibility of the course helped them meet students' needs more than if it had been a rigid syllabus (n=72)	90.3%

Sources: NESA enrolments data for NSW Government school students; Numeracy CEC teacher surveys.

Stakeholders and teachers considered the course syllabus and materials to be appropriate for developing students' core numeracy skills

In interviews, NESA course designers reported that they had explicitly developed the content of Numeracy CEC to align with the Level 3 requirements of the Australian Core Skills Framework. This alignment is reflected in teachers' perceptions of the course.

In surveys, Year 11 and Year 12 teachers rated the suitability of the course in developing core numeracy skills 7.7 and 7.3 out of 10 respectively.

Representatives from the Mathematical Association of NSW (MANSW) and the department's vocational education unit agreed that the course aligned well with functional numeracy.

Teachers are satisfied with the support provided by NESA and stakeholders spoke positively about the collaboration between sectors in delivering this course

Teachers rated their satisfaction with the support provided by NESA relatively highly, specifically 7.5/10. This suggests that NESA performed the support role effectively despite this not being one of their usual functions.

NESA and department staff interviewed for this evaluation also reported that their partnership in delivering support was beneficial and could be extended to other syllabuses. The benefits of the partnership were also noted by a teacher interviewed for this evaluation, who described receiving 'two layers' of support, and finding it useful.

Teachers and stakeholders support the expansion of the course in NSW schools

Stakeholders and teachers interviewed for this evaluation universally supported the continuation and statewide rollout of the course. Many of those interviewed also saw benefit in the expansion or adaptation of the course material to Stage 4 and 5 students, with the view of increasing mathematics participation and achievement in Stage 6.

NESA staff interviewed for this evaluation reported being sufficiently resourced for a statewide rollout of the course. They proposed to make 2 changes to the support model to ensure its sustainability:

- moving the online resources from SharePoint to a learning management system
- finding virtual or scalable ways of delivering the professional learning previously done via face-to-face conferences.

Outcome evaluation

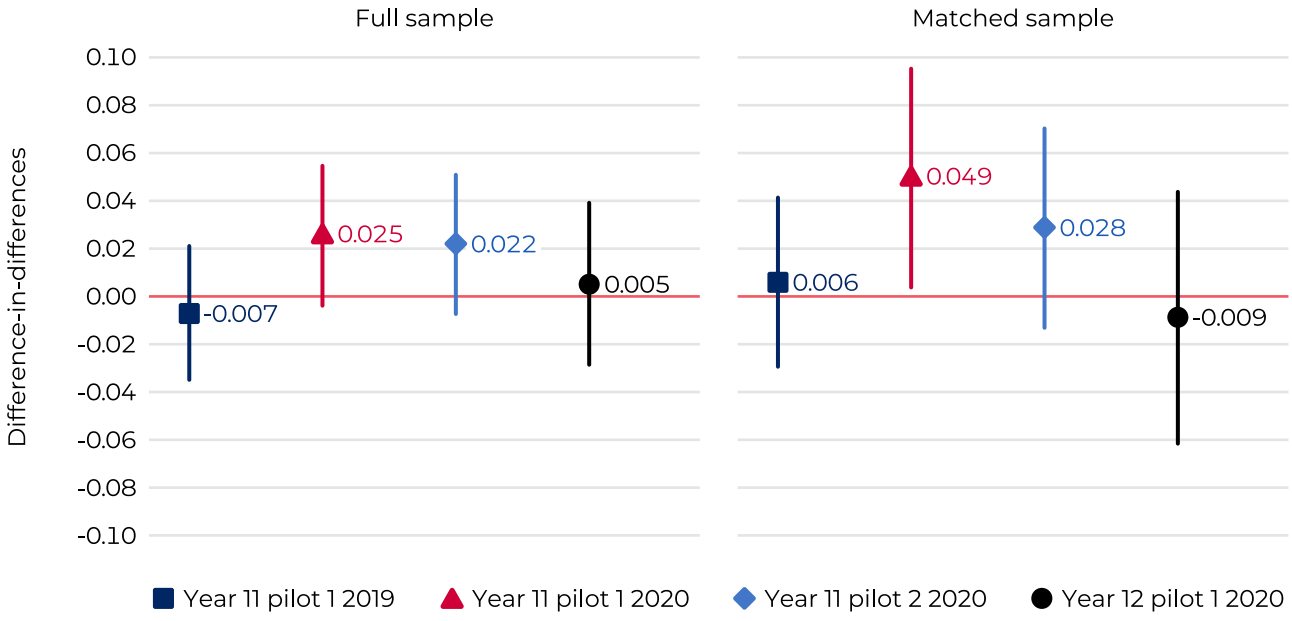
The course increased mathematics participation by approximately 2-5 percentage points in pilot 2 schools and the second cohort of students in pilot 1 schools

Figure 3 shows our estimates of the impact of the Numeracy CEC mathematics participation among students in pilot schools. We found no increase in mathematics participation among Year 11 students in the first year of the pilot (Year 11 pilot 1, 2019). Unsurprisingly, we found no impact on Year 12 mathematics participation for this cohort as well.

Our estimates suggest that the course was more successful at increasing participation in mathematics for the second cohort of students in pilot 1 schools (Year 11 pilot 1, 2020). When we compare pilot 1 schools to all schools who did not participate in the pilot, we estimate the impact is 2-5 percentage points, significant at the 90% level. When we compare pilot 1 schools to a similar set of schools, this estimate increases to 5 percentage points significant at the 95% level.

Figure 3:

DID estimates and 95% confidence intervals for Stage 6 mathematics participation, pilot schools versus comparison schools



We estimate that the course increased mathematics participation among Year 11 students in pilot 2 schools by approximately 2-3 percentage points, although this is not statistically significant. This may be due to high levels of variability in our estimates, which may be caused by the differences in how the course is implemented in different schools (for example as an alternative to mathematics participation or as a mathematics subject to students for whom other offerings are unsuitable)[17].

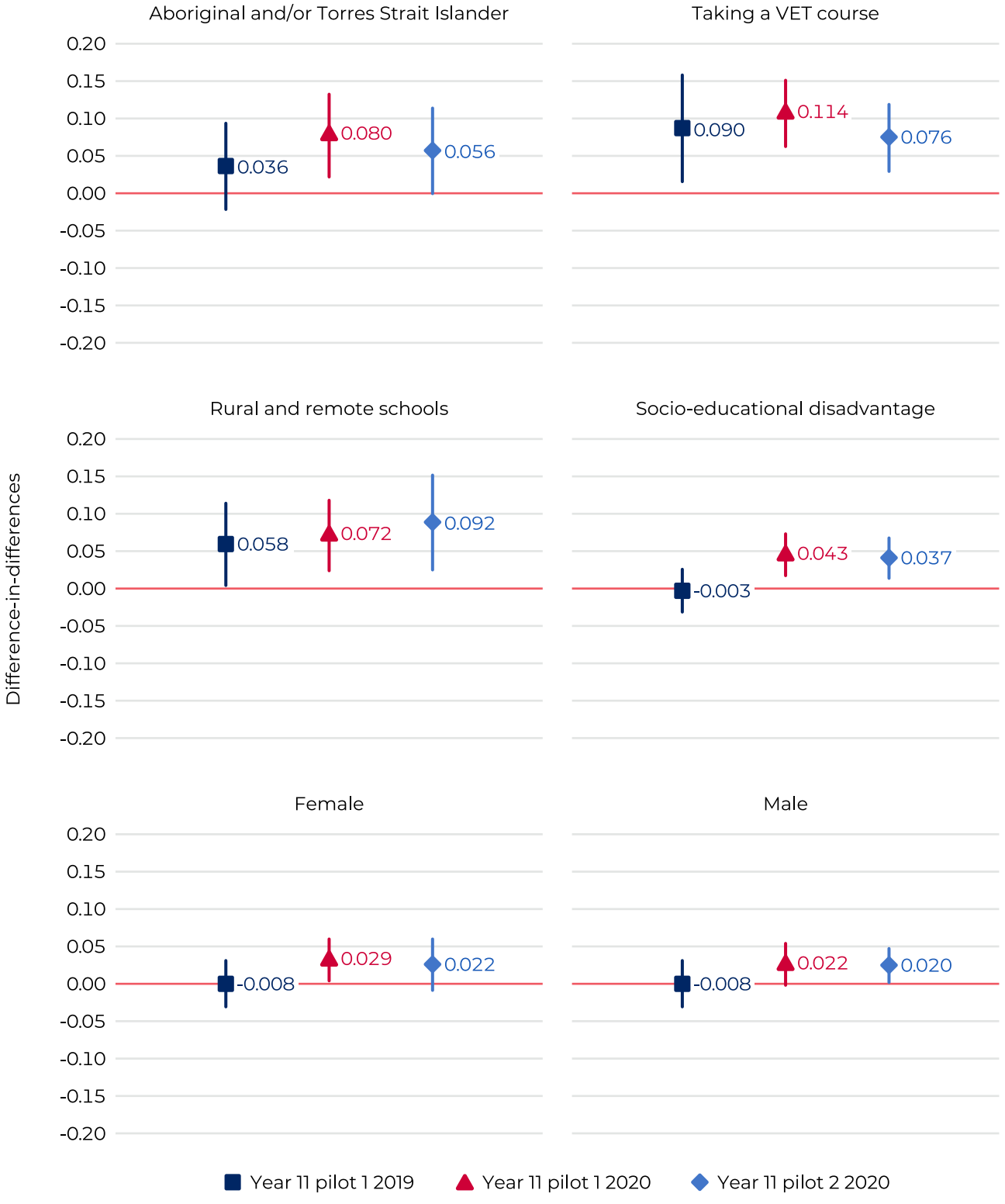
Taken together, these results suggest that there is a benefit to advertising the course through subject selection processes, and there may be 'maturation effects'. Students may be more likely to participate in the course after it has been established in a school.

18 We rule out a lack of power as an explanation. We are sufficiently powered to detect a one percentage point difference between the groups in our unmatched analyses.

The course increased mathematics participation substantially (by 8-11 percentage points) for students studying VET courses, with Aboriginal and Torres Strait Islander backgrounds, and from rural and remote schools

Figure 4:

DID estimates and 95% confidence intervals for Stage 6 mathematics participation, pilot schools versus comparison schools by group



The course has greater impacts on particular groups of students. Our estimates show the largest impact (11 percentage points) on Stage 6 mathematics for students concurrently enrolled in a VET course in Year 11 in pilot 1 schools in 2020 (the second cohort in pilot 1 schools). For the 2 other cohorts we examine (the first cohorts in pilot 1 and pilot 2), we estimated these impacts to be approximately 8 and 9 percentage points respectively.

Participation increased by 8 percentage points for Aboriginal and/or Torres Strait Islander students in Year 11 in pilot 1 schools in 2020. We estimated positive, but non-significant impacts, ranging from 4 to 6 percentage points for Aboriginal and Torres Strait islander students in pilot 1 schools in 2019 and pilot 2 schools in 2020. The lack of significance may be caused by our low sample size[18]. We also identified impacts ranging from a 5-9 percentage point increase in Stage 6 mathematics participation for students in rural and remote schools.

We estimated a 4 percentage point increase for low SEA students. Note we only observe this for the 2020 cohorts. We find little difference in the course's impact on male or female students' mathematics participation. Collectively, these findings suggest that the course is filling a need for students who may be underserved by existing mathematics offerings.

The course reduced participation in mathematics standard by approximately 8-11 percentage points

We find that students are approximately 8-11 percentage points less likely to study mathematics standard in Numeracy CEC pilot schools, for both Year 11 and Year 12 students. These results are mostly consistent when we use a matched sample, except for Year 11 pilot 1 students in 2020. On balance, these results support the findings from the process evaluation which suggest that some schools position the course as a more appropriate course for some students who would have otherwise studied mathematics standard.

Figure 4 shows the DID estimates and 95% confidence intervals for participation in mathematics advanced and extension among students in pilot schools. As may be expected, we estimate that there is no impact on participation in mathematics advanced in pilot schools. There is an increase of 2 percentage points in participation in mathematics advanced for Year 11 students in pilot 2 schools, however this result is non-significant. It should be noted that our common trends tests for the matched sample suggests that there are larger differences in prior trends between the groups, and thus this is a less robust comparison than the unmatched analysis (Appendix A1).

On balance, these findings support our findings from interviews, where some teachers reported positioning the Numeracy CEC as a more appropriate mathematics course to some students who would otherwise undertake mathematics standard.

19 In 2019, there were 1,936 Aboriginal and/or Torres Strait Islander students in comparison schools, and 378 in pilot schools. This translates to approximately 7% power to detect a difference of one percentage point in this comparison and 38% power for a difference of 4 percentage points. Ideally, we would like to have 80% power to detect differences that we observe.

Figure 5:

DID estimates and 95% confidence intervals for Stage 6 mathematics standard participation, pilot schools versus comparison schools

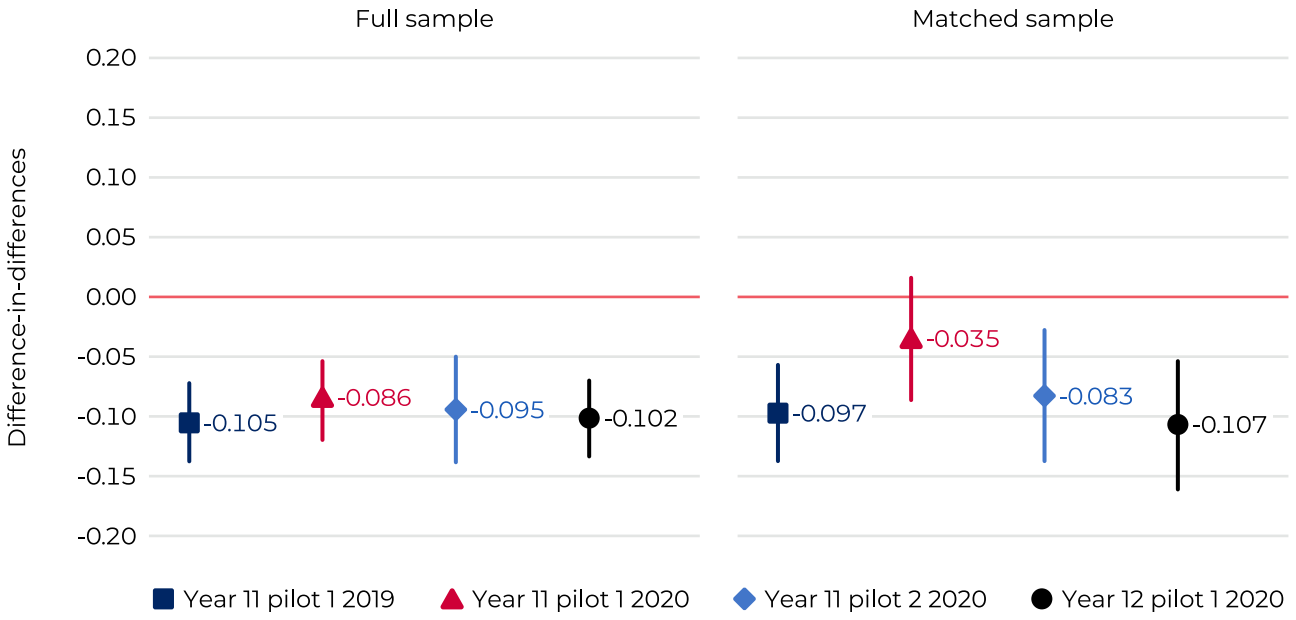
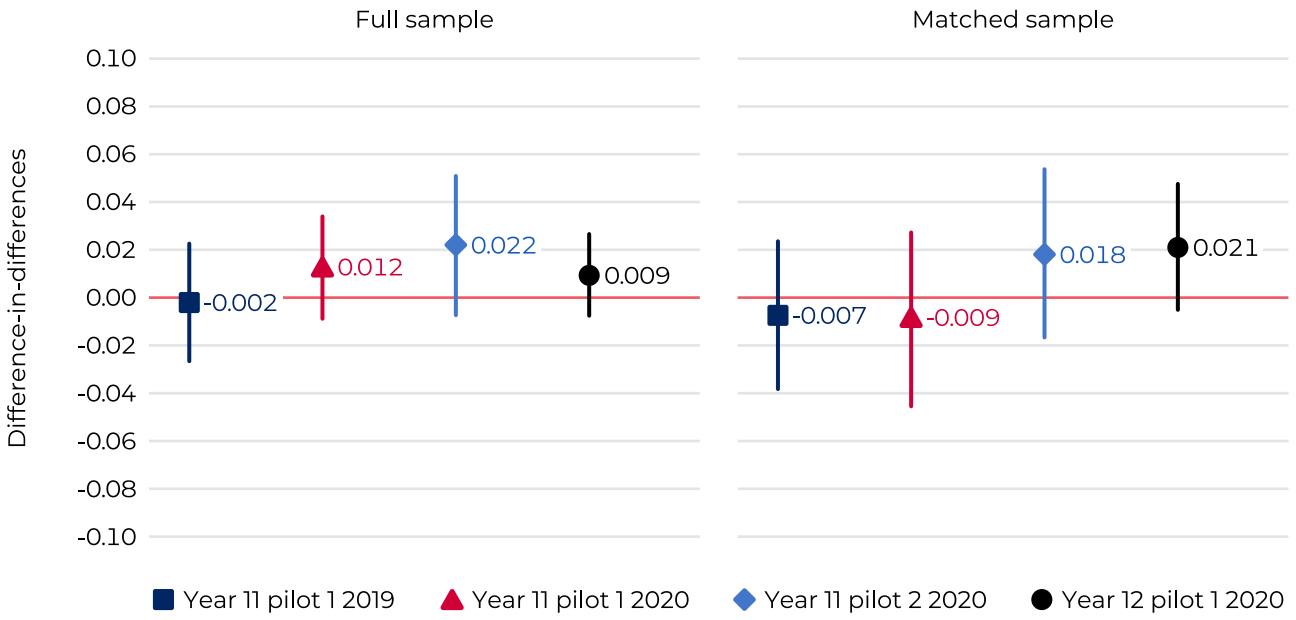


Figure 6:

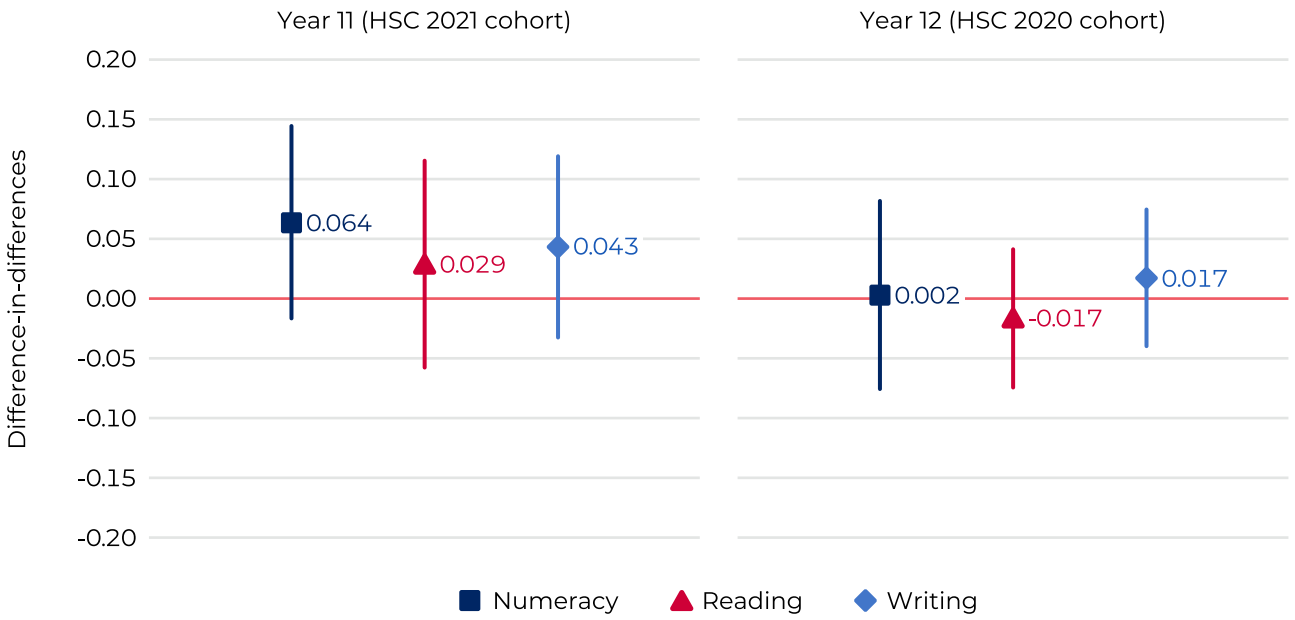
DID estimates and 95% confidence intervals for Stage 6 mathematics advanced and extension participation, pilot schools versus comparison schools



There is limited evidence that the course increased achievement in the HSC minimum standard for numeracy for the HSC 2021 cohort

Figure 7:

DID estimates and 95% confidence intervals for achievement of HSC minimum standard



Finally, we also looked at the impact of Numeracy CEC on achievement of the HSC minimum standard. The common trends test for the achievement of the numeracy minimum standard (Appendix A1) suggests there are differences in prior trends between groups for the Year 12 cohorts when the model includes covariates and school fixed effects. Therefore for this analysis we present the simplest model without covariates and school fixed effects in Figure 7.

For Year 11 students in pilot schools in 2020 (the HSC 2021 cohort), we estimated a 6 percentage point lift in the likelihood of achieving the HSC minimum standard in numeracy. However, this is not statistically significant. There is no difference in the achievement of HSC minimum standard in numeracy for the Year 12 students (the HSC 2020 cohort).

We also estimate minor insignificant increases (3-4 percentage points) on achievement of the reading and writing tests. We proposed this as a supplementary test for the validity of this analysis. If pilot and comparison schools' testing patterns are similar (and the Numeracy CEC does not have any plausible impacts on students' achievement of these), these estimates should be close to zero.

These positive, although non-significant, estimates may indicate that schools have different test taking patterns which may be driving the results. Pilot schools may be testing students earlier, and thus more likely to appear to be achieving the minimum standard. We cannot disentangle the impact of the CEC from these differences. As we only used achievement of the minimum standard as of August 2020, students in both cohorts still have time to meet the minimum standard before the HSC is awarded in 2020 and 2020. Therefore there is no guarantee that these results will hold in a further analysis. One positive sign, however, is that the magnitude of our estimate for numeracy is higher than that of reading and writing.

Chapter 4: **Discussion**

We evaluated the implementation of the Numeracy CEC pilot in NSW Government schools as of September 2020 and its effectiveness so far. We undertook a process evaluation, which examined the effectiveness of different aspects of the course's implementation. We also undertook an outcome evaluation to estimate the course's impact on mathematics course-taking in Stage 6 and achievement of the HSC minimum standard.

We found the course was implemented well, with the exception that the syllabus was delivered late in 2018 to pilot 1 schools. This impacted schools' ability to communicate to and recruit students via usual subject selection processes. Otherwise, teachers were extremely satisfied with the support provided by NESA through online resources and conferences. Stakeholders and teachers also found the course material appropriate for developing students' functional numeracy skills.

We found that the course increased Stage 6 mathematics participation among Year 11 students by approximately 2-5 percentage points, except for the first cohort of students in pilot 1 schools in 2019, who are Year 12 students in 2020. We found no impact of the course on these students' mathematics participation, potentially due to the late communication of the course.

We found a concurrent reduction in the proportion of students undertaking mathematics standard, indicating that some schools position the course as a more appropriate mathematics option for some students.

We also found that the course resulted in substantial increases (ranging from 8-11 percentage points) in Stage 6 mathematics participation among students enrolled in VET courses, from rural and remote schools and with Aboriginal or Torres Strait Islander backgrounds. We find the course resulted in a moderate increase (3-4 percentage points) for students with socio-educational disadvantage, though only for the cohorts in Year 11 in 2020.

We find no evidence that the course impacted achievement of the HSC minimum standard in numeracy among Year 12 students in 2020 (the first pilot cohort). We find limited evidence the course increased achievement of the HSC minimum standard in numeracy among Year 11 students in 2020. However, we cannot rule out that part of this may be caused by different testing patterns in pilot and comparison schools. This may be worth investigating in a follow up evaluation once the HSC 2021 and 2022 cohorts have completed Year 12.

In addition to the evidence we found for the course's effectiveness, teachers and stakeholders interviewed for this evaluation strongly supported its continuation and statewide expansion. The range of ways schools were using the course to support students who were disengaged or struggling with mathematics suggests that it can perform an important function among Stage 6 mathematics offerings. Some interviewees even suggested that its content could be adapted to provide greater support in Stages 4 and 5 to help students access higher-level mathematics once they reach Stage 6.

Note that there are various limitations of this evaluation that should be considered. Our process evaluation relied heavily on surveys of small groups of teachers and a small set of interviews with schools and stakeholders. It is possible that there may be views conflicting to those we have reported here that we did not obtain due to sampling. Meanwhile, our outcome evaluation only covers the 2 pilot cohorts that have implemented the course to date, and the second cohort is only halfway through. Furthermore, our 2020 outcome data is current as of August and September 2020, as opposed to the end of Term 4, 2020 and may not represent or capture impacts that are observed later such as HSC minimum standard testing results for schools who test their students later. We have also assumed that there were no other changes occurring to the pilot or comparison group of schools at the introduction of the pilot. This may be an unrealistic assumption as the changes to the HSC minimum standard may have meant that schools who were not in the pilot offered other mechanisms and support to help students achieve the HSC minimum standard in Numeracy. Finally, we cannot evaluate at this stage whether any shifts of students from mathematics standard or advanced into Numeracy were appropriate as HSC 2020 results, which we could use to test this with pilot 1, are not yet available.

Our findings suggest that continuing and expanding the course statewide could have important benefits for students whose needs were not met by other mathematics curriculum offerings in Stage 6. The support offered to teachers by NESA in partnership with the department has been perceived as valuable and effective. However, NESA has identified that the conferences, an aspect of the support model which was rated as particularly useful by teachers, are unlikely to be scalable. How NESA and the department can provide a similar level of quality of professional learning to teachers through other mechanisms will be a major challenge in any expansion of the course. A further challenge for future implementation will be the positioning of the course. The perception of it only as a tool to support achievement of the HSC minimum standard may limit participation among students who could benefit from it but have already met the minimum standard.

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